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VISUAL *Manufacturing*[®]

Functional Specification

For Release 6.1.3

**Peter D. Erdman
The Virant Group, Inc.
December 1, 2000**

**THIS FUNCTIONAL SPECIFICATION CONTAINS
PROPRIETARY AND CONFIDENTIAL INFORMATION ABOUT
THE VISUAL MANUFACTURING[®] PRODUCT.**

Document Revision History

REVISION	DESCRIPTION	DATE	BY
PRE-1	Structural changes preparing for 6.1.3 version. Removed the zillions of styles not currently in use and changed erroneous style usages. Change indenting of certain sections of Trans Level Briefs so that each sub-system has the same document centric focus.	9/13/00	Peter
PRE-2	Add many more Screen Dialogues from previous version. These are still not right. Make sure things are in the correct columns. The first column should be the general theme of the dialogue, the second should be the specific conversation, and the third should be validations. Following the example above this would be: Column #1; The customer wants to make a reservation for future air travel, or The customer wants to check in for a flight, or The customer wants a refund for a ticket never used. Column #2 follows the back and forth conversation. For the reservation it might be the customer making the initial request, system asking for name and destination, customer responding, system presenting flight options, customer selecting one or asking for more information on one of them, system providing information requested, customer makes final selection, system asks for seating preferences, customer responds, system asks for payment, customer provides. Column #3 would validate various information at each step. Such as the validating the destination is a valid city flown to, seat selection is available for flight selected, payment type is valid for customer, etc.		Josh / Colleen
PRE-3	Re-write every report in Transaction Level Briefs, previous version was inadequate. Validate each report against the actual software.		Jay
EXTERNAL SPEC	Revise Virant Style Guide to version 6 to reflect decisions made in capitalization and business terms usage. These changes reflect examining LSA user manuals, online help, and screen text.		Tony / Peter
PRE-4	Proofread and polish sections not finished on previous version. Apply new Virant Style Guide rules of capitalization uniformly throughout document. Change remaining first person references to third person.		Tony
PRE-5	Integrate Hard Allocation Trans Level Briefs and Screen Dialogues into all applicable areas of existing spec.		Peter
PRE-6	Add functionality that is totally new to release 6.x.		Peter

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PRE-7	Update existing Trans Level Briefs and Screen Dial's with logic that has changed in release 6.x. Use 'modes' as much as possible for things like AMTS so that logic commonality is exposed regardless of the method of data collection.		Peter
PRE-8	Abstract out all Master Data that can be regarded as Collections and put into their own Trans Level Briefs. These master data were merely implied in the previous spec version by where the data was used.		Jay
PRE-9	Write EDI section.		Peter
PRE-10	Re-write EIS section to reflect the rewriting of this module in CTD.		Peter / Josh
PRE-11	Write a forward to help the reader understand why certain decisions were made in writing and formatting the spec.		Peter
PRE-12	We still have references to the user interface objects and other "real world" wording. These need to be changed to FUNCTIONAL terminology. For example eliminate words such as button, combo box, window, check box, etc. Try to keep the dialogue similar to a conversation between a user and a computer ("the system"). Use the terms "user" and "The System". Think in terms of how you would describe what a system dialogue would be like if the computer were a person. A good example would be like the conversation that would take place at a airline reservation counter or other customer service counter. The dialogue is between the customer (The user) and the person behind the counter running the computer (The System). Like a ping-pong match of info being served from one side of the net to the other.		Tony / Josh / Jay
A	Initial Release to LSA		Peter0

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5. Screen Dialogues

This section presents the major transactions screen dialogues in VISUAL Manufacturing. In addition to the dialogues are field level information, validations performed by VISUAL Manufacturing based upon user information entry. The following dialogues are reviewed:

- ☐ System Level Functions
- ☐ Quoting and Estimating
- ☐ Sales
- ☐ Engineering and Job Definition
- ☐ Scheduling
- ☐ Material and Service Planning
- ☐ Throughput Analysis
- ☐ Purchasing
- ☐ Receiving
- ☐ Inventory Control
- ☐ Shop Floor Control
- ☐ Shipping
- ☐ Service and Repair
- ☐ Invoicing
- ☐ Manufacturing Costing
- ☐ Work Flow Messages
- ☐ Operations Parameters
- ☐ Purging

5.0 Common System Level Screen Dialogues

5.0.1 Basic Searching for Field Entry Processes

OPERATION	DIALOGUE	VALIDATIONS
Data field entry needed from a standard or short list of options; Using basic search types, Of: 1. Drop down lists. 2. Editable drop down lists	For field entry from a required predefined list of data, a drop down list used. List exists for future data processing requirements.	None, if entry only allowed from list. (exp. Status, in Customer Order) Validate user entry against list, if user entry/modification allowed (example: sales representative, in Customer Order) List match – allow entry. Non-match – error, reentry required
	For field entry of informational data that need not be on a defined list, an editable drop down list used. Entities are not added to defined list. The list exists only to speed up standard entry.	None and entry need not match list (example: Ship Via)

5.0.2 Advanced Searching and Select List Functions for Field Entry Processes

OPERATION	DIALOGUE	VALIDATION
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Data field entry needed from a long or multi-column list of data	Data entered directly	Validate user entry; If valid, accept; If not valid – give one of two responses 1. Error given of invalid data 2. Give notice that data not on list and ask if to “add on the fly”?
	Search screen selected to locate data. Advanced search screen is presented.	Validate user default settings for ☐ Ascending / descending ☐ Viewable columns and positions ☐ Search on initial entry ☐ Auto browse enabled.
	user enters any or all search values and selects “and” / “or” search type. Once the search list is returned, the user can print, search again, or select and close. The selected item is filled into the data field.	Validate, search, and return any matches. At anytime during a search, a user needs be able to abort. Validate if the data selected allows scrolling of the data in the entry field

5.0.3 Specifications and Notes Functions

OPERATION	DIALOGUE	VALIDATION
Object specifications requested	Specifications screen presented	Validate / stamp current date, time, and user ID for each new entry
	Specification is printable on reports	
Object notations requested	Notation screen presented notes do not print	

5.0.4 Automatic Numbering Function

Automatic numbering is used where a large number of unique identifications are required. This function provides for both a standard entry sequence and a time saving of data entry for the user.

OPERATION	DIALOGUE	VALIDATION
Object unique identification requested	The system requires a unique object identification, done by: ☐ Manual entry by user ☐ Auto entry by system	Validate that an entry is unique. If entry is blank, use auto entry. Validate auto-entry is setup and use next unique alphanumeric sequence. If auto entry not valid, prompt user.
Automatic numbering setup	The setup screen is presented. Allow the user to set the following: ☐ Next sequential number ☐ Alphanumeric prefix / suffix ☐ Number of digits and leading zeroes	

5.1 Quoting and Estimating Processes

This provides the functionality to produce quotations for Customers and/or prospects. The quotation does not have to be completed in detail to continue the estimating process. Details such as Customer, part number, delivery dates, and costs can be entirely skipped over in the generation of a quote. Once the basic quote information is entered, a router and Bill of Material is built to support the Work Order that will eventually be used to create the item. This engineering detail can be built custom for the quote, copied from a previous quote or similar part, or built through an optional product configurator module. The engineering detail is then used to roll up estimated costs for the various quantities quoted. These costs then are used to develop a quoted selling price for the customer or prospect. All the quote details are stored separate from any Work Order information ensuring that the original estimating processes are preserved.

5.1.1 Create a Quote

OPERATION	DIALOGUE	VALIDATION
Enter header information	Enter date of quote	Defaults to current date
	If quote numbers are manually assigned, enter quote ID. Otherwise, leave it blank for auto numbering to populate.	Validate that the quote ID does not currently exist if manually entered
	Search/enter ID of: 1. Current customer for whom quote is being prepared OR	Must exist in Customer Master
	2. Prospect for whom quote is being prepared. user does not need to enter prospect in Customer Master. If prospect is entered, system will have customer ID. If not entered, leave customer ID blank.	None
	If (1), system will populate name, address, contact information, sales representative, FOB, Ship Via, entity, discount code, and terms	The system will populate fields if entered in Customer Master
	If (2), enter prospect's name	None
	If (2), optionally enter prospect's address	None
	If (2), optionally enter prospect's contact information	None
	If (2), optionally enter prospect's sales representative	Sales representative must exist in master
	If (2), optionally enter territory	None
	If (2), optionally enter FOB point	None
	If (2), optionally enter Ship Via	None
	If (2), optionally modify entity	Defaults to manufacturing entity and must exist in master
	If (2), optionally enter discount code	Discount code must exist in master

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	If (2), optionally modify currency	Defaults to system currency and must exist in master
	If (1) or (2), user can request system to create Quote Masters for Master Product Configurator (MPC) line items	None
	If (1) or (2), enter date quote expires	Must be valid date
	If (1) or (2), enter date to call customer for follow-up on quote	Must be valid date
	If (1) or (2), verify/modify expected date of Customer Order	Must be valid date. Defaults to the “quote date” on clear and subsequent quotes.
	If (1) or (2), enter percent of probability that the customer will place the order	Defaults to 100%. Two decimal places of precision.
	If (1) or (2), enter days quoted from placement of order to delivery	Must be whole integer
	If (1) or (2), can enter comments about winning or losing the quote	None
	Enter status: 1. In-house. Quote not yet complete. 2. Ready. Quote ready. 3. Printed. If user requests system to print quote, system will designate quote as printed and display time printed. 4. Won. If user enters won, system will enter date. user can modify date. 5. Lost. If user enters lost, system will enter date. User can modify date. 6. Cancel. User can designate cancelled or user can delete quote, and system will record quote as cancelled.	Defaults to in-house. If (3), system will record time printed as system time. If (4) or (5), system will enter default date as system date.
	If (1) or (2), optionally enter specifications for the quote	None
	If (1) or (2), optionally enter notes for the quote	None
	If (1) or (2), optionally enter customer notes	None

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If (2) prospect, can optionally enter terms	Select type of net terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	None
	If (1), then prompts for number of days OR	Must not be negative
	If (2), then prompts for the day of month OR	Must be one to thirty-one
	If (3), then prompts for the date OR	Must be a valid date
	If (4), then prompts for months and day of month	Day of month must be one to thirty-one
	Select type of discount terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	None
	If (1), then prompts for number of days OR	Must not be negative
	If (2), then prompts for the day of month OR	Must be one to thirty-one
	If (3), then prompts for the date OR	Must be a valid date
	If (4), then prompts for months and day of month	Day of month must be one to thirty-one
	Enter discount percent	Must be zero to one hundred. Two decimal places of precision.
	Optionally enter user defined terms	None
	Enter freight terms	Enter prepaid, billed, or collect
Optionally modify default header information from Customer Master	If (1), can optionally modify/add header information as designated above	See above
Enter line information	Specify the quoted part or service: 1. Quoted inventory part will be from inventory 2. Quoted inventory part will be made to order from an Engineering Master 3. Quoted part will be custom order without a part ID 4. Quoted service	

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	If (1) or (2), enter/search for part ID.	Must exist in Part Master
	If (3), user does not designate part ID.	
	If (4), enter service charge ID. Service charge cannot be entered for a part	Service charge ID must be in master
	If (1), (2), or (3), enter one or more quantities for quoting	user can enter two decimal places of precision. System rounds to one decimal place of precision.
	If (1), user requests system to retrieve costs from part maintenance	Part ID must exist in system
	If (2), user requests system to retrieve costs from Engineering Master	Engineering Master must exist in system
	If (3), user requests system to use Quote Master feature. User then creates new Quote Master for part designating operations and materials. See section on Quick Quote.	Resources and materials needed for Quote Master must exist in system
	If (1) or (2), part description defaults from system.	If (1) or (2), part ID must exist in system.
	If (3) or (4), enter part or service description.	If (3), none.
	If (1) or (2), customer part ID may default from system. If not, can enter customer part ID for (1), (2) or (3).	If defaults from Customer Master, must exist in system. If entering customer part ID, there is no validation.
	If (1), (2), or (3), optionally enter drawing ID and revision.	None
	If (1) or (2), product code defaults from system. If not, can enter product code for (1), (2), or (3).	If defaults from Part Master, product code must exist in master. If entering product code, there is no validation.
	If (1) or (2), commodity code defaults from system. If not, can enter commodity code for (1), (2), or (3).	If defaults from Part Master, commodity code must exist in master. If entering commodity code, there is no validation.
	Optionally enter line specifications	None
	Save initial quote information	None
	User requests save. System assigns quote ID.	None

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Retrieving costs for quoted parts or services	Specify the quoted part or service: 1. Quoted inventory part will be from inventory 2. Quoted inventory part will be made to order from an Engineering Master 3. Quoted part will be custom order without a part ID 4. Quoted service	Quote must be saved to request costs
	User requests system cost for producing a part: If (1), system will retrieve part cost OR	Part ID and part ID costs must be defined in system
	If (2), system will retrieve cost from Engineering Master OR	Engineering Master must be defined in system
	If (3), user must create Quote Master. (see below) system will retrieve costs from newly created Quote Master OR	Resources or materials must be defined in system to create Quote Master
	If (4), system will retrieve cost of service	Service ID and service ID cost must be defined in system
	[Need to explain Quick Quote somewhere in here, this may be another dialogue]	
Preparing prices for quoted parts or services	User requests system to retrieve price information for designated line of quote. If (1), selling price will default from Part Master OR	Part ID and part ID selling price must be defined in master
	If (1), (2) or (3), user chooses quantity and then enters information as follows. System will calculate unit price.	
	If (1), (2) or (3), enter percent markups for general services administration cost. (this is a percent of total cost.) The system will add the calculated amount to the original cost resulting in the calculated unit cost. This percent can be applied to the following five cost categories: ☐ Purchased material ☐ Fabricated material ☐ Labor cost ☐ Burden cost ☐ Service cost	Three decimal places of precision

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	If (1), (2) or (3), enter fixed markup amount for quantity chosen. The system will then take the calculated unit cost from above step and add this fixed cost per unit to the previously calculated unit cost. (the system takes the fixed amount user has entered and divides that fixed amount by the designated quantity.) The new amount is the calculated unit cost. This fixed amount can be applied to five different cost categories as listed above.	Four decimal places of precision
	If (1), (2) or (3), enter price markups percent. (the system takes the calculated unit cost from above two steps, adds markup percent, and the result is the calculated unit price.) This percent can be applied to five different cost categories as listed above.	Three decimal places of precision
	If (1), (2), or (3), user requests system to recalculate calculated unit price	None
	If (1), (2), or (3), the user can optionally have system use quantity breaks on purchases during the recalculation	None
	If (1), (2) or (3), the user can optionally have system replace quoted unit price (price that will appear on customer quote) with calculated unit price after each recalculation	None
	If (1), (2) or (3), the user can request system to lookup price for current customer for quoted part and quantity. If no price is defined for customer/quantity/part combination, system will replace quoted unit price to zero. If price is defined, the user can enter price in quoted unit price.	None
	If (4), the selling price will default from service ID	Service ID must exist in master
	The user can manually override quoted unit price	Four decimal places of precision
	Optionally enter trade discount for each quantity	Three decimal places of precision
	Optionally enter unit of measure	Unit of measure must be defined in system

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	Optionally request system to include quantity on proforma report (for estimates of revenue)	System defaults by having all quantities chosen to be in proforma report
	Optionally user may request system to insert all available purchase price breaks into quote table	None
Save quote	User requests save	None
Print quote		
Check availability		

5.1.2 Modify A Quote

OPERATION	DIALOGUE	VALIDATION
Retrieve existing quote	Enter quote ID or search for it	Validate that quote exists in system
Modify header parameters	Once a quote has been printed, only the won/lost information can be edited	Validate that the status is: in house or ready
	Change status to won or lost and enter date and reason. If the quote used to generate order, status and date updated by system.	
	Modify name	
	Modify address	
	Modify contact person	
	Modify dates: expires, follow up, expect	
	Modify probability percent	
	Modify lead-time	
	Modify sales representative	Must exist in sales representative master
	Modify territory	
	Modify FOB point	
	Modify Ship Via	
	Modify discount code	
	Modify entity	
	Modify terms	
	Change status	
	Save quote	
Modify line information		
Add additional parts	See "Enter Line Information" above	
Modify existing part information	Go to the field to be modified and make modifications. Quantities and part ids are not modifiable.	

5.1.3 Delete A Quote

OPERATION	DIALOGUE	VALIDATION
Retrieve existing quote	Enter or search for existing quote	Validate quote exists in system
Delete lines	Go to part to be deleted and do so	

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	Save line modifications	
Delete entire quote	user requests delete	This also deletes all referenced quote and Engineering Masters
	Change status to cancel	This would not delete quote and Engineering Masters
	Save deletion or status change	

5.1.4 Create An Engineering Estimate (Quote Master)

OPERATION	DIALOGUE	VALIDATION
Create a Quote Master header (this is like 5.3.1 creating a eng/job definition)	User requests system to create Quote Master	Quote Master chosen
	Enter/search part ID OR	Part ID must exist in system
	Create new part ID if not in system	Can enter up to thirty characters
	If creating new part ID, enter description	Can enter up to thirty characters
	If creating new part ID, enter if fabricated, purchased, and /or if detail only. Then user OK's (user will need to enter additional part information later)	Can enter: ☐ Fabricated ☐ Purchased ☐ Detail only ☐ Fabricated and purchased ☐ Fabricated and detail only
	Enter Quote Master ID	Revision required
	Enter Quote Master revision	ID and revision combination must be unique
	Enter quantity for standard lot size for this part	Two decimal places of precision
	Enter specifications	None
	Enter engineered by	None
	Enter engineered date	Must be valid date
	Enter drawing number	None
	Enter drawing revision	None
	Enter linked drawing file	None
	Enter product code	None
	Enter commodity code	None
	User may choose to forward schedule from release date	None
	Associate a graphic or picture object with master	Object may be ☐ Pasted from ☐ Inserted ☐ Lined
	Enter name of variable to define variable dimensions referenced in material requirements	None
	Enter value of defined variable	System rounds to two decimal places of precision

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	Optionally override General Ledger accounts: ☐ Material ☐ Labor ☐ Burden ☐ Service	General Ledger accounts must be defined in system
	User requests save. System creates new master.	None
Adding an operation	User requests system to add operation	This can be done for existing or just created Quote Master that is open
	Optionally enter/select operation type	Operation type must exist in system
	Review/adjust sequence number	Op number defaults to ten plus the last operation number. Can enter up to five numeric characters. Zero decimal places of precision.
	Enter/select resource ID: 1. Resource ID for internal operation 2. Resource ID for outside service (subcontractor)	Resource ID must exist in system
	If (2), enter/select service ID	Service ID must exist in system
	If (1), enter/modify setup hours	Default is zero. Two decimal places of precision.
	If (1), enter/modify run time	Five decimal places of precision
	If (1), enter/modify run type	Defaults to hours per piece. Must choose one of the following: ☐ Hours per piece ☐ Pieces per hour ☐ Minutes per piece ☐ Pieces per minute ☐ Hours per load ☐ Loads per hour
	If (2), enter/modify run type	Defaults to days per piece. Must choose one of the following: ☐ Days per piece ☐ Pieces per day ☐ Days per load ☐ Loads per day
	If (1), and run type is hrs/load or loads/hrs, enter load size. If (2), and run type is days/load or loads/day, enter load size.	Three decimal places of precision
	If (1) or (2), enter/modify move hours (number of hours that must pass between the end of this operation and the beginning of the next)	Two decimal places of precision

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	If (1), enter/modify minimum number of pieces that can be moved from one operation to the next when total operation is not yet complete. For maximum overlap possible, enter .0001.	System rounds to four decimal places of precision
	If (2), enter/modify transit days	Two decimal places of precision
	If (1) or (2), enter specifications	None
	If (1), enter/modify setup cost per hour	Two decimal places of precision
	If (1), enter/modify run cost per hour	Two decimal places of precision
	If (2), enter/modify service base charge	Two decimal places of precision
	If (2), enter/modify service minimum charge	Two decimal places of precision
	If (1) or (2), enter/modify run cost per unit	Four decimal places of precision
	If (1), enter/modify burden percent for setup	Four decimal places of precision
	If (1), enter/modify burden percent of run	Four decimal places of precision
	If (1), enter/modify setup burden per hour	Two decimal places of precision
	If (1), enter/modify run burden per hour	Two decimal places of precision
	If (1), enter/modify run burden per unit	Two decimal places of precision
	If (1), enter fixed burden	Two decimal places of precision
	If (1) or (2), user can request system not to reset the costs for this particular operation when the system is globally updating costs	None
	If (1) or (2), enter/modify designation as scrap or yield (scrap lost from that quantity or final yield from start quantity)	Must enter scrap or yield
	If (1) or (2), enter/modify scrap/yield percent	Four decimal places of precision
	If (1) or (2), enter/modify fixed scrap quantity	Two decimal places of precision
	If (1) or (2), user may choose to override quantities system automatically calculates	None
	If (1) or (2), and user chooses to override quantities, user enters start quantity and end quantity	Two decimal places of precision
	If (1), enter/select Test ID. System runs the test after entering results in visual quality	Test ID must be in system
	If (1), enter drawing number	None
	If (1), enter revision	None
	If (1), enter drawing file	None

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	If (1), enter/modify maximum capacity use (maximum number of resource units this operation will use)	Rounds to integer
	If (1), enter/modify minimum capacity use (minimum number of resource units needed for this operation)	Rounds to integer
	If (1), user may schedule discontinuous	None
	If (1), and user schedules discontinuous, enter minimum number of hours of run that should be scheduled in one segment	System rounds to one decimal place of precision
	If (1), user optionally can enter/select concurrent resource (concurrent resource needs to be scheduled at same time as resource defined in operation)	Resource ID must exist in the system
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed during operation setup	System defaults specifying concurrent resource is needed during setup
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed during operation run	System defaults specifying concurrent resource is needed during run time
	If (1), user reviews/modifies duration percent of the concurrent resource. (a duration percent indicates that the resource is concurrent for a designated percent of the operation.)	System defaults to 100.00%. System rounds to two decimal places of precision
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed from the start of the operation	System defaults specifying concurrent resource is needed at start of the operation
	If (1) or (2), user may request system to paste picture or object into specified operation	Picture or object must exist and user must specify path to picture or object
	User selects operation to add material requirement	Operation must be defined in Work Order/Master
Adding materials to Quote Master	User requests system to add material to operation. Material required can be: 1. Inventory part 2. Non-inventory part	Operation must be defined in Work Order/Master
	User must choose to add material to master or leg/detail to master	System defaults to adding material
	Review/modify piece number	Must enter whole integer

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	If (1), enter/search part ID. System retrieves cost information for the part if defined in part maintenance. OR	Part ID must exist in system
	If (1), create new part ID if not in system	Can enter up to thirty characters
	If (1), and creating new part, enter part description	Can enter up to thirty characters
	If (1), and creating new part ID, enter if fabricated, purchased, and if detail only. Then user OK's. (user will need to enter additional part information later)	Can enter: ☐ Fabricated ☐ Purchased ☐ Detail only ☐ Fabricated and purchased ☐ Fabricated and detail only
	If (2), do not enter part ID	None
	If (1) or (2), enter/modify quantity of the material that is required per unit	Eight decimal places of precision
	If (1) or (2), enter/modify quantity per type as start quantity or end quantity	Must enter as quantity per start quantity or quantity per end quantity
	If (1) or (2), enter/modify fixed quantity	Two decimal places of precision
	If (1) or (2), enter/modify scrap percent	System saves to four decimal places of precision
	If (1) or (2), optionally enter/modify dimensions	Dimensions must be specified in SAL language
	If (1) and quantity of the part that is required for the operation is specified using a different unit of measure than the stock unit of measure, enter usage unit of measure. user needs to define relationship between stock unit of measure and usage unit of measure. If (2), optionally enter usage unit of measure	Unit of measure must be defined in system
	If (1) or (2), optionally enter reference number	None
	If (1) or (2), enter specifications	None
	If (1) or (2), optionally enter/modify drawing ID and revision	None
	If (1) or (2), optionally enter/modify drawing effective date	Must be valid date
	If (1) or (2), optionally enter/modify drawing discontinue date	Must be valid date
	If (1) or (2), enter/modify material unit cost	Four decimal places of precision

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	If (1) or (2), review/modify labor unit cost	Four decimal places of precision
	If (1) or (2), review/modify burden unit cost	Four decimal places of precision
	If (1) or (2), review/modify service unit cost	Four decimal places of precision
	If (1) or (2), enter/modify fixed cost	Two decimal places of precision
	If (1) or (2), enter/modify issue burden per unit	Four decimal places of precision
	If (1) or (2), enter/modify burden percent	Four decimal places of precision
	If (1) or (2), review/enter vendor ID	Vendor ID must exist in system
	If (1) or (2), review/enter vendor's catalog number for the part	None
	If (1) or (2), enter part manufacturer	None
	If (1) or (2), enter manufacturer's part ID	None
	If (1) or (2), user may request system to paste picture or object for material requirement	Picture or object must exist and user must specify path to picture or object
	If (2), non-inventory part, and material is for Quote Master, user may set quantity break costs	Must be non-inventory part and for Quote Master function
	User enters quantity break or up-to quantity for designating price breaks, depending how system is set up for purchase quotes	Two decimal places of precision
	Enter unit cost	Four decimal places of precision
	Enter fixed cost (one time cost of the purchase)	Four decimal places of precision
	Enter minimum cost for purchasing designated quantity	Four decimal places of precision
	User selects operation to add leg (or any material associated with that operation)	Operation must be defined in Work Order/Master
Adding legs	User requests system to add leg/detail to operation.	Operation must be defined in Work Order/Master
	User must choose to add leg/detail or material to master	System defaults to adding leg/detail
	Review/modify piece number	Must enter whole integer
	Review/modify sub ID if necessary	System defaults to zero. Main leg is always zero.
	Optionally enter part ID. This indicates that the assembly corresponds to a part that is also a separate inventory part. However, user must still enter engineering structure	If entering part ID, must exist in system

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	User specifies quantity information. Specify all this information in the exact same way as for materials. User is simply indicating the amount of fabricated assembly needed, rather than an inventory part. See add material above.	Validation for each field as designated in “adding material”
	Enter leg’s specifications	None
	Enter leg’s engineering drawing number	None
	Enter leg’s engineering revision number	None
	Enter drawing effective date	Must be a valid date
	Enter drawing discontinue date	Must be a valid date
	User requests system to save the leg and add it to the structure. User can now add an operation to this leg, and add additional operations, material requirements, and other legs.	None

5.1.5 Modify An Engineering Estimate (Quote Master)

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Quote Master	Enter or search for existing Quote Master	Validate Quote Master exists in system and open it
Modify header card	The following may not be modified: ☐ Quote Master ID ☐ QM description	Gray an changes not allowed
	All other fields may be modified and function the same as shown above in the “creation” section 5.1.4	Same validations as during creation process
Modify operation card	The following may not be modified: ☐ Operation Sequence Number ☐ Operation Type ☐ Resource ID ☐ Service ID	Changes not allowed
	All other fields may be modified and function the same as shown above in the “creation” section 5.1.4	Same validations as during creation process
Modify material card	The following may not be modified: ☐ Material Piece Number	Changes not allowed
	All other fields may be modified and function the same as shown above in the “creation” section 5.1.4	Same validations as during creation process

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Modify leg card	The following may not be modified: ☐ Quote Master Sub ID ☐ Material Piece Number	Changes not allowed
	All other fields may be modified and function the same as shown above in the “creation” section 5.1.4	Same validations as during creation process

5.1.6 Delete An Engineering Estimate (Quote Master)

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Quote Master	Enter or search for existing Quote Master	Validate Quote Master exists in system
Delete material card	Select existing material card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete operation card	Select existing operation card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete leg card	Select existing leg card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete entire Quote Master	Select existing header (top most) card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing

5.1.7 Process A Quote (Checking Availability)

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Quote Master	Enter or search for existing Quote Master	Validate Quote Master exists in system
Setup settings for availability check	User starts availability check process.	Validate Quote Master must be open or selected
	System shows Quote Master ID/revision being checked.	
	Select schedule ID to check against	Must be a valid schedule
	Enter desired release date	Default to current date Must be a valid date.
	Enter desired want date	Must be a valid date
	Enter desired quantity	Two decimal places of precision
	Select if material availability should be checked or not	None
	Select if service availability should be checked or not	None
	Select if force forward schedule should be used or not	None
Process availability check	Schedule	Ensure above validations have been checked. Allow the user to “abort” schedule process

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Display results	Output information: ☐ Scheduled start date ☐ Scheduled finish date ☐ Determinant path delay ☐ Total days delay	Valid dates, and Delays in fractional days
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5.2 Sales

Sales focuses on creating and maintaining orders taken from a Customer. New order creation is done by one of four methods:

- ☐ Manual entry
- ☐ Copying a quote
- ☐ Copying an existing Customer Order
- ☐ Using the product configurator

Drill-down features provide for both Customer Summary and Part Selling History. The Customer Summary provides:

- ☐ Credit status
- ☐ Customer currency
- ☐ Average days to pay
- ☐ Date of last order
- ☐ Amounts for open orders
- ☐ Open receivables
- ☐ Total paid Invoices

The Part Selling History provides a one-line/sale summary of Customer, dates, prices, and quantities. Further drill-down will open the original Customer Order the part was sold on. Also, the availability of inventory and scheduled capacity checking can be performed.

5.2.1 Create An Order

OPERATION	DIALOGUE	VALIDATION
Enter header information	Enter date that customer placed order	Defaults to current date
	Enter date customer wants shipment (default for lines)	Must be a valid date
	If order numbers are manually assigned, enter order ID. Otherwise, leave blank for auto numbering to populate	Validate that order ID does not currently exist if entered
	Search or enter the ID of the customer placing the order. The system populates customer information.	Check customers status: ☐ If on hold stop, an order cannot be taken for this customer ☐ If orders on hold, an order can be taken for this customer but the order status must be set to on hold. The status cannot be changed from on hold until the customer status is OK.
	Optionally enter the customer's Purchase Order number or search for an existing Purchase Order for the customer	None
	Enter a new or search/select an existing ship-to address if different from the sold-to address	Validate the state is in the State Master
	Indicate if order is to be printed	None

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	Indicate if order is an Electronic Data Interchange (EDI) release	None
	Indicate if order is a separate backorder	None
	Enter specification text	None
	Enter notation text	None
Optionally modify default header information from Customer Master	Modify/search/select FOB point	None
	Modify/search/select Ship Via	None
	Modify/search/select sales representative	Must exist in sales representative master
	Modify/select territory	None
	Modify/select sales tax ID	Must exist in Sales Tax Master
	Modify/select discount	Must exist in discount master
	Modify/select entity ID	Must exist in entity master
Optionally modify terms	Select type of terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	None
	If (1), then prompts for number of days OR	
	If (2), then prompts for the day or	Must be on to thirty-one
	If (3), then prompts for the date OR	Must be a valid date
	If (4), then prompts for months and day of month	Day of month must be one to thirty-one
	Select type of discount terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	None
	If (1), then prompts for days OR	
	If (2), then prompts for the date OR	Must be one to thirty-one
	If (3), then prompts for the date OR	Must be a valid date
	If (4), then prompts for months and day of month	Day of month must be one to thirty-one
	Enter discount percent	Two decimal places of precision
	Enter user defined terms description	None
	Select freight terms: 1. Prepaid 2. Billed 3. Collect	None
Optionally set currency hedging	User requests current exchange rates to be retrieved from database	Current Customer Order must not be in native system currency

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	User enters the following: ☐ As of date ☐ Buy rate ☐ Sell rate	Date must be any valid date
Optionally enter blanket order information	Indicate if blanket order is from Electronic Data Interchange (EDI)	None
	Enter EDI blanket number	None
	Enter contract ID	None
Enter line information	Enter quantity	None
	Specify the ordered item: 1. Inventory item not linked to a Work Order 2. Inventory item that will be linked to a new Work Order 3. Inventory item that will be linked to an existing Work Order 4. Miscellaneous item	
	If (1), then enter part ID	Must be in Part Master
	If (2), then enter part ID and indicate that a new Work Order needs to be created. Optionally, enter the ID, lot, and split of the Work Order to be created. If left blank auto numbering will assign an ID.	Part ID must be in Part Master
		Work Order ID must not be a current Work Order
	System prompts for the status of the new Work Order	Must be unreleased, firm, or released
	If (3), then enter part ID and enter the Work Order ID, lot, and split that is to be linked to this Customer Order line	Must be an existing Work Order and be on a status of unreleased, firm, or released
	If (4), then enter a description of the item, and unit price, optionally enter the product code, commodity code, and customer part ID	Unit price has four decimal places of precision. Note: product code, commodity code not to be validated against their respective masters.
	Enter specification text	None
	Enter notation text	None
Optionally modify default line information from Part Master and Customer Master	Modify commission percent	Two decimal places of precision
	Modify the Value Added Tax (VAT) code and wholesale unit cost	Must be in VAT Master
	Enter/search sales tax ID to override header	Must be in Sales Tax Master
	Enter revenue General Ledger account	Must be in Chart of Accounts

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	Enter Cost of Goods Sold General Ledger accounts by entering one or more of the following: ☐ Material General Ledger account ☐ Service General Ledger account ☐ Labor General Ledger account ☐ Burden General Ledger account	Must be in Chart of Accounts
	Enter/select ship-to	Must be a valid ship-to for the customer
	Enter drawing ID and revision	None
	Enter promise date	Must be a valid date
Optionally establish a delivery schedule for line(s)	Enter quantity	None
	Enter desired ship date	Must be a valid date
	Enter release number	None
	Enter ship-to	Must be a valid ship-to for the customer
	Enter two user defined fields	None
Save Customer Order	User requests save	If customer has outstanding payments older than their receiving age limit, notify the user: 1. If override is set in the Customer Master, then continue 2. If override is not set in the Customer Master, then prevent the saving of the Customer Order If this order will cause the customer to exceed the credit limit established in the Customer Master, notify the user: 1. If override is set in the Customer Master, then continue 2. If override is not set in the Customer Master, then prevent the saving of the Customer Order
Print Customer Order acknowledgement		

5.2.2 Create An Order From A Quotation

OPERATION	DIALOGUE	VALIDATION
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Find applicable quotation	The system presents search dialog for user to find quotation based on: ☐ Quote ID ☐ Customer ID ☐ Customer name	
	User selects applicable quote	
	The system retrieves quote information including all quoted lines	
Create basic Customer Order	user selects one or more lines for inclusion on the Customer Order	
	Enter date customer wants shipment (default for lines)	Must be a valid date equal to or greater than current date
	If order numbers are manually assigned, enter order ID. Otherwise leave blank for auto numbering to populate.	Validate that order ID does not currently exist if entered
	Enter/search ID of the customer placing the order	Check customers status: 1. If on hold stop, an order cannot be taken for this customer 2. If orders on hold, an order can be taken for this customer but the order status must be set to on hold. The status cannot be changed from on hold until the customer status is OK.
	Optionally enter the customer's Purchase Order number or search for an existing Purchase Order for the customer	None
	Optionally enter the original promise date for the order	Must be a valid date
	Select status for the new Customer Order	Must be a status of either firm or released
	Indicate if specifications from the quote are to be copied to the Customer Order	
	Indicate if a Work Order is to also be created. If so, then indicate if the next available Work Order number (auto numbering) should be used or if the Work Order number should be the same as the Customer Order number.	
Enter unique header information	Enter a new or select an existing ship-to address if different from the sold-to address	Validate the state is in the State Master
	Indicate if order is to be printed	None
	Indicate if order is an Electronic Data Interchange (EDI) release	None

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	Indicate if order is a separate backorder	None
	Enter specification text	None
	Enter notation text	None
This dialogue continues starting with the section “optionally modify default header information from Customer Master” in “Take A New Order” above		

5.2.3 Modify An Order

OPERATION	DIALOGUE	VALIDATION
Retrieve existing order	Enter order ID OR	Validate that order ID exists in system
	Search for order	
Modify header information	Modify customer’s Purchase Order number	None
	Enter a new or select an existing ship-to address	Validate the state is in the State Master
	Modify the flag indicating the order is to be printed	
	Modify the flag indicating that the order is an EDI release	
	Modify the flag indicating that the order is a separate backorder	
	Enter/modify specification text	
	Enter/modify notation text	
	Modify FOB point	
	Modify Ship Via	
	Modify sales representative	Must exist in sales representative master
	Modify territory	
	Modify sales tax ID	Must exist in sales representative master
	Modify discount	Must exist in discount master
	Modify entity	Must exist in entity master
Modify line information	- For Customer Orders without shipping - For Customer Orders with shipping - For Customer Orders that have been shipped and Invoiced	Customer Order must not be closed or cancelled.

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	If (1), can modify quantity. If (2), can modify quantity for data entry error. System will not automatically adjust inventory transactions or packing slips to reflect this modification. If (3), can modify quantity for Data entry error. System will not automatically adjust inventory transactions, packing slips, or existing Invoices to reflect this modification.	None
	If (1) or (2), can modify sales representative but will manually need to replace commission percent if different for this sales representative. If (3), can modify sales representative but will manually need to replace commission percent if different for this sales representative. System will not update price for existing Invoice.	Must exist in sales representative master
	If (1) or (2), can modify sales tax but will manually need to replace sales tax percents if different for this sales tax. If (3), can modify sales tax but will manually need to replace sales tax percents if different for this sales tax. System will not update price for existing Invoice.	Must exist in Sales Tax Master
	If (1), (2) or (3), can modify ship date but will need to update the Work Order want date	Must be valid date
	If (1) or (2), can modify customer ID but may need to have system re-price item according to that customer's pricing structure. If (3), can modify customer ID but may need to have system re-price item according to that customer's pricing structure. System will not update price for existing Invoice.	Must exist in customer ID table

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	If (1) or (2), can modify discount codes but may need system to re-price item according to that discount code If (3), can modify discount codes but may need system to re-price item according to that discount code. System will not update price for existing Invoice.	Must exist in discount code table
	If (1), (2) or (3), can modify job ID	
	If (1), can modify part ID. If (2), can modify part ID for data entry error where different part ID was actually shipped than was recorded. If (3), can modify part ID for data entry error where different part ID was actually shipped than was recorded. System will not update price for existing Invoice.	Must exist in Part Master. If Work Order, part ID must be in Work Order.
	If (1) or (2), can modify unit price. If (3), can modify unit price, but system will not update price for existing Invoice.	Four decimal points of precision
	If (1) or (2), can modify disc percent. If (3), can modify disc percent, but system will not update price for existing Invoice.	Three decimal points of precision
	If (1) or (2), can modify commission percent. If (3), can modify commission percent, but system will not update price for existing Invoice.	Three decimal points of precision
	If (1) or (2), can modify tax group ID. If (3), can modify tax group ID but system will not update price for existing Invoice.	Must exist in tax group table
	If (1) or (2), can modify product code. If (3), can modify product code but system will not update General Ledger accounts for existing Invoice.	Product code must be in table. Account numbers must be in Chart of Accounts.

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	If (1) or (2), can modify revenue account ID.	Account number must be in Chart of Accounts
	If (3), can modify revenue account ID but system will not update General Ledger account for existing Invoice.	
	If (1) or (2), can modify miscellaneous reference/description. If (3), can modify miscellaneous reference/description but system will not update existing Invoice.	None
Save Customer Order	User requests save	None

5.2.4 Process an Order

OPERATION	DIALOGUE	VALIDATION
Check material availability	User identifies line item for material checking	Line must contain a part number
	System returns: ☐ Part ID ☐ Description ☐ Quantity ordered ☐ Ship date ☐ Promise date ☐ Projected quantity after shipment ☐ On hand quantity	
Check schedule availability	User identifies line item for schedule checking	Line must contain a Work Order
	System presents list of available schedules and user selects one schedule	
	Check availability in 1 of 2 ways: 1. Determine lead-time to quote 2. Determine if quoted dates are possible with current schedule	
	If (1), then enter expected release date for when the order will be received and indicate a “force forward schedule”. The system responds with an anticipated completion date.	Date must be a valid date equal to or greater than the current date
	If (2), then enter expected release date for when the order will be received and the desired ship date as the Work Order completion date.	Dates must be a valid date equal to or greater than the current date

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	User adjusts quantity if wanted and indicates if material and/or services are to be checked concurrently with the capacity.	
	User start scheduling	
	System returns: ☐ Scheduled start date ☐ Scheduled finish date ☐ Determinant path days delay ☐ Total days delay	
Check service availability		
View selling history		
View customer summary		
View EDI order accumulators		
Print Customer Order acknowledgement		

5.2.5 Delete an Order

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Customer Order	Enter or search for Customer Order ID to be deleted	Customer Order must be in Customer Order table
Delete Customer Order	Delete Customer Order: 1. Delete Customer Order that has not been shipped 2. Delete Customer Order that has been shipped 3. Delete Customer Order that has been Invoiced	
	If (1), have system delete the Customer Order	
	If (2), return items in shipping entry, and have system delete the Customer Order	
	If (3), delete Invoice if not posted. Otherwise, do a credit for Invoice. Next, return items in shipping entry. Finally, have system delete the Customer Order.	

5.2.6 Retrieve Order Status

OPERATION	DIALOGUE	VALIDATION
Search for one or more orders based on multiple criteria	Enter search criteria	
	System returns list of orders meeting search criteria	
	User selects desired order from list	
	System retains search result list	

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	System displays Customer Order summary	
Show shipments and Invoices	User requests list of shipments and Invoices for Customer Order System returns list	
Show backorders	User requests list of backorders for Customer Order User optionally selects a backorder and requests order to be displayed System displays Customer Order summary	
Show Work Order status	User requests list of Work Orders for Customer Order System returns list User optionally selects a Work Order and requests operation detail to be displayed System returns operation detail	
Show customer MTD/YTD summary	User requests customer MTD/YTD summary to be displayed System returns summary	
Display next order from search list	User requests next part System displays next Customer Order summary	Must be more than one part returned in original search

5.2.7 Establish Progress Billing for An Order

Progress billing can be set up to bill Customer and recognize revenue on certain date (event) or on completion of an operation of a Work Order (milestone). Recognizing costs can be set up by milestone. If milestone not designated, system will recognize costs in normal system functionality, which is at shipping.

OPERATION	DIALOGUE	VALIDATION
Enter header information	Enter/search for Customer Order ID. System fills in default header information	Order ID must exist in system
Optionally modify default line information from Customer Order	Enter/modify specific line on Customer Order and link/unlink to Work Order. The system retrieves information on Customer Order line's link to Work Order and user can choose different Work Order or delete Work Order link.	Work Order must exist in system

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	Enter/modify line specifications. The system will designate on the Customer Order line that there are line specifications.	None
	Enter/modify Invoice specifications. T he system will designate on Customer Order line that there are Invoice specifications.	None
	Enter/modify billing specifications. The system will designate on Customer Order line that there are billing specifications.	None
	Enter/modify customer notations	None
	Enter/modify order notations	None
	Enter/modify order specifications	None
Cost recognition: Enter progress billing milestone For line on Customer Order or System defines cost at shipping	1. Event (based on date) 2. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is in the system 3. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is not set up in the system	
	If (1), and no milestone is defined for Customer Order line, then full cost is recognized at time of shipping product	Customer Order exists in system
	If (2) or (3), user selects Customer Order line	Customer Order exists in system
	If (2) or (3), user requests milestone option and system retrieves dialog for the operations for the associated Work Order	Customer Order line must be linked to Work Order. Work Order must exist in system.
	If (2) or (3), user selects operation from Work Order	Work Order must be defined in system
	If (2), enter or search for milestone ID. The system retrieves milestone ID and populates description and cost accounts for material, labor, burden, and service.	Milestone ID must exist in system
	If (3), enter milestone ID	None
	If (3), enter description of milestone ID	None

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	If (3), enter cost account for material	Account must exist in Chart of Accounts
	If (3), enter cost account for labor	Account must exist in Chart of Accounts
	If (3), enter cost account for burden	Account must exist in Chart of Accounts
	If (3), enter cost account for service	Account must exist in Chart of Accounts
	If (2) or (3), user requests system to set operation to milestone	None
	User requests save	None
Billing and revenue recognition: enter progress billing event or milestone for line on Customer Order	1. Event (based on date) 2. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is in the system 3. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is not set up in the system	
	If (1), (2), or (3), user selects Customer Order line	Customer Order must exist in system
	If (1), (2), or (3), user requests event option for Customer Order line	Customer Order must exist in system
	If (1), (2), or (3), enter optional description. The system will assign a sequence number to each progress billing line that is added to modify original Customer Order line.	None
	If (1), (2), or (3), enter billing amount OR	If billing amount, two decimal places of precision. Total of billing amounts and billing percent amount can not be greater than line item total.
	If (1), (2), or (3), enter billing percent	If percent, enter as whole integer. Total of billing amounts and billing percent amount can not be greater than line item total.
	If (1), (2), or (3), enter revenue amount. If user leaves revenue amount blank, system assumes entire billing amount for the event is unrealized revenue. OR	If revenue amount, two decimal places of precision. Total of revenue amounts and revenue percent amount can not be greater than line item total.
	If (1), (2), or (3), enter revenue percent. If user leaves revenue amount blank, system assumes entire billing amount for the event is unrealized revenue.	If percent, enter as whole integer. Total of revenue amounts and revenue percent amount can not be greater than line item total.

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	If (1), (2), or (3), enter General Ledger account number or let system assign General Ledger number from GL interface table.	Account must be defined in Chart of Accounts
	For (1), enter event date OR	Must be valid date
	For (2), enter milestone ID OR	None
	For (3), define milestone ID (see cost recognition operation above) and then enter milestone ID.	None
	For (1), (2), or (3), the user can request system to renumber sequence lines. The system then rennumbers starting at ten in multiples of ten.	None
Save progress billing entry	User requests save	None

5.2.8 Modify A Progress Billing

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Customer Order with progress billing	Enter/search for Customer Order ID. The system fills in default header information.	Order ID must exist in system
Optionally modify line information from Customer Order	Enter/modify specific line on Customer Order and link/unlink to Work Order. The system retrieves information on Customer Order line's link to Work Order. The user can choose different Work Order or delete Work Order link.	Work Order must exist in system
	Enter/modify line specifications. The system will designate on Customer Order line there are line specifications.	None
	Enter/modify Invoice specifications. The system will designate on Customer Order line there are Invoice specifications.	None
	Enter/modify billing specifications. The system will designate on Customer Order line there are billing specifications.	None

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	Enter/modify customer notations	None
	Enter/modify order notations	None
	Enter/modify order specifications	None
Modify cost recognition: Modify progress billing milestone for Customer Order line OR System defines cost at shipping if no milestone is defined for Customer Order line	1. Event (based on date) 2. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is in the system 3. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is not set up in the system	
	If modify (2) or (3), user selects Customer Order line	Customer Order exists in system
	If modify (2) or (3), user requests milestone option and system retrieves dialog for the operations for the associated Work Order	Customer Order line must be linked to Work Order. Work Order must exist in system.
	If modify (2), user selects operation from Work Order. If line had previously selected milestone, user can request system to clear operation milestone. User can then choose new milestone and set operation to milestone.	Work Order must be defined in system. Milestone ID must be defined in system.
	If (3), user can enter new milestone ID	None
	If (3), enter description of milestone ID	None
	If (3), enter cost account for material	Account must exist in Chart of Accounts
	If (3), enter cost account for labor	Account must exist in Chart of Accounts
	If (3), enter cost account for burden	Account must exist in Chart of Accounts
	If (3), enter cost account for service	Account must exist in Chart of Accounts
	If (2) or (3), user can modify cost account for material	Account must be in Chart of Accounts
	If (2) or (3), user can modify cost account for labor	Account must be in Chart of Accounts
	If (2) or (3), user can modify cost account for burden	Account must be in Chart of Accounts
	If (2) or (3), user can modify cost account for service	Account must be in Chart of Accounts
	If (2) or (3), user requests system to set operation to milestone	None
	User requests save	None

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Modify billing and revenue recognition: modify progress billing event or milestone for line on Customer Order	1. Event (based on date) OR 2. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is in the system OR 3. Milestone (based on point in time, such as end of operation in Work Order) and milestone ID is not set up in the system	
	If modify (1), (2), or (3), user selects Customer Order line	Customer Order must exist in system
	If modify (1), (2), or (3), user requests event option for Customer Order line	Customer Order must exist in system
	If (1), (2), or (3), user chooses line in progress billing	Event must be defined in progress billing
	If (1), (2), or (3), user can modify sequence number	Sequence number must be whole integer
	If (1), (2), or (3), user can modify optional description	None
	If (1), (2), or (3), user can modify billing amount OR	If billing amount, two decimal places of precision. Total of billing amounts and billing percent amount can not be greater than line item total.
	If (1), (2), or (3), user can modify billing percent	If percent, enter as whole integer. Total of billing amounts and billing percent amount can not be greater than line item total.
	If (1), (2), or (3), user can modify revenue amount. If user leaves revenue amount blank, the system assumes entire billing amount for the event is unrealized revenue OR	If revenue amount, two decimal places of precision. Total of revenue amounts and revenue percent amount can not be greater than line item total.
	If (1), (2), or (3), user can modify revenue percent. If user leaves revenue amount blank, the system assumes entire billing amount for the event is unrealized revenue.	If percent, enter as whole integer. Total of revenue amounts and revenue percent amount can not be greater than line item total.
	If (1), (2), or (3), user can modify General Ledger account number	Account must be defined in Chart of Accounts

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	For (1), user can modify event date OR	Must be valid date
	For (2), user can modify milestone ID OR	None
	For (3), user can define milestone ID (see modify cost recognition operation above) and then enter milestone ID	None
Save progress billing entry	User requests save	None

5.3 Engineering and Job Definition Screen Dialogues

5.3.1 Create a Definition

OPERATION	DIALOGUE	VALIDATION
Specifying Work Order/Master	Select type of Work Order/Master	Must choose one of the following: ☐ Engineering Master ☐ Work Order ☐ Quote Master
	Select size preference of Work Order/Master (see § 5.3.2 Additional Functions)	Must be defined in system
	Select viewing mode option (see § 5.3.2 Additional Functions)	Must select one of the following: ☐ Graphical (one window) ☐ Graphical (two windows) ☐ Text (one window) ☐ Text (two windows)
	To open existing Work Order/Master, enter/search base ID, lot ID or engineering ID, and split ID (Work Orders only). For an Engineering Master, the base ID must be the same as the part ID it represents. For a Quote Master, the base ID always matches the quote ID of the quotation to which it belongs. For a Work Order, the base ID is sometimes called the job ID and uniquely identifies the order. OR	Work Order/Master must exist in system
	User enters new Work Order/Master (see below)	None
Create an engineering master and adding operation to Work Order/Master	User requests system to create Engineering Master	Must choose Engineering Master, Work Order, or Quote Master
	Enter/search part ID OR	Part ID must exist in system
	Create new part ID if not in system	Can enter up to thirty characters
	Enter part description	Can enter up to thirty characters
	If creating new part ID, enter if fabricated, purchased, and if detail only. Then user OK's (user will need to enter additional part information later)	Can enter: ☐ Fabricated ☐ Purchased ☐ Detail only ☐ Fabricated and purchased ☐ Fabricated and detail only
	Review or enter engineering ID. If new part, specify zero.	Defaults to zero
	Enter quantity for standard lot size for this part	Two decimal places of precision
	Enter specifications	None
	Enter engineered by	None

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	Enter date of this revision of the master	Must be valid date
	Enter drawing number	None
	Enter drawing revision	None
	Enter product code	None
	Enter commodity code	None
	User may choose to forward schedule from release date	None
	User may associate a graphic or OLE2 object with the Engineering Master	User must define path to object
	Enter name of variable to define variable dimensions referenced in material requirements	None
	Enter value of defined variable	System rounds to two decimal places of precision
	Optionally override Cost of Goods Sold accounts: ☐ Material Cost of Goods Sold ☐ Labor Cost of Goods Sold ☐ Burden Cost of Goods Sold ☐ Service Cost of Goods Sold	General Ledger accounts must be defined in system
	Enter part unit of measure	Unit of measure must exist in system.
	User requests save. System creates new master.	None
	User selects leg to add operation. User can select master header to add to main leg or a leg header to add operation to that leg. User may also select leg by choosing any other operation or material in the same leg.	Work Order/Master must exist in system
	User requests system to add operation	Work Order/Master must exist in system
	Optionally enter/select operation type	Operation type must exist in system
	Review/adjust sequence number. The new sequence number for an operation always defaults to ten plus the last operation number.	Can enter up to five numeric characters. Zero decimal places of precision.
	Enter/select resource ID: 1. Resource ID for internal operation 2. Resource ID for outside service (subcontractor)	Resource ID must exist in system
	If (2), enter/select service ID	Service ID must exist in system
	If (1), enter/modify setup hours	Default is zero. Two decimal places of precision.
	If (1), enter/modify run time	Five decimal places of precision

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	If (1), enter/modify run type	Defaults to hours per piece. Must choose one of the following: ☐ Hours per piece ☐ Pieces per hour ☐ Minutes per piece ☐ Pieces per minute ☐ Hours per load ☐ Loads per hour
	If (2), enter/modify run type	Defaults to days per piece. Must choose one of the following: ☐ Days per piece ☐ Pieces per day ☐ Days per load ☐ Loads per day
	If (1), and run type is hours/load or loads/hour, enter load size. If (2), and run type is days/load or loads/day, enter load size.	Three decimal places of precision
	If (1) or (2), enter/modify move hours (number of hours that must pass between the end of this operation and the beginning of the next)	Two decimal places of precision
	If (1), enter/modify minimum number of pieces that can be moved from one operation to the next when total operation is not yet complete. For maximum overlap possible, enter .0001.	System rounds to four decimal places of precision
	If (2), enter/modify transit days	Two decimal places of precision
	If (1) or (2), enter specifications	None
	If (1), enter/modify setup cost per hour	Two decimal places of precision
	If (1), enter/modify run cost per hour	Two decimal places of precision
	If (2), enter/modify service base charge	Two decimal places of precision
	If (2), enter/modify service minimum charge	Two decimal places of precision
	If (1) or (2), enter/modify run cost per unit	Four decimal places of precision
	If (1), enter/modify burden percent for setup	Four decimal places of precision
	If (1), enter/modify burden percent of run	Four decimal places of precision
	If (1), enter/modify setup burden per hour	Two decimal places of precision
	If (1), enter/modify run burden per hour	Two decimal places of precision
	If (1), enter/modify run burden per unit	Two decimal places of precision
	If (1), enter fixed burden	Two decimal places of precision

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	If (1) or (2), user can request system not to reset the costs for this particular operation when the system is globally updating costs	None
	If (1) or (2), enter/modify designation as scrap or yield (scrap lost from that quantity or final yield from start quantity)	Must enter scrap or yield
	If (1) or (2), enter/modify scrap/yield percent	Four decimal places of precision
	If (1) or (2), enter/modify fixed scrap quantity	Two decimal places of precision
	If (1) or (2), user may choose to override quantities system automatically calculates	None
	If (1) or (2), and user chooses to override quantities, user enters start quantity and end quantity	Two decimal places of precision
	If (1), enter/select test ID. System runs the test after entering results in visual quality	Test ID must be in system
	If (1), enter drawing number	None
	If (1), enter revision	None
	If (1), enter drawing file	None
	If (1), enter/modify maximum capacity use (maximum number of resource units this operation will use)	Rounds to integer
	If (1), enter/modify minimum capacity use (minimum number of resource units needed for this operation)	Rounds to integer
	If (1), user may schedule discontinuous	None
	If (1), and user schedules discontinuous, enter minimum number of hours of run that should be scheduled in one segment	System rounds to one decimal place of precision
	If (1), user optionally can enter/select concurrent resource (concurrent resource needs to be scheduled at same time as resource defined in operation)	Resource ID must exist in the system
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed during operation setup	System defaults specifying concurrent resource is needed during setup
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed during operation run	System defaults specifying concurrent resource is needed during run time

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	If (1), user reviews/modifies duration percent of the concurrent resource. (a duration percent indicates that the resource is concurrent for a designated percent of the operation.)	System defaults to 100.00%. System rounds to two decimal places of precision
	If (1), and user is scheduling concurrent resource, user can specify if concurrent resource is needed from the start of the operation	System defaults specifying concurrent resource is needed at start of the operation
	If (1) or (2), user may request system to paste picture or object into specified operation	Picture or object must exist and user must specify path to picture or object
Adding materials to engineering definition	User selects operation to add material requirement	Operation must be defined in Work Order/Master
	User requests system to add material to operation. Material required can be: ☐ 1. Inventory part ☐ 2. Non-inventory part	Operation must be defined in Work Order/Master
	User must choose to add material to master or leg/detail to master	System defaults to adding material
	Review/modify piece number	Must enter whole integer
	If (1), enter/search part ID. System retrieves cost information for the part if defined in part maintenance OR	Part ID must exist in system
	If (1), create new part ID if not in system	Can enter up to thirty characters
	If (1), and creating new part, enter part description	Can enter up to thirty characters
	If (1), and creating new part ID, enter if fabricated, purchased, and if detail only. Then user OK's. (user will need to enter additional part information later)	Can enter: ☐ Fabricated ☐ Purchased ☐ Detail only ☐ Fabricated and purchased ☐ Fabricated and detail only
	If (2), do not enter part ID	None
	If (1) or (2), enter/modify quantity of the material that is required per unit	Eight decimal places of precision
	If (1) or (2), enter/modify quantity per type as start quantity or end quantity	Must enter as quantity per start quantity or quantity per end quantity
	If (1) or (2), enter/modify fixed quantity	Two decimal places of precision
	If (1) or (2), enter/modify scrap percent	System saves to four decimal places of precision
	If (1) or (2), optionally enter/modify dimensions	Dimensions must be specified in SAL language

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	If (1), and quantity of the part that is required for the operation is specified using a different unit of measure than the stock unit of measure, enter usage unit of measure. User needs to define relationship between stock unit of measure and usage unit of measure. If (2), optionally enter usage unit of measure	Unit of measure must be defined in system
	If (1) or (2), optionally enter reference number	None
	If (1) or (2), enter specifications	None
	If (1) or (2), optionally enter/modify drawing ID and revision	None
	If (1) or (2), optionally enter/modify drawing effective date	Must be valid date
	If (1) or (2), optionally enter/modify drawing discontinue date	Must be valid date
	If (1) or (2), enter/modify material unit cost	Four decimal places of precision
	If (1) or (2), review/modify labor unit cost	Four decimal places of precision
	If (1) or (2), review/modify burden unit cost	Four decimal places of precision
	If (1) or (2), review/modify service unit cost	Four decimal places of precision
	If (1) or (2), enter/modify fixed cost	Two decimal places of precision
	If (1) or (2), enter/modify issue burden per unit	Four decimal places of precision
	If (1) or (2), enter/modify burden percent	Four decimal places of precision
	If (1) or (2), review/enter vendor ID	Vendor ID must exist in system
	If (1) or (2), review/enter vendor's catalog number for the part	None
	If (1) or (2), enter part manufacturer	None
	If (1) or (2), enter manufacturer's part ID	None
	If (1) or (2), user may request system to paste picture or object for material requirement	Picture or object must exist and user must specify path to picture or object
	If (2), non-inventory part, and material is for Quote Master, user may set quantity break costs	Must be non-inventory part and for Quote Master function

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	User enters quantity break or up-to quantity for designating price breaks, depending how system is set up for purchase quotes	Two decimal places of precision
	Enter unit cost	Four decimal places of precision
	Enter fixed cost (one time cost of the purchase)	Four decimal places of precision
	Enter minimum cost for purchasing designated quantity	Four decimal places of precision
Adding legs	User selects operation to add leg (or any material associated with that operation)	Operation must be defined in Work Order/Master
	User requests system to add leg/detail to operation.	Operation must be defined in Work Order/Master
	User must choose to add leg/detail or material to master.	System defaults to adding leg/detail
	Review/modify piece number	Must enter whole integer
	Review/modify sub ID if necessary	System defaults to zero. Main leg is always zero.
	Optionally enter part ID. This indicates that the assembly corresponds to a part that is also a separate inventory part. However, user must still enter engineering structure	If entering part ID, must exist in system
	User specifies quantity information. Specify all this information in the exact same way as for materials. User is simply indicating the amount of fabricated assembly needed, rather than an inventory part. (see add material above)	Validation for each field as designated in “adding material”
	Enter leg’s specifications	None
	Enter leg’s engineering drawing number	None
	Enter leg’s engineering revision number	None
	Enter drawing effective date	Must be a valid date
	Enter drawing discontinue date	Must be a valid date
	User requests system to save the leg and add it to the structure. User can now add an operation to this leg, and add additional operations, material requirements, and other legs.	None

5.3.2 Additional Functions

OPERATION	DIALOGUE	VALIDATION
Defining size preference for Work Order/Master	Review/select preference number of font and size template	Must be one of six defined font and size templates
	Review/select font	Font must be defined in system

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	Review/select font size	For true type fonts, select any size desired. For non-true type fonts, size must exist in system for that font.
	Review/select normal or bold style	Must select normal or bold
	Review/enter lines of text ☐ In graphical mode, this is number of lines visible ☐ In text mode, this is the number of columns of displayed information	Must select one, two or three
	Review/enter width of card in graphical mode, in terms of the number of characters shown in the selected font and size	Width must be a value ≥ 15 and ≤ 60
	Review/enter height of card in graphical mode, in terms of the number of characters shown in the selected font and size	Height must be ≤ 6 and at least one higher than number of lines
	Review/enter the offset (horizontal distance between edges of successive cards) in terms of the number of characters shown in the selected font and size	Offset must be ≤ 6
	Optionally save preference template as default size for workstation	None
	User OK's setting up of size preference template	None
	User requests system to review/modify color preferences	None
Define color preferences for Work Order/Master	User can set individual colors for each of the following six classes of objects shown: ☐ Work Order/Master header line or card	System defaults to white for the header
	☐ Engineering leg	System defaults to light violet
	☐ Internal operation	System defaults to green
	☐ Sub-contracted operation	System defaults to light blue
	☐ Material	System defaults to red
	☐ Tool/fixture	System defaults to violet
	User can request system to change color of any of the six objects listed above. System retrieves color grid. User chooses color	Color must be defined in system
	User can adjust brightness and hue of the color	Brightness and hue variables must be defined in system
	User may add custom color to template	None

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	User may save new color selections as default for six objects listed above	None
Defining viewing mode for Work Order/Master	User selects one of the following: ☐ Graphical (one window) ☐ Graphical (two windows) ☐ Text (one window) ☐ Text (two windows)	Work Order/Master must exist in system
	User selects graphical view (one window). System returns graphical view. Each object (header, operation, material, leg) is represented by rectangular “card”. The card shows some basic information about the object and its relation to the other objects, and is used to select and edit all of the object’s contents.	Work Order/Master must exist in system
	User selects graphical view (two windows). System returns graphical view as above in bottom window. The top window shows materials for the selected operation.	Work Order/Master must exist in system
	User selects text view (one window). System returns text view. The header is first line of display. Operations appear indented beneath the header. Material requirements appear indented beneath their operations. Legs are also shown indented beneath their operations.	Work Order/Master must exist in system
	User selects text view (two windows). System returns text view as above in left window. The right window shows materials for the selected operation.	Work Order/Master must exist in system
Using the show/hide options in the Engineering Definitions/Work Order	User requests system to: 1. Use any show/hide options to control the display of all legs on the Work Order/Master 2. Use show/hide options to control the display for individual legs on the Work Order/Master	None

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	User requests system to show/hide operations. System displays: 1. Whole Work Order/Master with suppression of operations 2. Selected leg of Work Order/Master with suppression of operations	View mode must not be text view (two windows)
	User requests system to show/hide operations. System displays: 1. Whole Work Order/Master with suppression of materials 2. Selected leg of Work Order/Master with suppression of materials	View must be in one window mode
	User requests system to hide all operation and material requirements and only show header and leg details. System displays: For (1) or (2), header and first card of all legs	View mode must not be text view (two windows)
	User requests system to show all operation and material requirements. System redisplay all operations, material requirements, and all legs.	View mode must not be text view (two windows)
Using the jump option with Engineering Definitions. This controls which portion of the fabrication model/Work Order appears on the available screen space. These options place an object in the home position. For graphic display, home position is the lower left corner of the screen. For text display, home position is the top line of the screen.	User selects jump home option. System places Work Order/Master header in home position.	View mode must not be text view (two windows)
	User selects jump option. System places currently selected option in the home position.	View mode must not be text view (two windows)
	User selects jump up option. System places parent leg header or Work Order/Master header of the selected object in the home position.	View mode must not be text view (two windows)
Copy and paste operations	User selects operation to copy	Operation must exist in Work Order/Master

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	User requests system to copy operation	None
	User requests system to replace contents of an existing operation with the copied operation by the paste function OR	Must be different sequence number than other operations on the leg
	User requests system to insert the operation as a new operation by selecting the main header or a leg header and using the paste function	Must be different sequence number than other operations on the leg
Copy and paste material requirements	User selects material requirement to copy	Material requirement must exist in Work Order/Master
	User requests system to copy material requirement	None
	User requests system to replace contents of an existing requirement with the copied material requirement by the paste function OR	Must be different piece number than other material requirements on the operation
	User requests system to insert the copied material requirement as a new requirement on an operation by selecting the operation and using the paste function.	Must be different piece number than other material requirements on the operation
	User enters piece number for new material requirement	Must be whole integers
Copy and paste a leg	Create a new leg. (see procedure above)	Work Order/Master must exist in system
	User selects leg to copy	Leg must exist in Work Order/Master
	User selects newly created leg and requests system to paste the copied leg	Leg must exist in Work Order/Master
Copying structures	User creates new master. (see above procedure)	Must choose one of the following: ☐ Engineering Master ☐ Work Order ☐ Quote Master
	User selects newly created header and requests system to copy from another master	Work Order/Master must be created in system
	Enter/search for existing Work Order/Master. User OK's selection.	Work Order/Master must exist in system
	System copies selected Work Order/Master to the new header.	
Copying entire Work Order/Masters to become legs of the current Work Order/Masters	User creates new leg using procedures described above.	Work Order/Master must exist in system
	User selects newly created leg and requests system to copy from another master	Leg must exist in Work Order/Master

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	Enter/search for existing Work Order/Master. User OK's selection.	Work Order/Master must exist in system
	System copies selected Work Order/Master to the new leg.	

5.3.3 Managing Work Orders

This section discusses the features and functions that are more specific to Work Orders than engineering and Quote Masters.

OPERATION	DIALOGUE	VALIDATION
Creating new Work Order	User requests system to create Work Order	Must choose Engineering Master, Work Order, or Quote Master
	Enter/search part ID OR	Part ID must exist in system
	Create new part ID if not in system	Can enter up to thirty characters
	Enter part description	Can enter up to thirty characters
	If creating new part ID, enter as fabricated. Then user OK's. (user will need to enter additional part information later)	Can enter: ☐ Fabricated ☐ Purchased ☐ Detail only ☐ Fabricated and purchased ☐ Fabricated and detail only
	Enter a base ID/job ID	Base ID/job ID must be unique
	Enter lot ID	Lot ID must be unique
	Enter split ID	Defaults to zero
	Enter release date	Must be valid date
	Enter want date	Must be valid date
	Enter quantity	Two decimal places of precision
	Enter specifications	None
	Enter engineered by	None
	Enter date of this revision of the Work Order	Must be valid date
	Enter drawing number	None
	Enter drawing revision	None
	Enter product code	None
	Enter commodity code	None
	User may choose to forward schedule from release date	None
	User may associate a graphic or OLE2 object with the Work Order	User must define path to object
	Enter name of variable to define variable dimensions referenced in material requirements	None
	Enter value of defined variable	System rounds to two decimal places of precision

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	Optionally override Cost of Goods Sold accounts: ☐ Material Cost of Goods Sold ☐ Labor Cost of Goods Sold ☐ Burden Cost of Goods Sold ☐ Service Cost of Goods Sold	General Ledger accounts must be defined in system
	User requests save. System creates new Work Order.	None

5.3.4 Modify a Definition

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Quote Master	Enter or search for existing Quote Master	Validate Quote Master exists in system and open it
Modify header card	The following may not be modified: ☐ Master ID ☐ Master description	Gray any changes not allowed
	All other data can be modified as shown in § 5.3.1 Create a definition	Same validations as during creation process
Modify operation card	The following may not be modified: ☐ Operation sequence number ☐ Operation type ☐ Resource ID ☐ Service ID	Changes not allowed
	All other data can be modified as shown in § 5.3.1 Create a definition	Same validations as during creation process
Modify material card	The following may not be modified: ☐ Material piece number	Changes not allowed
	All other data can be modified as shown in § 5.3.1 Create a Definition	Same validations as during creation process
Modify leg card	The following may not be modified: ☐ Master sub ID ☐ Material piece number	Changes not allowed
	All other data can be modified as shown in § 5.3.1 Create a definition	Same validations as during creation process

5.3.5 Delete A Definition

OPERATION	DIALOGUE	VALIDATION
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Retrieve a specific Work Order/Master	Enter or search for existing Work Order/Master	Validate master exists in system
Delete a material card	Select existing material card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete an operation card	Select existing operation card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete a leg card	Select existing leg card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing
Delete entire definition	Select existing header (top most) card, then delete and Answer “OK” to confirmation	Require a “confirm delete” user response before processing

5.3.6 Process A Work Order

OPERATION	DIALOGUE	VALIDATION
Retrieve a specific Work Order/Master	Enter or search for existing master	Validate master exists in system
Setup input settings	Show master ID/revision being checked.	Validate master must be open or selected
	Select schedule ID to check against	Must be a valid schedule
	Enter desired release date	Default to current date Must be a valid date.
	Enter desired want date	Must be a valid date
	Enter desired quantity	Two decimal places of precision
	Select if material availability should be checked or not.	None
	Select if service availability should be checked or not.	None
	Select if force forward schedule should be used or not.	None
Process	Schedule	Ensure above validations have been checked. Allow the user to “abort” schedule process
Display results	Output information: ☐ Scheduled start date ☐ Scheduled finish date ☐ Determinant path delay ☐ Total days delay	Valid dates, and delays in fractional days

5.3.7 Check Work Order Status

OPERATION	DIALOGUE	VALIDATION
Search for specific Work Order/Master	Enter or search for existing master	Validate master exists in system

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Show Work Order scheduling audit trail	Work Order audit info: ☐ Work Order ID ☐ Part ID ☐ Scheduled rank # of # ☐ Pass count ☐ Desired ☐ Release date ☐ Want date ☐ Quantity ☐ Scheduled ☐ Start date ☐ Finish date ☐ Received quantity Schedule audit info: ☐ Attempt no. ☐ Sub ID ☐ Sequence no. ☐ Resource ID ☐ Unit no. ☐ Work Order pass number ☐ Audit result ☐ Result detail ☐ Start date ☐ Finish date	Work Order audit detail information is obtained during the schedule process. Possible audit results are: ☐ Insufficient capacity ☐ Determinant ☐ Efficiency ☐ Load exists ☐ Material ☐ Service ☐ Not set ☐ Concurrent resource conflict ☐ Success ☐ Before today ☐ Frozen
View cost information for estimated, actual and projected costs	Display one line of information for each level of a master as: ☐ Header costs ☐ Operation costs ☐ Material costs ☐ Leg costs	Detail each line displayed by ID, name, and description
	For each line with in a master, display info for: ☐ Quantity ☐ Estimated cost ☐ Actual cost ☐ Variance cost ☐ Projected cost ☐ Estimated hours total ☐ Actual hours total ☐ Variance hours total	Default is summary info. Detailed information is optional for each displayed piece of information.
	Detailed costs include: ☐ Material ☐ Labor ☐ Burden ☐ Service	Unit cost must equal sum of each detailed costs
	Detailed hours include: ☐ Setup ☐ Run	Total hours must equal sum of each detailed hours
View Work Order status (progress)	Display one line of information for each Work Order operation	Must be a valid Work Order

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	For each operation line display: ☐ Start date ☐ Finish date ☐ Estimated setup hrs ☐ Actual setup hrs ☐ Estimated run hrs ☐ Actual run hrs ☐ Variance ☐ percent variance ☐ Transit days ☐ Estimated quantity in ☐ Estimated quantity out ☐ Actual quantity in ☐ Actual quantity out ☐ Scrap quantity ☐ Yield percent ☐ Available quantity	Detail each operation line displayed by sequence number and operation name
View labor detail to-date	Display one line of information for each labor transaction	Must be a valid Work Order
	For each labor transaction display: ☐ Transaction date ☐ Transaction ID ☐ Description ☐ Sub ID ☐ Sequence no. ☐ Type ☐ Quantity good ☐ Quantity deviated ☐ Hours worked ☐ Employee ☐ Department ☐ Resource ☐ Clock in/out ☐ Break hours	Allow detail to be sequenced by: ☐ Date ☐ Operation
View material detail to-date	Display one line of information for each material transaction	Must be a valid Work Order
	For each labor transaction display: ☐ Transaction date ☐ Transaction ID ☐ Description ☐ Sub ID ☐ Sequence no. ☐ Piece number ☐ Type ☐ Part ID ☐ Quantity ☐ Location	Allow detail to be sequenced by: ☐ Date ☐ Material
View service detail to-date	Display one line of information for each service transaction	Must be a valid Work Order Display both: ☐ Dispatches ☐ Receipts

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	For each service transaction display: ☐ Sub ID ☐ Sequence no. ☐ Service ☐ Vendor ☐ Service part ID ☐ Purchase Order ☐ Purchase Order line number ☐ Order quantity ☐ Dispatch transaction ID ☐ Dispatch ID ☐ Dispatch line number ☐ Dispatched quantity ☐ Receipt transaction ID ☐ Receiver ID ☐ Receiver line number ☐ Receipt date ☐ Receipt quantity good ☐ Receipt quantity bad	Display both: ☐ Dispatches ☐ Receipts
Show Work Order in schedule	[tdb]	
Show material plan	[tdb]	
View Customer Order status	Display the following overall summary information as “totals” for: ☐ Production ordered ☐ Production received ☐ Ordered quantity ☐ Shipped quantity	Must be a valid Work Order display options are: ☐ Original booked orders ☐ Backlog ☐ Shipments
	Display one line of information for each Customer Order using the Work Order production as follows: ☐ Customer Order ID ☐ Order line no. ☐ Customer ☐ Part / description ☐ Order quantity ☐ Shipped quantity ☐ Status ☐ Ship on date ☐ Promise date ☐ Shipped date	Must be a valid Work Order. Allow Customer Order drill down for a selected order.

5.3.8 Purchase Materials and Services to a Job

OPERATION	DIALOGUE	VALIDATION
Retrieve a specific Work Order/Master	Enter or search for existing master and open	Validate master exists in system
Select a material or service	Select or highlight existing material or service to be purchased	Must be an existing material or service

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Gather pertinent purchasing information from requirement	Once selected the system returns the following material information: ☐ Required quantity (calculated) ☐ Additional quantity (user given) ☐ Required pieces (calculated)	Must be a valid material
	Also, returns Work Order(s) needing selected material or service, as follows: ☐ Work Order ID ☐ Sequence no. ☐ Piece no. ☐ Net quantity required ☐ Net pieces required	Must be valid Work Order(s)
Look up Purchase Order links of selected requirement	For each Work Order needing requirements, it can be highlighted an existing linked Purchase Order info shows as follows: ☐ Total quantity required ☐ Total quantity issued Purchase Order detailed as: ☐ Purchase Order ID ☐ Order line no. ☐ Vendor ☐ Order quantity	Work Order must have a linked Purchase Order to display
Look up pricing based on vendor and quantity	[tbd]	
Adjust order quantity as needed	This allows the user to enter any additional order quantity that determine is needed ☐ Additional quantity	Four decimal places of precision
Create a Purchase Order	Opens the Purchase Order screen and automatically fills per the information from this window	User must have permission to Purchase Order screen

5.4 Scheduling Screen Dialogues

5.4.1 Define A Global Schedule

OPERATION	DIALOGUE	VALIDATION
Establish calendar information for shop resources	Enter the starting time for the first shift for each day of the week.	Must be a valid time. (default is A.M.)
	For each day that has 1 st shift start time, enter the length of the first, second, and third shifts (in hours).	Total of the three shifts cannot exceed 24 hours. Zero if not worked
Establish calendar exceptions for any or all shop schedule or resource	Enter the date range of the exception	Must be a valid date
	Enter the starting time for the first shift for each date range exception	Must be a valid time. (default is A.M.)
	Enter the shift duration for the exception for the first, second, and third shifts in hours. Use zero, if the shift is not to work at all.	Total of the three shifts cannot exceed 24 hours. Zero if not worked.
Establish resource capacities overrides	For each resource, enter the capacity length of the first, second, and third shifts (in hours)	Total of the three shifts cannot exceed 24 hours. Zero if not worked.
Select schedule type	The two types of schedules supported are finite and. Infinite capacity	None
	Finite capacity schedule uses the capacities defined for each shop resource	First look for capacity resource, if does not exist, then use calendar resource
	Infinite capacity schedule ignores any capacity constraints	None
Establish concurrent checking	This option allows material(s) and service(s) quantities and lead times to affect the schedule.	Material check for: on-hand quantities, planned availability, and part acquisition lead times. Service check for vendor lead-time

5.4.2 Create A Global Schedule

OPERATION	DIALOGUE	VALIDATION
Establish Work Order priorities	Enter priority (global rank) of firmed and released Work Orders. High priorities are scheduled first.	Rank of 50 is the default. Zero is highest priority. Any two-digit number is valid.
Set scheduling parameters	Enter the date and time to start schedule as of	Must be a valid date and time
	Select sort by method. ☐ Order want date ☐ Priority, want date	Order want date is default

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	Select schedule started Work Orders from options: ☐ Normal ☐ Don't freeze start op(s) ☐ Freeze start operations	Normal start is default
	Check material availability option	Material checks for on-hand quantities, planned availability, and part acquisition lead times.
	Check service availability option	Service check for vendor lead-time.
Perform scheduling	Start scheduling process	
	See § 7.1 U.S Patent 5,787,000 and § 7.2 U.S Patent 6,088,626	

5.4.3 Review and Modify A Schedule

OPERATION	DIALOGUE	VALIDATION
Select schedule view	Select one desired schedule from the possible list	Display possible schedules to select from
	Display options are: 1. Replace current window 2. Create new window 3. Add to current window	
	If (1), then close current schedule and display select schedule in a same window	Must be a valid schedule
	If (2), then open new window and display select schedule	Must be a valid schedule
	If (3), then refresh current window and display current schedule and new schedule together	Must be a valid schedule. Allow up to three schedules to be displayed in one window.
Select which groups of resources to view (shop view)	This option limits the resources to be displayed for a given schedule	Must be a valid schedule. Must be a valid resource group (shop view).
Copy of schedule	To allow "what if" schedules, a schedule can be copied as a new schedule	Must be a valid schedule
	Copy options 1. Calendars and schedule 2. Calendars only 3. Copy sub-options 4. Priority settings	
	If (1), then copy both calendars and schedule	Create if a new schedule. Warn if coping to existing schedule.
	If (2), then only copy calendars	Create if a new schedule. Warn if coping to existing schedule.
	If (3), for either (1 or 2), then also copy the priority settings	None
Allow various views of the schedules components	Show/hide capacity info	None
	Show/hide operation info.	None

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	Toggle popup menus	None
	Set schedule display desired start date	Must be a valid date
	Zoom in/out	In to hours, out to months – still showing each day
Freeze specific operations	Select operation to freeze	None
	Enter the rescheduled date and time for the operation to freeze.	Must be a valid date and time
Show the audit of how an operation was scheduled	Select the operation to audit	None
	[tbd]	
Display an animation of the scheduling order of a Work Order	[tbd]	

5.4.4 Delete A Global Schedule

OPERATION	DIALOGUE	VALIDATION
Select global schedule	Select one desired schedule from the possible list	Display possible schedules to select from
Delete schedule	Delete selection	None

5.5 Material and Service Planning Screen Dialogues

5.5.1 Create Forecast

The forecast can be entered into the system manually with an auto-fill feature or by importing. A forecast for specific Customers can also be created manually or by using an auto-fill feature. Customer forecasts can be transferred to part forecasts.

OPERATION	DIALOGUE	VALIDATION
Create forecast lines manually	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	Enter forecast dates	Must be a valid date
	Enter forecast quantities	Must be zero or greater
	System returns for each line: ☐ Available to promise for line ☐ Cumulative available to promise	
	User requests save. System saves forecast lines.	
Create forecast lines with auto-fill feature	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	Enter fill quantity	Must be zero or greater
	Enter starting date	Must be a valid date
	Enter number of periods to fill	Must be an integer
	Enter period size	Must be an integer
	Request forecast to be filled. System creates forecast lines.	
	User modifies forecast date and forecast quantity as desired.	Date must be valid
		Quantity must be zero or greater
	User requests save. System saves forecast lines.	
Create forecast lines by importing	Enter/search file name and path	Must be a valid path and file name
	Optionally choose to import to the Master Schedule simultaneously	
	Optionally choose to purge prior data before import	
	User starts import processing. System imports forecast.	Meter displays relative progress with import. User given option to abort during processing.
	System returns for each line: ☐ Available to promise for line ☐ Cumulative available to promise	
Create customer forecast lines manually	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part

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	Enter/search customer	Must be in Customer Master
	Enter forecast dates	Must be a valid date
	Enter forecast quantities	Must be zero or greater
	User requests save. System saves customer forecast lines.	
Create customer forecast lines with auto-fill feature	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	Enter/search customer	Must be in Customer Master
	Enter fill quantity	Must be zero or greater
	Enter starting date	Must be a valid date
	Enter number of periods to fill	Must be an integer
	Enter period size	Must be an integer
	Request forecast to be filled. System creates forecast lines.	
	User modifies forecast date and forecast quantity as desired.	Date must be valid
		Quantity must be zero or greater
Transfer customer forecasts to part forecasts	User requests save. System saves forecast lines.	
	Optionally choose to import to the Master Schedule simultaneously	
	Optionally choose to purge prior data before import	
	Optionally choose to import using bucket-less time	
	Enter period size	Only enabled if bucket-less time is not chosen
	Optionally enter/select customer forecast starting part	Must be in Part Master. Default is beginning of Part Master.
	Optionally enter/select customer forecast ending part	Must be in Part Master. Default is ending of Part Master.
	Optionally enter/select product code	If selected, must be in product code master. If keyed no validation takes place.
	Enter start date	Must be a valid date
	Enter end date	Must be a valid date
	User starts transfer processing. System transfers forecast.	Meter displays relative progress with import. User given abort option.

5.5.2 Create Master Production Schedule (MPS)

The Master Production Schedule is entered into the system manually with an auto-fill feature by importing, or by copying the forecast.

OPERATION	DIALOGUE	VALIDATION
Create schedule lines manually	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	Enter schedule dates	Must be a valid date
	Enter schedule quantities	Must be zero or greater

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	System returns for each line: ☐ Day of week ☐ Available to promise for line ☐ Cumulative available to promise	
	User requests save. System saves schedule lines.	
Create schedule lines with auto-fill feature	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	Enter fill quantity	Must be zero or greater
	Enter starting date	Must be a valid date
	Enter number of periods to fill	Must be an integer
	Enter period size	Must be an integer
	Request forecast to be filled. System creates schedule lines.	
	User modifies forecast date and forecast quantity as desired.	Date must be valid
		Quantity must be zero or greater
	User requests save. System saves schedule lines.	
	System returns for each line: ☐ Available to promise for line ☐ Cumulative available to promise	
Create schedule lines by importing	Enter/search file name and path	Must be a valid path and file name
	Optionally choose to import to the forecast simultaneously	
	Optionally choose to purge prior data before import	
	User starts import processing.	
	System imports schedule.	
	Meter displays relative progress with import. User given option to abort during processing.	
	System returns for each line: ☐ Available to promise for line ☐ Cumulative available to promise	
Create schedule lines by copying the forecast	Enter/search for part	Must be in Part Master
		Must be a Master Scheduled part
	User requests copy.	
	System copies forecast details to the schedule.	
	User requests save.	
	System saves schedule lines.	

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	System returns for each line: ☐ Available to promise for line ☐ Cumulative available to promise	
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5.5.3 Modify A Forecast and Master Production Schedule (MPS)

The forecast and Master Production Schedule can each be modified manually. Alternatively, the existing forecast and schedule can be appended by using the creation functionality described above.

OPERATION	DIALOGUE	VALIDATION
Modify existing forecast and/or schedule manually	Enter/search part	Must be in Part Master
		Must be a Master Scheduled part
	System returns forecast and schedule	
	Modify forecast date	Must be a valid date
	Modify forecast quantity	Must be zero or greater
	Modify schedule date	Must be a valid date
	Modify schedule quantity	Must be zero or greater
	User requests save	
	System returns for each line: ☐ Day of week ☐ Available to promise for line ☐ Cumulative available to promise	

5.5.4 Export Actuals for Forecast Analysis

Actual activity can be exported for use in third party analysis tools in generating a forecast. This forecast can then be imported into the system.

OPERATION	DIALOGUE	VALIDATION
Create schedule lines by importing	Enter/search file name and path	Must be a valid path and file name
	Enter periods per cycle	
	Optionally enter/select starting part	Must be in Part Master. Default is beginning of Part Master.
	Optionally enter/select ending part	Must be in Part Master. Default is ending of Part Master.
	Optionally enter/select product code	If selected, must be in product code master. If keyed no validation takes place.
	Enter start date	Must be a valid date
	Enter end date	Must be a valid date

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	User selects one or more of the following: ☐ Export shipments ☐ Export issues ☐ Export adjustments out ☐ Adjust by shipment returns ☐ Adjust by issue returns ☐ Adjust by adjustments in System selects records accordingly when processing the export	
	User starts export processing System exports data and creates file	Meter displays relative progress with import. User given abort option.

5.5.5 Create Material Plan Using Material Requirements Planning (MRP)

Running MRP, and reviewing the recommendations that it makes, generates the materials plan. Only parts that are setup for MRP are included in the material plan.

OPERATION	DIALOGUE	VALIDATION
Run MRP	User chooses processing mode: 1. Regeneration 2. Net change	
	Optionally choose to only process one level deep	
	Choose exception marking limits: 1. No horizon 2. Fixed horizon 3. Plus lead-time	
	If (2) or (3), then enter horizon	Horizon must be an integer
	User starts MRP processing	Meter displays relative progress with MRP. User given abort option.
Review planning exception messages	Enter search criteria	
	System returns list of parts meeting search criteria that have one or more MRP exception messages	
	User selects desired part from list	
	System retains search result list	
	System displays all supply and demand orders and nets line-by-line against available inventory (this is the same functionality as 5.5.6 Analyze Material Requirements)	
Display next part from exception list	User requests next part	Must be more than one part returned in original search

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5.5.6 Analyze Material Requirements Using Batch Display Mode

The complete material plan for a chosen part is presented here. A complete netting takes place including MRP and Global Scheduler results. This display mode is batch oriented and is best suited for batch manufacturers. Each line contains an individual order.

OPERATION	DIALOGUE	VALIDATION
Enter or search for parts based on various criteria	Enter/search part OR	Must exist in Part Master
	User enters search criteria System returns list of parts meeting search criteria User selects desired part from list System retains search result list	
Display netting for the part	System displays all supply and demand orders and nets line-by-line against available inventory	
Optional viewing modes for material netting	User chooses one or more of the following: 1. Show unreleased status 2. Show firm status 3. Show released status 4. Show closed status 5. Show cancelled status System restricts netting to only include orders with the respective statuses. Note that these choices do not affect which orders are displayed.	Released status is always chosen by the system
	User chooses to: ☐ Detail quantities System displays derived quantity information for each line	
	User chooses to: ☐ Show exception severity System displays severity information for each line	
	User chooses to either: 1. Net by MRP rules 2. Net by date If (1), system attempts to line up supply and demand If (2), system displays lines by date	Default is to net by date

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	User chooses one or both: 1. Net using available quantity 2. Deduct safety stock If (1), then system deducts on-hand inventory when calculating projected quantity If (2), then system deducts safety stock when calculating projected quantity	
	User chooses to: ☐ Show planned orders System displays MRP planned orders in addition to other orders	Default is to not show planned orders
	User selects lead-time to be expressed as: 1. Four day weeks 2. Five day weeks 3. Six day weeks 4. Seven day weeks The system adjusts recommendations based on the selection and the specified part lead time (expressed in days)	Default is five day weeks
Drill into specific supply and demand orders	User selects desired order If line contains a demand, system returns Customer Order or Work Order If line contains a supply, system returns Work Order or Purchase Order	
Show inventory transactions	User enters date range	Must be valid dates
	System returns list of all inventory transactions for the part within the date range	
Show inventory by location	User requests inventory by location listing	
	System returns list of all valid locations for the part and inventory balances	
Show inventory dimensional detail	User requests dimensional inventory listing	
	System returns list of all unique dimensions in stock	

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	User can request primary sort by: ☐ Length ☐ Width ☐ Height System re-sorts list accordingly.	
	User can request secondary sort by: ☐ Length ☐ Width ☐ Height System re-sorts list accordingly.	
	User can request list be sorted in descending order (default is ascending order) System re-sorts list accordingly.	
Show purchasing history	Enter/search part	Must be in Part Master. Defaults to current part.
	System returns list of all Purchase Orders for selected part.	
	User can select sort by: ☐ Order date ☐ Desired receive date ☐ Purchase Order System re-sorts list accordingly.	
	User can request list sequenced: ☐ Ascending ☐ Descending System re-sorts list accordingly.	
Show selling history	Enter/search part	Must be in Part Master. Defaults to current part.
	System returns list of all Customer Orders for selected part	
	User chooses list sort: ☐ Order date ☐ Desired ship date ☐ Customer Order System re-sorts list accordingly	Default is order date
	User chooses list sequence: ☐ Ascending ☐ Descending System re-sorts list accordingly	Default is ascending
Show subordinate Bill of Material	User selects desired order	Line must reference a part

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	User selects origin of Bill of Material	Line must contain a material requirement for a Work Order
	1. Engineering Master 2. Selected material requirement order 3. Selected Work Order	Only options relevant to selected line type are enabled
	System displays Bill of Material from selected origin	
	User can select a part from the Bill of Material and request: 1. The part be viewed 2. The parent part be viewed	
	If (1), then system returns to material netting display for the selected subordinate part	
	If (2), the system returns to material netting display for the Bill of Materials parent part	
Display next part from search list	User requests next part	Must be more than one part returned in original search
Display netting for the part	System displays all supply and demand orders and nets line-by-line against available inventory	
Purchase requirement to Work Order	User selects desired requirement	Must be a demand (not a supply)
	User requests system to purchase requirement to Work Order	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter an additional order quantity	Must be zero or greater
	Optionally modify the order quantity	
	Optionally modify vendor	Must be in Vendor Master
	Optionally enter Purchase Order ID	
	If Purchase Order ID exists, order will be appended If Purchase Order ID does not exist, a new Purchase Order will be created	
	Optionally set status: ☐ Firm ☐ Release System will create Purchase Order with set status	Default is release

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	Optionally set to not link to each requirement	Default is to link
	System will purchase to inventory instead of to the Work Order	
	User requests Purchase Order created	
	System creates Purchase Order	
Purchase requirement to inventory	User selects desired requirement	Must be a demand (not a supply)
	User requests system to purchase requirement to inventory	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter an additional order quantity	Must be zero or greater
	Optionally modify the order quantity	
	Optionally modify vendor	Must be in Vendor Master
	Optionally enter Purchase Order ID	
	If Purchase Order ID exists order will be appended	
	If Purchase Order ID does not exist a new Purchase Order will be created	
	Optionally set status: ☐ Firm ☐ Release	Default is release
	System will create Purchase Order with set status	
	Optionally set to link to each requirement	Default is to not link
	System will purchase to Work Order instead of to inventory	
	User requests Purchase Order created	
Place Work Order for requirement	System creates Purchase Order	
	User selects desired requirement	Must be a demand (not a supply)
	User requests system to place Work Order for requirement	
	System returns recommendation for Work Order detail including existing Work Order links	

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	Enter/select Engineering Master revision	Revision must exist for selected part
	System uses this revision when copying the Engineering Master to the Work Order	
	Optionally modify the order quantity	
	Optionally modify release date	Must be a valid date
	Optionally modify want date	Must be a valid date
	Optionally choose to: ☐ Forward schedule from release date	Default is not chosen
	System creates Work Order with this option set	
	Optionally enter Work Order ID	Work Order must not exist
	Optionally set status: ☐ Unreleased ☐ Firm ☐ Release	Default is release
Firm/release planned order	System will create Work Order with set status	
	User requests Work Order created	
	System creates Work Order	
	User selects desired requirement	Must be a planned Work Order or Purchase Order
	Requirement can be: 1. Fabricated 2. Purchased	
	If (1) and (2), then system asks user for desired action: 1. Place Work Order 2. Place Purchase Order	
	User responds with one choice	
	If (1), enter/select Engineering Master revision	Revision must exist for selected part
	System uses this revision when copying the Engineering Master to the Work Order	
	If (1) or (2), optionally modify the order quantity	
	If (1) or (2), optionally modify release date	Must be a valid date
	If (1) or (2), optionally modify want date	Must be a valid date

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	If (1), optionally choose to: ☐ Forward schedule from release date System creates Work Order with this option set	Default is not chosen
	If (2), optionally enter/select vendor	Must be in Vendor Master
	If (1), optionally enter Work Order ID	Work Order must not exist
	If (2), optionally enter/select Purchase Order ID	
	If (1), optionally set status: ☐ Unreleased ☐ Firm ☐ Release System will create Work Order with set status	Default is release
	If (2), optionally set status: ☐ Firm ☐ Release System will create Purchase Order with set status	
	If (1) or (2), user requests order be created System creates the appropriate order	
Delete planned order	User selects desired planned order System marks order for deletion	Must be a planned order
	User requests save System deletes all marked planned orders	

5.5.7 Analyze Material Requirements Using Repetitive Display Mode

The complete material plan for a chosen part is presented here. A complete netting takes place including MRP and Global Scheduler results. This display mode is process oriented and is best suited for repetitive manufacturers. Orders are aggregated into buckets of time.

OPERATION	DIALOGUE	VALIDATION
Enter or search for parts based on various criteria	Enter/search part OR	Must exist in Part Master

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	Enter search criteria System returns list of parts meeting search criteria User selects desired part from list System retains search result list	
Display netting for the part	System aggregates orders into buckets of time and nets each bucket against available inventory	
Optional viewing modes for material netting	User chooses one or more of the following: 1. Show unreleased status 2. Show firmed status 3. Show released status 4. Show closed status 5. Show cancelled status System restricts netting to only include orders with the respective statuses. Note that these choices do not affect which orders are displayed.	Released status is always chosen by the system
	User chooses to: ☐ Detail quantities System displays derived quantity information for each line	
	User chooses to: ☐ Show exception severity System displays severity information for each line	
	User chooses to: ☐ Suppress zeros System does not show zeros in time buckets without a quantity	
	User chooses to either: 1. Net by MRP rules 2. Net by date If (1), system attempts to line up supply and demand If (2), system displays lines by date	Default is to net by date

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	User chooses one or both: 1. Net using available quantity 2. Deduct safety stock If (1), then system deducts on-hand inventory when calculating projected quantity If (2), then system deducts safety stock when calculating projected quantity	
	User chooses to: ☐ Show planned orders System displays MRP planned orders in addition to other orders	Default is to not show planned orders
	User selects lead-time to be expressed as: 1. Four day weeks 2. Five day weeks 3. Six day weeks 4. Seven day weeks The system adjusts recommendations based on the selection and the specified part lead time (expressed in days)	Default is five day weeks
Drill into specific supply and demand orders	User selects desired demand or supply type System returns all order detail for the type of supply or demand selected	
Show inventory transactions	User enters date range	Must be valid dates
	System returns list of all inventory transactions for the part within the date range	
Show inventory by location	User requests inventory by location listing	
	System returns list of all valid locations for the part and inventory balances	
Show inventory dimensional detail	User requests dimensional inventory listing	
	System returns list of all unique dimensions in stock	
	User can request primary sort by: ☐ Length ☐ Width ☐ Height System re-sorts list accordingly	

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	User can request secondary sort by: ☐ Length ☐ Width ☐ Height System re-sorts list accordingly	
	User can request list be sorted in descending order (default is ascending order) System re-sorts list accordingly	
	Enter/search part	Must be in Part Master. Defaults to current part.
	System returns list of all Purchase Orders for selected part	
Show purchasing history	User can select sort by: ☐ Order date ☐ Desired receive date ☐ Purchase Order System re-sorts list accordingly	
	User can request list sequenced: ☐ Ascending ☐ Descending System re-sorts list accordingly	
	Enter/search part	Must be in Part Master. Defaults to current part.
	System returns list of all Customer Orders for selected part	
	User chooses list sort: ☐ Order date ☐ Desired ship date ☐ Customer Order System re-sorts list accordingly	Default is order date
Show selling history	User chooses list sequence: ☐ Ascending ☐ Descending System re-sorts list accordingly	Default is ascending
	User selects desired order	Line must reference a part
	User selects origin of Bill of Material: 1. Engineering Master 2. Selected material requirement order 3. Selected Work Order System displays Bill of Material from selected origin	Line must contain a material requirement for a Work Order Only options relevant to selected line type are enabled
Show subordinate Bill of Material	User can select a part from the Bill of Material and request: 1. The part be viewed 2. The parent part be viewed	

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	If (1), then system returns to material netting display for the selected subordinate part	
	If (2), the system returns to material netting display for the Bill of Materials parent part	
Display next part from search list	User requests next part	Must be more than one part returned in original search
Display netting for the part	System displays all supply and demand orders and nets line-by-line against available inventory.	
Purchase requirement to Work Order	User selects desired requirement	Must be a demand (not a supply)
	User requests system to purchase requirement to Work Order	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter an additional order quantity	Must be zero or greater
	Optionally modify the order quantity	
	Optionally modify vendor	Must be in Vendor Master
	Optionally enter Purchase Order ID	
	If Purchase Order ID exists, order will be appended	
	If Purchase Order ID does not exist, a new Purchase Order will be created	
	Optionally set status: ☐ Firm ☐ Release	Default is release
	System will create Purchase Order with set status	
	Optionally set to not link to each requirement	Default is to link
	System will purchase to inventory instead of to the Work Order	
	User requests Purchase Order created	
	System creates Purchase Order	
Purchase requirement to	User selects desired requirement	Must be a demand (not a supply)

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inventory	User requests system to purchase requirement to inventory	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter an additional order quantity	Must be zero or greater
	Optionally modify the order quantity	
	Optionally modify vendor	Must be in Vendor Master
	Optionally enter Purchase Order ID	
	If Purchase Order ID exists, order will be appended	
	If Purchase Order ID does not exist, a new Purchase Order will be created	
	Optionally set status: ☐ Firm ☐ Release	Default is release
Place Work Order for requirement	System will create Purchase Order with set status	
	Optionally set to link to each requirement	Default is to not link
	System will purchase to Work Order instead of to inventory	
	User requests Purchase Order created	
	System creates Purchase Order	
	User selects desired requirement	Must be a demand (not a supply)
	User requests system to place Work Order for requirement	
	System returns recommendation for Work Order detail including existing Work Order links	
	Enter/select Engineering Master revision	Revision must exist for selected part
	System uses this revision when copying the Engineering Master to the Work Order	
	Optionally modify the order quantity	
	Optionally modify release date	Must be a valid date
	Optionally modify want date	Must be a valid date

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	Optionally choose to: ☐ Forward schedule from release date System creates Work Order with this option set	Default is not chosen
	Optionally enter Work Order ID	Work Order must not exist
	Optionally set status: ☐ Unreleased ☐ Firm ☐ Release System will create Work Order with set status	Default is release
	User requests Work Order created	
	System creates Work Order	
Firm/release planned order	User selects desired requirement Requirement can be: 1. Fabricated 2. Purchased	Must be a planned Work Order or Purchase Order
	If (1) and (2), then system asks user for desired action: 1. Place Work Order 2. Place Purchase Order User responds with one choice	
	If (1), enter/select Engineering Master revision System uses this revision when copying the Engineering Master to the Work Order	Revision must exist for selected part
	If (1) or (2), optionally modify the order quantity	
	If (1) or (2), optionally modify release date	Must be a valid date
	If (1) or (2), optionally modify want date	Must be a valid date
	If (1), optionally choose to: ☐ Forward schedule from release date System creates Work Order with this option set	Default is not chosen
	If (2), optionally enter/select vendor	Must be in Vendor Master
	If (1), optionally enter Work Order ID	Work Order must not exist
	If (2), optionally enter/select Purchase Order ID	

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	If (1), optionally set status: ☐ Unreleased ☐ Firm ☐ Release System will create Work Order with set status	Default is release
	If (2), optionally set status: ☐ Firm ☐ Release System will create Purchase Order with set status	
	If (1) or (2), user requests order be created System creates the appropriate order	
Delete planned order	User selects desired planned order	Must be a planned order
	System marks order for deletion	
	User requests save System deletes all marked planned orders	

5.5.8 Analyze Service Requirements

The complete plan for an outside service is presented here including results from MRP and the Global Scheduler.

OPERATION	DIALOGUE	VALIDATION
Enter or search for an outside service based on various criteria	User supplies either or both: ☐ Enter/search service ☐ Enter/search service part OR	Service must exist in Service Master Part must exist in Part Master
	Enter search criteria	
	System returns list of parts meeting search criteria	
	User selects desired part from list	
Display all activity for the service	System retains search result list	
	System displays all supply and demand orders including dispatch information	

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Optional viewing modes for services display	User chooses one or more of the following: 1. Show unreleased status 2. Show firm status 3. Show released status 4. Show closed status 5. Show cancelled status System restricts display to only include orders with the respective statuses	Released status is always chosen by the system.
	User chooses to: ☐ show selected vendor only User must enter/search a vendor System restricts display to only include orders for the selected vendor	Vendor must be in Vendor Master
Show purchasing history	Enter/search service	Must be in Service Master. Defaults to current service.
	System returns list of all Purchase Orders for selected service	
	User can select sort by: ☐ Order date ☐ Desired receive date ☐ Purchase Order ☐ Service part System re-sorts list accordingly	
	User can request list sequenced: ☐ Ascending ☐ Descending System re-sorts list accordingly	
Show dispatch history	Enter/search service	Must be in Service Master. Defaults to current service.
	System returns list of all dispatches for selected service	
	User chooses sort list by: ☐ Dispatch date ☐ Desired receive date ☐ Dispatch ☐ Service part ☐ Order date ☐ Purchase Order System re-sorts list accordingly	Default is dispatch date
	User chooses list sequenced: ☐ Descending ☐ Ascending System re-sorts list accordingly	Default is descending

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	User can optionally: ☐ Exclude fully received dispatches System restricts dispatch history to not include those fully received	Default is to include fully received dispatches
Show vendor Service Dispatches	Enter/search vendor	Must be in Vendor Master
	System returns list of all dispatches for selected vendor	
	User chooses sort list by: ☐ Service ☐ Vendor service ☐ Service part ☐ Purchase Order ☐ Order date ☐ Promise date ☐ Dispatch ☐ Dispatch date ☐ Desired receive date System re-sorts list accordingly	Default is service
	User chooses list sequenced: ☐ Descending ☐ Ascending System re-sorts list accordingly	Default is descending
	User optionally chooses to: ☐ Exclude fully received dispatches System restricts display of dispatches to not include those fully received	
Show Work Order dispatches and receipts	User selects desired Work Order service	Must contain a Work Order
	System returns list of all services for the Work Order	
Purchase service to Work Order	User selects desired requirement	Must be a demand (not a supply)
	User requests system to purchase service to Work Order	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter a dispatch quantity	Must be zero or greater
	System will automatically creates a dispatch with the Purchase Order	
	User requests order to be created System returns Purchase Order in native editor	

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	User modifies Purchase Order as desired	
	User requests Purchase Order saved	
	System saves Purchase Order	
Dispatch service on a Purchase Order	User selects desired requirement	Must be a requirement with a Purchase Order
	User requests system to dispatch the selected Purchase Order	
	System returns recommendation for dispatch detail including existing Work Order links	
	Enter dispatch quantity	Must be zero or greater
	User requests dispatch to be created	
	System returns dispatch in native editor	
	System returns Purchase Order in native editor	
	User modifies Purchase Order as desired	
	User requests Purchase Order created	
	System creates Purchase Order	
	User requests system to purchase service to Work Order	
	System returns recommendation for Purchase Order detail including existing Purchase Order links	
	Optionally enter a dispatch quantity	Must be zero or greater
	System automatically creates a dispatch with the Purchase Order	
	System returns dispatch in native editor	
	User modifies dispatch as desired	
	User requests dispatch saved	
	System saves dispatch	

5.6 Throughput Analysis Screen Dialogues

5.6.1 Perform Throughput Analysis

OPERATION	DIALOGUE	VALIDATION
Define soft allocation parameters	Start the soft allocations setup	Load last saved settings
	Enter schedule execution days of week and time of day as follows: ☐ Sunday at given time ☐ Monday at given time ☐ Tuesday at given time ☐ Wednesday at given time ☐ Thursday at given time ☐ Friday at given time ☐ Saturday at given time	Must be a valid time
	Select any or all allocation options from: ☐ Linked order first ☐ Unavailable inventory ☐ On-hand inventory	None
	Select whether or not to show status meter while performing calculations	None
Perform soft allocations	Create soft allocations	Require a “confirm run” to “calculate soft allocations now?” for user response before processing
	While processing show a progress status meter and allow the user to cancel if needed	Monitor for cancellation
Display customer service impact	[tbd]	
Display contention inquiry	Enter the desired date range for contention run	Must be valid dates Default start is current date and range of two weeks
	Select schedule(s) to be used	Must be valid schedule(s) in system. Default standard schedule. One must be selected
	Optionally, select a single resource, per list or search. If a single resource is selected then request resource time frame as follows: ☐ Monthly ☐ Weekly ☐ Last day of week ☐ Daily	Default to all resources. For all resources then only one schedule used. For one resource then multiple schedules can be used.
	Optionally, select any or all load options from: ☐ Ignore load exists during backward scheduling ☐ Ignore load exists for on time Work Orders ☐ Use first incident only	None

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	Select one contention summarize load exists by: ☐ Occurrences ☐ Severity	One must be selected
	Display results and allow them to be printed	None
Display material constraint inquiry	Enter the desired date range for contention run	Must be valid dates Default start is current date and range of two weeks
	Select schedule(s) to be used	Must be valid schedule(s) in system. Default standard schedule. One must be selected
	Optionally, select a single material (part), per list or search. If a single material is selected, then request resource time frame as follows: ☐ Monthly ☐ Weekly ☐ Last day of week ☐ Daily	Default to all resources. For all material then only one schedule used. For one material then multiple schedules can be used.
	Optionally, select any or all load options from: ☐ Ignore material constraint during backward scheduling ☐ Ignore material constraint for on time Work Orders	None
	Select one material constraint summarize load by: ☐ Occurrences ☐ Severity	One must be selected
	Display results and allow them to be printed	None
Display utilization inquiry	Enter the desired date range for contention run	Must be valid dates. Default start is current date and range of two weeks.
	Select schedule(s) to be used	Must be valid schedule(s) in system. Default standard schedule. One must be selected
	Optionally, select a single resource, per list or search. If a single resource is selected, then request resource time frame as follows: ☐ Monthly ☐ Weekly ☐ Last day of week ☐ Daily	Default to all resources. For all resources then only one schedule used. For one resource then multiple schedules can be used.
	Display results and allow them to be printed	None
Display actual throughput	Enter the desired ending date	Must be a valid date Default to current date

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	Select the graph display option from: ☐ Monthly ☐ Weekly ☐ Last day of week ☐ Daily	Provide list to select the last day of week from
	Display results and allow them to be printed	None
Display expected throughput	Enter the desired base date	Must be a valid date. Default to current date.
	Optionally, allow the finish date to be rounded up to the next day, if the Work Order is finished after a given time.	Must be a valid time
	Select schedule(s) to be used	Must be valid schedule(s) in system. Default standard schedule. One must be selected
	Select the graph display option from: ☐ Monthly ☐ Weekly ☐ Last day of week ☐ Daily	Provide list to select the last day of week from
	Select one reporting option for what happens when the Work Order finishes before the ship date, options are: ☐ Use ship date as throughput date ☐ Use Work Order schedule finish date as throughput date ☐ Use later of Work Order schedule finish date or 'n' day(s) before ship date	One must be selected. 'n' day(s) is user given.
	Display results and allow them to be printed	None
Display actual throughput by resource	Select the resource, per list or search	Must be a valid resource
	Enter the desired date range	Must be valid dates. Default start is current date and range of four weeks
	Select whether to include or exclude Work Orders for selected resource	One must be selected
	Display results and allow them to be printed	None
Display expected throughput by resource	Select the resource, per list or search	Must be a valid resource
	Select whether to include or exclude Work Orders for selected resource	One must be selected

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	Display results and allow them to be printed	None
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5.7 Purchasing Screen Dialogues

5.7.1 Review Purchasing History

OPERATION	DIALOGUE	VALIDATION
Choose either part or service history		

5.7.2 Create a Vendor Request for Quote

OPERATION	DIALOGUE	VALIDATION
Select data entry mode	User can either key information in by hand or generate it automatically from a quote	

5.7.3 Create a Purchase Order for Materials

OPERATION	DIALOGUE	VALIDATION
Enter header information	Enter date of Purchase Order.	Defaults to current date.
	If order numbers are manually assigned, enter order ID. Otherwise leave blank for auto numbering to populate.	Validate that order ID does not currently exist if entered.
	Search or enter the ID of the vendor from whom the part is being ordered. System populates vendor information.	Must exist in Vendor Master.
	Enter desired received date or use calendar feature.	Must be valid date. Defaults to current date.
	Enter original promise date or use calendar feature.	Must be valid date.
	Enter Purchase Order status.	User definable defaults to firm or released. Must be firm, released, closed, or cancelled/void.
	Dispatch for outside services: enter a new or search/select an existing ship-to address if different from default ship-to address.	Validate the state is in the State Master.
	Dispatch for outside services: enter a new or search/select an existing ship-from address if different from default ship-from address.	Validate the state is in the State Master.
	Dispatch for outside services: modify/search/select FOB point.	None
	Dispatch for outside services: modify/search/select Ship Via.	None
	Optionally enter vendor notes.	None
	Optionally enter order notes.	None
	Optionally enter order specs.	None
Optionally modify default header	Modify contact name.	None

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information from Vendor Master	Modify contact position/salutation.	None
	Modify contact telephone.	None
	Modify contact fax.	None
	Enter a new or search/select an existing purchase-from address if different from default purchase-from address.	Validate the state is in the State Master.
	Enter a new or search/select an existing ship-to address if different from the company's default ship-to address.	Validate the state is in the State Master.
	Modify/search/select FOB point.	None
	Modify/search/select ShipVia.	None
	Modify buyer.	Defaults to employee signed in to terminal
	Modify/search/select entity ID.	Defaults to entity defined for vendor.
Optionally modify terms	Select type of net terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	
	If (1), then prompts for number of days, OR	Number of days must be non-negative.
	If (2), then prompts for the day of month OR	Must be one to thirty-one.
	If (3), then prompts for the date OR	Must be a valid date.
	If (4), then prompts for number of months and day of month.	Day of month must be one to thirty-one. Number of months must be non-negative.
	Select type of discount terms: 1. Age of Invoice 2. Day of month 3. Specified date 4. Invoice age, day of month	
	If (1), then prompts for number of days OR	Number of days must be non-negative.
	If (2), then prompts for the day of month OR	Must be one to thirty-one.
	If (3), then prompts for the date OR	Must be a valid date.
	If (4), then prompts for number of months and day of month.	Day of month must be one to thirty-one. Number of months must be non-negative.

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	Enter discount percent.	Two decimal places of precision.
	Enter user defined terms description.	None
Optionally set currency hedging	User requests current exchange rates to be retrieved from database.	Current Purchase Order must not be in native system currency
	User enters the following: As of date Buy rate Sell rate	Date must be any valid date
Optionally enter blanket order information	Indicate if order is Electronic Data Interchange (EDI)	None
	Optionally enter EDI blanket Purchase Order number.	None
	Optionally enter EDI contract ID (for the delivery schedule)	None
	Optionally enter EDI Ship-To ID (for the delivery schedule)	Validate the state is in the State Master
Enter line information	Enter quantity.	None
	Specify the ordered item: 1. Purchasing an inventory part from any vendor 2. Purchasing an inventory part from preferred vendor 3. Purchasing a non-inventory part 4. Purchasing an inventory part with a blanket order 5. Purchasing a part to a Work Order 6. Purchasing a miscellaneous item	
	If (1), enter part ID OR	Part must be in Part Master.
	If (2), leave vendor ID blank in header. Enter part ID and preferred vendor will populate. Can also choose vendor from table of vendors supplying this part OR	Must be in Part Master and must have preferred vendor specified.
	If (3), enter unit of measure, unit price, General Ledger account ID, and description OR	Unit of measure must be in Unit of Measure Master and General Ledger account ID must be in Chart of Accounts. Description may not be null.
	If (4), select/modify Ship-To ID and enter part ID. OR	Part must be in Part Master.
	If (5), enter/search for Work Order ID or bring up previously created Work Order and identify specific material requirements OR	Material requirement must be set up in Work Order.
	If (6), enter unit price and General Ledger number.	G/L account number must be in Chart of Accounts.

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	Optionally enter line specifications.	None
Optionally modify default line information from Part Master and Vendor Master	Modify unit price.	Four decimal places of precision.
	Modify discount percent.	Four decimal places of precision.
	Modify fixed/base charge.	Two decimal places of precision.
	Modify minimum charge.	Two decimal places of precision.
	Modify General Ledger account.	Must be in Chart of Accounts.
	Modify VAT code.	Defaults from part maintenance. VAT code must be defined in system.
	View VAT percent. Cannot modify.	VAT code must be defined in system and have assigned percent.
	View VAT amount. Cannot modify. Based on VAT percent.	VAT code must be defined in system and have assigned percent.
	View VAT receiving percent. Cannot modify. Based on VAT code.	VAT code must be defined in system.
	View VAT receiving amount. Cannot modify. Based on VAT percent.	VAT code must be defined in system and have assigned percent.
Save Purchase Order	User requests save. System generates Purchase Order number.	Must be a valid Purchase Order ID.
Print Purchase Order acknowledgment	User chooses the destination of the acknowledgment from the following: ☐ Print the acknowledgment ☐ View the acknowledgment ☐ Write the acknowledgment to a file ☐ E-mail the acknowledgment	None
	User chooses one of the following as the format: ☐ Standard ☐ Print Form ☐ User-defined 1 ☐ User-defined 2 ☐ User-defined 3	None
	Optionally choose draft mode.	None
	Optionally choose to print Barcodes.	None
	User chooses one of the following: ☐ Print Current Order ☐ Print Current Order and release ☐ Print All Firmmed Orders through specified date ☐ Print All Firmmed Orders and release through specified date	

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	If (1), user requests print. System prints order currently displayed. OR	None
	If (2), user requests print. System prints order currently displayed and changes the status from firmed to released. OR	None
	If (3), user enters date or uses calendar feature and then requests print. System prints all orders with a firm status with a date equal to or less than the specified date. OR	Must be valid date.
	If (4), user enters date or uses calendar feature and then requests print. System prints all orders with a firm status with a date equal to or less than the specified date and then changes the status from firmed to released.	Must be valid date.

5.7.4 Enter a Purchase Order for Services

OPERATION	DIALOGUE	VALIDATION
Enter unique header information	Enter date of Purchase Order.	Defaults to current date.
	If order numbers are manually assigned, enter order ID. Otherwise, leave blank for auto numbering to populate.	Validate that order ID does not currently exist if entered.
	Search or enter the ID of the vendor from whom the part is being ordered.	Must exist in Vendor Master.
	Enter desired received date or use calendar feature.	Must be a valid date. Defaults to current date.
	Enter original promise date or use calendar feature.	Must be valid date.
	Enter Purchase Order status.	User definable defaults to firmed or released. Must be firmed, released, closed, or cancelled/void.
	Dispatch for outside services: enter a new or search/select an existing Ship-To address if different from default ship-to address.	None

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	Dispatch for outside services: enter a new or search/select an existing ship-from addresses if different from default ship-from address.	None
	Dispatch for outside services: modify/search/select FOB point.	None
	Dispatch for outside services: modify/search/select Ship Via.	None
	Optionally enter vendor notes.	None
	Optionally enter order notes.	None
	Optionally enter order specs.	None
Optionally modify default header information from Vendor Master	Modify contact name.	None
	Modify contact position/salutation.	None
	Modify contact telephone.	None
	Modify contact fax.	None
	Enter a new or search/select an existing purchase-from address if different from default purchase-from address.	None
	Enter a new or search/select an existing ship-to address if different from the company's default ship-to address.	None
	Modify/search/select FOB point.	None.
	Modify/search/select Ship Via.	None.
	Modify buyer.	Defaults to employee signed in to workstation.
	Modify/search/select entity ID.	Defaults to entity defined for selected vendor.
Optionally modify terms	Select type of net terms: ☐ Age of Invoice ☐ Day of month ☐ Specified date ☐ Invoice age, day of month	
	If (1), System prompts for number of days OR	None
	If (2), System prompts for the day of month OR	Must be one to thirty-one.
	If (3), System prompts for the date OR	Must be valid date.
	If (4), System prompts for number of months and day of month.	Day of month must be one to thirty-one. Number of months must be non-negative.

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	Select type of discount terms: ☐ Age of Invoice ☐ Day of month ☐ Specified date ☐ Invoice age, day of month	
	If (1), System prompts for number of days OR	None
	If (2), System prompts for the day of month OR	Must be one to thirty-one.
	If (3), System prompts for the date OR	Must be valid date.
	If (4), System prompts for number of months and day of month.	Day of month must be one to thirty-one. Number of months must be non-negative.
	Enter discount percent.	Two decimal places of precision.
	Enter user defined terms description.	None
Optionally set currency hedging	User requests current exchange rates to be retrieved from database.	Current Purchase Order must not be in native system currency.
	User enters the following: As of date Buy rate Sell rate	Date must be any valid date
Optionally enter blanket order information	Indicate if order is Electronic Data Interchange (EDI)	None
	Optionally enter EDI blanket Purchase Order number	None
	Optionally enter EDI contract ID (for the delivery schedule)	None
	Optionally enter EDI Ship-To ID (for the delivery schedule)	Validate the state is in the State Master
Enter line information	Enter quantity.	None
	Optionally enter dispatch quantity.	Total dispatched cannot exceed order quantity.
	Specify the service ID.	Service ID must be in Outside Service Master.
	Enter base ID/lot ID/split ID OR Enter service part ID.	Work Order must be in Work Order Master OR Part ID must be in Service Part Master.
	Specify sub ID/sequence number for service for service.	Sub ID/sequence number must be defined in Work Order.
	Enter line specifications.	None
	Modify VAT code. Defaults from Part Master.	Vat code must be defined in system.
	View VAT percent. Cannot modify.	VAT code must be defined in system and have assigned percent.

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	View VAT amount. Cannot modify. Based on VAT percent.	Vat code must be defined in system and have assigned percent.
	View VAT receivable percent. Cannot modify. Based on VAT code.	Vat code must be defined in system.
	View VAT receivable amount. Cannot modify. Based on VAT percent.	Vat code must be defined in system and have assigned percent.
Optionally modify default line information from Part Master and Vendor Master	Modify unit price.	Four decimal places of precision.
	Modify discount percent.	Four decimal places of precision.
	Modify fixed/base charge.	Two decimal places of precision.
	Modify minimum charge.	Two decimal places of precision.
	Modify General Ledger account.	Must be in Chart of Accounts.
Save Purchase Order	User requests save.	None
	System assigns Purchase Order ID if required and saves Purchase Order.	

5.7.5 Modify a Purchase Order

OPERATION	DIALOGUE	VALIDATION
Retrieve existing order	Enter order ID OR	Order ID exists in system.
	Search for order ID.	Order ID exists in system.
Modify header parameters as required	Modifying information in Purchase Order except our order ID if: 1. There has been no Receivers against this Purchase Order or there has been Receivers against this Purchase Order but all items have been returned and the order is firmed or released 2. There have been receipts against this Purchase Order and the Purchase Order is released 3. The order has been closed	Order ID exists in system.
	Can modify purchase-from address if (1)	None
	Can modify vendor ID if (1). If (2), and vendor ID is incorrect, need to return material and then issue new Purchase Order and receipt with correct vendor ID. If (3), must re-release Purchase Order and there has not been receipts against Purchase Order.	Vendor ID must exist in Vendor Master.

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	If (1) or (2), can modify ship-to address.	None
Can modify line information	For Purchase Orders without receipts, can modify all Purchase Order lines	
	For Purchase Orders with receipts, can modify some items	
	If (1) or (2), can modify quantity.	None
	If (1) or (2), can enter dispatch quantity.	Total quantity dispatched cannot exceed total order quantity.
	If (1), can modify part ID or service ID.	Part ID or service ID must be in part or Service Masters.
	If (1) or (2), can modify vendor part ID.	None
	If (1) or (2), can modify unit of measure.	Unit of measure must be in masters.
	If (1) or (2), can modify receivable date.	Must be valid date.
	If (1) or (2), can modify unit price.	Four decimal points of precision.
	If (1) or (2), can modify discount.	Four decimal points of precision.
	If (1) or (2), can modify fixed charge.	Two decimal points of precision.
	If (1) or (2), can modify estimated freight.	Two decimal points of precision.
	If (1) or (2), can modify General Ledger expense account ID.	Account number must be in Chart of Accounts.
	If (1), can modify links to Work Order.	Work Order must be in master.
	If (2), can modify links to Work Order for material that has not been received. Additional links to a Work Order can be established as required.	Work Order must be in master.
	If (2), link a Work Order to line for material that has already been received. Use assign to Work Order. An inventory transaction entry must be used to manually issue the material from inventory to the Work Order.	Work Order must be in master.
	If (2), remove a Work Order link for material that has already been received. Use assign to Work Order to delete the link. Inventory transaction entry must then be used to return the material to inventory.	Work Order must be in master.
	If (2), can reassign materials already received from one Work Order to another.	Work Order must be in master.
	If (1) or (2), can add new line items to Purchase Order.	None

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	If (3), must re-release closed Purchase Order to add new line items.	None
	If (1) or (2), can delete any unreceived lines.	None
	Can assign latest part price from updated vendor quote to line items in Purchase Order. User selects line to re-price, and then chooses re-price lines.	Prices must be in vendor quote table.
	After deleting lines in line table, need to renumber. User chooses renumber lines feature.	None
Save Purchase Order	User requests save. System saves Purchase Order.	None

5.7.6 Delete A Purchase Order

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Purchase Order	Enter or search for Purchase Order ID to be deleted.	Purchase Order to be deleted must exist.
Delete Purchase Order	Delete Purchase Order: 1. Delete Purchase Order that has not been received OR 2. Delete Purchase Order that has been received.	
	If (1), delete Purchase Order with a confirmation prior to actual deletion.	
	If (2), delete Purchase Order receiver then delete Purchase Order with a confirmation prior to actual deletion.	

5.7.7 Review Dispatch History

OPERATION	DIALOGUE	VALIDATION
Enter service ID	Enter service ID or search for one	Must be valid service ID. Returns all Purchase Order lines for the specified service.
Display dispatch history	Choose to sort the dispatch history by one of the following: ☐ Dispatch date ☐ Desired received date ☐ Dispatch ID ☐ Service part ID ☐ Order date ☐ Purchase Order	None
	Choose to view the dispatch history in either ascending or descending order.	None

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	Optionally choose to exclude all fully received services.	None
View selected dispatch	System displays detail for each Dispatch.	None

5.7.8 Dispatch An Outside Service

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Purchase Order	Enter order ID or search for one.	Order ID exists in system.
Enter line dispatch information	Choose line item.	Must be for service ID.
	Enter quantity to dispatch in dispatch quantity column.	Quantity must be non-negative.
	Enter appropriate quantity in the actual freight column.	Quantity must be non-negative.
	Enter shipping weight in the shipping weight column.	Shipping weight must be positive.
	Enter weight unit measure in the weight unit measure column.	Unit measure must be defined in system.
	Optionally enter any links in the links column.	None
	Select the vendor address.	None
Save Service Dispatch	User requests save.	Must be valid Service Dispatch.
	System saves Dispatch.	
Print dispatch	User chooses one of the following: ☐ Print the dispatch ☐ View the dispatch ☐ E-mail the dispatch ☐ Save the dispatch to a file	
	User chooses one of the following: 1. Print the current Purchase Order Service Dispatch 2. Print orders dispatched on a given date	
	If (2), enter date or use calendar feature.	Must be valid date.

5.7.9 Retrieve Order Status

OPERATION	DIALOGUE	VALIDATION
Search for one or more orders based on multiple criteria	Enter search criteria.	None
	System returns list of Purchase Orders meeting search criteria.	
	user selects desired order from list.	None
	System retains search result list.	None
Show receipts and vouchers	System displays Purchase Order summary.	
	user requests list of receipts and vouchers for Purchase Order.	None

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	System returns list.	
Show backorders	User requests list of backorders for Purchase Order.	None
	User optionally selects a backorder and requests order to be displayed.	None
	System displays Purchase Order summary.	
Show Work Order status	User requests list of Work Orders for Purchase Order.	None
	System returns list.	
	User optionally selects a Work Order and requests operation detail to be displayed.	None
	System returns operation detail.	
Show vendor MTD/YTD summary	User requests vendor MTD/YTD summary to be displayed.	None
	System returns summary.	
Display next order from search list	User requests next part.	Must be more than one part returned in original search.
	System displays next Customer Order summary.	

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5.8 Receiving Screen Dialogues

5.8.1 Receive a Purchase Order for Materials

Receipts of items on a Purchase Order may include inventoried items, non-inventoried items, consumables, lot-traced items, and dimensional inventory.

OPERATION	DIALOGUE	VALIDATION
Retrieve Purchase Order that is to be received	Enter or search for order ID.	Purchase Order must exist.
Enter header information	If Purchase Order does not have back orders OR If Purchase Order does have back orders. If auto backorder mode is selected, system will select backorders based on Purchase Order order ID.	
	If (1), original Purchase Order is selected.	Purchase Order must have status of released.
	If (2), System will select backorders based on Purchase Order order ID.	Purchase Order must have status of released.
	If (1) or (2), Receiver numbers are manually assigned, enter Receiver ID, or leave blank for auto numbering to assign.	Validate that Receiver ID does not currently exist if manually entered.
	If (1) or (2), enter/modify actual received date. Defaults to system date or defaults to last Receiver date if several Purchase Orders are received consequently.	Must be valid date.
Optionally modify default header information from Purchase Order	Modify FOB.	None
	Modify ShipVia.	None
Optionally modify default line information from Purchase Order	Modify warehouse ID and/or location ID for: ☐ Inventory part ☐ OR ☐ Non-inventory part	
	If (1), inventory part.	At least one location ID must be defined for part ID to be received in inventory. Location ID must be valid for part ID or need to enter newly assigned warehouse ID and location ID.
	If (2), non-inventory part.	None
	Enter/modify Purchase Order specifications.	None
	Enter/modify Purchase Order line item specifications.	None
	Enter/modify Receiver notations.	None
	Enter/modify vendor notations.	None

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	Enter/modify Purchase Order notations.	None
	Enter/modify inspection of part. user can choose one of the following: Mark the part for return Mark the part for release	
	View/edit Intrastat data when saving Purchase Order receipt.	Intrastat data must be defined in system.
Receive Purchase Order	To receive (1), all materials, designate to system receive all. System will then close Purchase Order.	Must be outstanding items on Purchase Order.
	To receive (2), partial receipt, tell system how many items are received. System prompts confirmation of operation, and gives user choices. 1. Leave order open. Purchase Order does not close 2. Copy remaining unreceived items to separate backorder. Original Purchase Order will close 3. Close order. Order is closed without receiving remaining items	Must be outstanding items on Purchase Order.
Save Purchase Order receipt	If receipt operation is successful, System generates a new Receiver ID and saves Receiver.	None

5.8.2 Receive a Purchase Order for Services

OPERATION	DIALOGUE	VALIDATION
Retrieve Purchase Order that is to be received	Enter or search for order ID.	Purchase Order must exist.
Enter header information	If Purchase Order does not have back orders OR If Purchase Order does have back orders. If auto backorder mode is selected, system will select backorders based on Purchase Order order ID.	
	If (1), original Purchase Order is selected.	Purchase Order must have status of released.
	If (2), system will select backorders based on Purchase Order order ID.	Purchase Order must have status of released.

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	If (1) or (2), Receiver numbers are manually assigned, enter Receiver ID OR Leave blank for auto numbering to assign.	Validate that Receiver ID does not currently exist if manually entered.
	If (1) or (2), enter/modify actual received date	Must be a valid date. Defaults to system date or defaults to last Receiver date if several Purchase Orders are received consequently.
	Optionally enter/modify Purchase Order specifications.	None
	Optionally enter/modify Receiver notations.	None
	Optionally enter/modify vendor notations.	None
	Optionally enter/modify Purchase Order notations.	None
Optionally modify default header information from Purchase Order	Modify FOB.	None
	Modify ShipVia.	None
Optionally modify default line information from Purchase Order	Enter/modify Purchase Order line item specifications.	None
	View/edit Intrastat data when saving Purchase Order receipt.	Intrastat data must be defined in system.
Receive Purchase Order	To receive (1), all services, designate to system receive all. System will then close Purchase Order.	Must be outstanding items on Purchase Order.
	To receive (2), partial receipt, tell system how many services are received. System prompts confirmation of operation, and gives user choices: 1. Leave order open. Purchase Order does not close. 2. Copy remaining unreceived items to separate backorder. Original Purchase Order will close. 3. Close order. Order is closed without receiving remaining items.	Must be outstanding items on Purchase Order.
Save Purchase Order receipt	If receipt operation is successful, System generates a new Receiver ID and saves Receiver.	None

5.8.3 Contra Purchase Order Receipt for Materials

An item that was purchased through purchasing can be returned to the vendor through a Purchase Order return process. This process creates new transactions that reverse the original ones.

OPERATION	DIALOGUE	VALIDATION
Retrieve Purchase Order that contains item to return	Enter order ID OR	Purchase Order must exist.

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	Search for order ID.	
Process return	Designate return in system.	Order ID must have some received items.
	Enter/modify return date.	Defaults to current date at startup.
	Enter quantity returned for each item.	Order ID must have some received items.
	For inventory parts, enter/modify warehouse ID and location ID	Defaults to primary warehouse designated for part.
Save purchase return	User requests save. If successful, System generates a new Receiver ID for the return. If Purchase Order was previously closed, System will re-release the Purchase Order.	None

5.8.4 Contra Purchase Order Receipt for Services

OPERATION	DIALOGUE	VALIDATION
Retrieve Purchase Order that contains services to reverse	Enter order ID OR Search for order ID	Order ID exists in system.
	Designate return in system.	Order ID must have some received services.
	Enter/modify return date.	Defaults to current date at startup.
	Enter quantity of services reversed.	Order ID must have some received services
	Enter location ID.	Location ID must be in system.
Save reversal of services	User requests save. If successful, system generates a new Receiver ID for the return. If Purchase Order was previously closed, system will re-release the Purchase Order.	None

5.8.5 Receive a Service

This dialogue is used when a service is to be received when a Purchase Order was not used in connection with the contracted service.

OPERATION	DIALOGUE	VALIDATION
Enter service order receipt information	Leave transaction ID blank for auto-numbering by system.	None
	Enter/modify transaction date	Defaults to current date.
	Enter/search for Work Order ID.	Work Order must exist in Work Order master and must be released.
	Enter/search for operation sequence number.	Released operations that use a subcontractor resource must exist in table of sequence numbers for the selected Work Order.

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	Service ID populates when operation specified. Can modify service ID by entering/searching service ID table.	Service ID must exist in master.
	Enter service part ID.	None
	Enter/search for vendor ID. Vendor service ID will populate when vendor is entered if set up in system to supply this service.	Vendor ID must exist in Vendor Master.
	Enter quantity received (good). System will tell user if quantity received is larger than quantity dispatched.	Two decimal places of precision.
	Enter quantity received (deviated). System will tell user if quantity received is larger than quantity dispatched.	Two decimal places of precision.
	Review/modify unit cost.	Unit cost defaults from estimated cost specified in operation.
	Review/modify base charge.	Base charge defaults from estimated cost specified in operation.
	Enter description or comment	None
Save service receipt	If receipt operation is successful, quantity completed for the operation is updated to account for new quantity reported. If quantity completed for the operation now meets or exceeds required quantity, System automatically closes the operation. System generates a new transaction ID.	None

5.8.6 Contra Service Receipt

This dialogue is used when a service is to be return received when a Purchase Order was not used in connection with the contracted service. The receipt record is simply deleted.

OPERATION	DIALOGUE	VALIDATION
Retrieve service receipt that is to be returned	Enter/search for transaction ID of service receipt to be deleted.	Transaction ID must exist in system.
Delete service receipt	Delete the transaction through the system.	None
Save deletion of service receipt	User requests save.	None

5.8.7 Receive a Return Material Authorization

OPERATION	DIALOGUE	VALIDATION
Retrieve Customer Order	Enter/search for Customer Order	Order must exist
Enter header information		
Enter line detail		
Save RMA receipt		

5.9 Inventory Control Screen Dialogues

5.9.1 Issue Inventory to a Work Order

OPERATION	DIALOGUE	VALIDATION
Enter transaction date	Enter a date or use calendar feature. System uses current date by default.	Must be a valid date.
Enter desired material requirement	Enter a Work Order ID or search for one.	Must be a valid Work Order ID.
	Is this a requirement currently on the Bill of Material?	
	<u>Yes</u> Enter a piece number or search for one. System returns part description, unit of measure, required quantity, issued quantity, due quantity, quantity on hand, quantity available, location and optional dimensional requirements: pieces, length, width, and height.	Must be a valid piece number.
	<u>No</u> Indicate that a new material is required, and then enter a part ID or search for one. System returns part description, unit of measure, quantity on hand, quantity available, location and optional dimensional requirements: pieces, length, width, and height.	The user must have permission to add a new material requirement. part ID must be a valid part ID.
Enter supply information	Enter the quantity.	Must be positive.
	If used, enter dimensional requirements.	Individual Dimensions must not be null if specified as required in the Part Master.
	If desired, change warehouse and location by either entering them or searching for them.	Must be valid warehouse and location.
	Optionally add a description to the supply information.	None

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	user must enter part traceability for parts designated as traceable: Traceability has already begun at receiving or Labor Ticket entry OR Traceability begins at shipping and lot number or serial number are auto-numbered by system OR Traceability begins at shipping and lot number or serial number are manually assigned by user	Parts must be defined in system as traceable.
Enter part trace information if required	If (1), (2) or (3), user designates line with traceable part and checks the part traceability.	Part must be defined in system as traceable.
	If (1), (2) or (3), user can change warehouse ID and location ID. If change warehouse ID and location ID, will also need to assign values for defined fields for part traceability.	Warehouse ID and location ID must be defined in system. Can only designate one warehouse ID and location ID per transaction.
	If (1), serial/lot numbers are already created in system.	Serial/lot number must be assigned in system.
	If (2), system will auto-number serial or lot numbers. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Part must be traceable and set up as auto-numbered for serial or lot number.
	If (3), user enters serial number or lot number. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Can enter up to fifteen alphanumeric characters.

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	System automatically fills in quantity fields to distribute total ship quantity across lot numbers. If (1), (2) or (3), user can modify ship quantity for a lot number. If quantity entered by user is different than original ship quantity, system will ask user if user wants to override old ship quantity with new entered ship quantity. This new ship quantity will not override shipping amount in general entry.	Four decimal places of precision.
	If (2) or (3), enter properties that are defined by alpha property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	None
	If (2) or (3), enter properties that are defined by numeric property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	Must be numeric.
	If (1), (2) or (3), optionally enter comments for each line	None
	If (1), (2) or (3), review/modify expiration date.	Must be valid date.
	User requests system to save traceability information	Required information set up in part traceability must be entered
	User requests save. System generates Packing List.	Customer shipments must not be on hold.
Enter inventory item piece tracking information if required.	Enter piece tracking information.	None
Save inventory transaction	Choose to save the inventory transaction entry. System creates inventory transactions.	Must be a valid Work Order, part ID, warehouse ID, location, and quantity must be positive.

5.9.2 Issue Inventory by Exception

OPERATION	DIALOGUE	VALIDATION
Enter transaction date	Enter date or select using calendar feature. System uses current date by default.	Must be a valid date.
Retrieve Work Order requirements	Enter a Work Order ID, or search for one. Select one of the following: A specific sub ID All sub ID's	Must be a valid released Work Order. None

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	If (1), then display that leg's requirements and current issue status.	Must be a valid sub ID.
	If (2), display all requirements for the Work Order and current issue status.	None
Start auto issue mode	Select type of auto issue mode: 1. Issue up to inventory balance 2. Ignore inventory balance of part 3. For each mode allow the following option: ☐ Preview transactions before saving	None
	If (1), then issue total quantity available per all available locations.	Commit transaction.
	If (1a), then show all locations with positive quantity available. Then allow the user to save or cancel.	None
	If (2), then issue total quantity available for all available locations and issue the balance inventory from the first listed warehouse/location and drive the quantity negative.	Commit transaction.
	If (2a), then issue total quantity available per all available locations and issue the balance inventory from the first listed warehouse/location and drive the quantity negative. Then allow the user to save or cancel.	None
	If (a), allow a save or cancel.	Save will commit transaction. Cancel will stop auto issue mode.
Enter issue exceptions	Type in overrides to recommended quantity and warehouse ID and location ID.	Quantity must be positive. Must be a valid warehouse ID and location ID.
	User must enter part traceability for parts designated as traceable: 1. Traceability has already begun at receiving or Labor Ticket entry or 2. Traceability begins at shipping and lot number or serial number are auto-numbered by system or 3. Traceability begins at shipping and lot number or serial number are manually assigned by user	Parts must be defined in system as traceable.
Enter part trace information if required	If (1), (2) or (3), user designates line with traceable part and checks the part traceability.	Part must be defined in system as traceable.

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	If (1), (2) or (3), user can change warehouse ID and location ID. If change warehouse ID and location ID, will also need to assign values for defined fields for part traceability.	Warehouse ID and location ID must be defined in system. Can only designate one warehouse ID and location ID per transaction.
	If (1), serial/lot numbers are already created in system	Serial/lot number must be assigned in system.
	If (2), system will auto-number serial or lot numbers. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Part must be traceable and set up as auto-numbered for serial or lot number.
	If (3), user enters serial number or lot number. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Can enter up to fifteen alphanumeric characters.
	System automatically fills in quantity fields to distribute total ship quantity across lot numbers. If (1), (2) or (3), user can modify ship quantity for a lot number. If quantity entered by user is different than original ship quantity, system will ask user if user wants to override old ship quantity with new entered ship quantity. This new ship quantity will not override shipping amount in general entry.	Four decimal places of precision.
	If (2) or (3), enter properties that are defined by alpha property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	None
	If (2) or (3), enter properties that are defined by numeric property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	Must be numeric.

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	If (1), (2) or (3), optionally enter comments for each line.	None
	If (1), (2) or (3), review/modify expiration date.	Must be a valid date.
	User requests system to save traceability information.	Required information set up in part traceability must be entered.
	User requests save. System generates Packing List.	Customer shipments must not be on hold.
Save inventory transactions	User must either: 1. Save with all inventory issued OR 2. Save with changes noted	None
	If (1), choose to either issue up to inventory balance of part or ignore inventory balance of part. Optionally choose to preview the transactions before saving. If (2), user just chooses to save.	Must be a valid Work Order.

5.9.3 Contra Issue Inventory to a Work Order

OPERATION	DIALOGUE	VALIDATION
Enter transaction date	Enter date or select using calendar feature. System uses current date by default.	Must be a valid date.
Enter Work Order	Enter a Work Order ID or search for one. System returns detail of original issue transactions.	Must be a valid Work Order ID.
Enter transaction information	Enter quantity received.	Must be positive.
	Enter receiving warehouse and location or search for them.	Must be valid warehouse and location.
	Enter unit costs: material, labor, burden, and service.	Must be non-negative.
	If required, enter dimensional inventory parameters.	None
	If required, enter part trace parameters.	None
Save inventory transaction	Choose to save the inventory transaction entry.	Must be a valid Work Order, part ID, warehouse ID, location, and quantity must be positive.
Print trace labels	If this is a part trace part then labels are available to print.	None

5.9.4 Receive A Job Into Inventory

OPERATION	DIALOGUE	VALIDATION
Enter Work Order	Enter a Work Order ID or search for one.	Must be a valid Work Order, and cannot be fully linked to Customer Order(s).

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	If Work Order is fully linked to Customer Order(s), it will be received automatically when shipped. Receipt of this Work Order is not allowed.	Receipt is not allowed for Work Order selected.
	If Work Order not linked.	Must be a valid Work Order ID.
	System returns Work Order details.	
Enter transaction information	Enter quantity received.	Must be positive.
	Enter receiving warehouse and location or search for them.	Must be valid warehouse and location.
	Enter unit costs: material, labor, burden, and service.	Must be non-negative.
	If required, enter dimensional inventory parameters.	None
	If required, enter part trace parameters.	None
Save inventory transaction	Choose to save the inventory transaction entry.	Must be a valid Work Order, part ID, warehouse ID, location, and quantity must be positive.
Print trace labels if required	If this is a part trace part, then labels are available to print.	None

5.9.5 Contra Receive A Job Into Inventory

OPERATION	DIALOGUE	VALIDATION
Enter transaction date	Enter date or select using calendar feature. System uses current date by default.	Must be a valid date.
Enter Work Order	Enter a Work Order ID or search for one.	Must be a valid Work Order ID. Returns detail of original issue transactions.
Enter transaction information	Enter quantity received.	Must be positive.
	Enter receiving warehouse and location or search for them.	Must be valid warehouse and location.
	Enter unit costs: material, labor, burden, and service.	Must be non-negative.
	If required, enter dimensional inventory parameters.	None
	If required, enter part trace parameters.	None
Save inventory transaction	Choose to save the inventory transaction entry.	Must be a valid Work Order, part ID, warehouse ID, location, and quantity must be positive.
Print trace labels if required	If this is a part trace part, then labels are available to print.	None

5.9.6 Adjust Inventory

OPERATION	DIALOGUE	VALIDATION
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Enter transaction date	Enter date or select using calendar feature. System uses current date by default.	Must be a valid date.
Specify direction of adjustment	Select direction of adjustment: 1. Adjust into inventory 2. Adjust out of inventory	
Enter part ID	Enter a part ID or search for one.	Must be a valid part ID.
Enter transaction information	If (1), enter quantity adjusting in.	Must be positive.
	If (2), enter quantity adjusting out.	
	If (1), enter receiving warehouse and location or search for them. If (2), enter warehouse and location containing extra part or search for them.	Must be valid warehouse and location.
	If (1), enter unit costs: material, labor, burden, and service if applicable.	Must be non-negative.
	Optionally enter adjust account ID.	Must be valid adjust account ID.
	If required, enter dimensional inventory parameters.	None
	If required, enter part trace parameters.	None
Save inventory transaction	Choose to save the inventory transaction entry.	Must be valid part ID, warehouse ID, location, and quantity must be positive.
Print trace labels	If this is a part trace part, then labels are available to print.	None

5.9.7 Transfer Inventory Between Locations

OPERATION	DIALOGUE	VALIDATION
Enter transaction date	Enter date or select using calendar feature. System uses current date by default.	Must be a valid date.
Enter part ID	Enter a part ID or search for one.	Must be a valid part ID. Returns part information.
Enter transaction information	Enter quantity to transfer.	Quantity must be positive.
	Enter warehouse ID and location from which the part to transfer comes or search for them.	Must be valid warehouse ID and location. Warehouse ID and location must also contain a quantity equal or greater than the quantity the user wishes to transfer.
	Enter warehouse ID and location to which the part to transfer is going, or search for them.	Must be valid warehouse ID and location.

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	If required, enter dimensional inventory parameters.	None
	If required, enter part trace parameters.	None
Save inventory transaction	Choose to save the inventory transaction entry.	Must be valid part ID, warehouse ID, location, quantity to transfer must be positive, and that quantity must be available to transfer for that part.

5.9.8 Process Inventory Counts

OPERATION	DIALOGUE	VALIDATION
Initialize count	Enter the physical count ID.	None
	Optionally enter a description.	None
	Enter a warehouse ID or select one from a list.	Must be a valid warehouse ID.
	Enter the number of tags per group.	Breaks the printing of tags into separate groups.
	Enter the starting and ending tag numbers. System adds preceding zeros to numbers that do not require seven digits. System automatically increases ending tag number if it is not large enough to accommodate the number of tags needed. System print extra tags as blanks if the ending tag number is larger than what is needed.	Must be a seven-digit number.
	Optionally enter the number of extra blank tags per part.	Must be non-negative.
	Optionally enter the number of extra blank tags per group.	Must be non-negative.
	Optionally enter an override asset account ID. If no account ID is entered, the adjustments to inventory account is used.	Must be a valid General Ledger account ID.
	Optionally choose to create blank tags only.	Tags will be printed without part ID and location.
	Optionally choose to lock each location and/or all part inventory. This will prevent transactions from occurring against all parts included in the physical inventory count.	None
	Choose one of the following: 1. Perform a full physical count 2. Perform a cycle count	

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	If (1), optionally choose to create tags in location/part order. System will run inventory count for a specific group rather than all parts.	None
	If (2), choose to enable cycle counting.	Cycle counting is enabled.
	If (2), enter ABC code and product code.	Must be valid ABC code and product code.
Print tags	Enter physical count ID.	Must be an existing valid physical count ID.
	Choose one of the following: 1. Print the tags 2. View the tags as a report 3. Write the tags to a file	None
	Choose to sort the tags by tag number or location ID/part ID	None
Enter counts	Enter count date or select count date using calendar feature. System uses current date by default.	Must be a valid date.
	Optionally choose to automatically save the count.	None
	Optionally choose to automatically advance to the next tag.	None
	Enter the seven-digit tag number. If this is a standard tag, System automatically fills in part ID and location ID.	None
	If this is not a standard tag, enter the part ID or search for it and enter the location ID or select it.	Must be valid part ID and location ID.
	Enter the quantity counted for this part.	Quantity must be non-negative.
	If required, enter the pieces, length, width, and height.	Pieces, length, width, and height must be non-negative.
	Optionally void the current tag.	Quantity must be non-negative.
	Save the current tag.	Must be valid tag number, part ID, location ID, and quantity must be non-negative.
Review counts	Choose to review the counts by: 1. Group number 2. Location ID/part ID	
	If (1), enter or select which group number to view.	Must be valid group number.
	If (2), enter or select which location ID to view.	Must be valid location ID.
	If (1), optionally modify the location ID where the part was counted for each tag.	Must be valid location ID.

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	Optionally modify the part ID that was counted for the location for each tag.	Must be a valid part ID.
	Optionally enter or modify an existing count for each tag.	Must be non-negative. Tag must be active.
	Optionally choose to activate or void any tag.	None
Enter recounts	Enter count date or select count date using calendar feature. System uses current date by default.	Must be a valid date.
	Optionally choose to automatically save the count.	None
	Optionally choose to automatically advance to the next tag.	None
	Enter the seven-digit tag number. If this is a standard tag, System automatically fills in part ID and location ID.	The count for this tag must have been entered previously using the enter count feature.
	If this is not a standard tag, enter the part ID or search for it and enter the location ID or select it.	Must be valid part ID and location ID.
	Enter the quantity counted for this part.	Quantity must be non-negative.
	If required, enter the pieces, length, width, and height.	Pieces, length, width, and height must be non-negative.
	Optionally void the current tag.	Quantity must be non-negative.
	User requests save of the current tag. System saves current tag.	Must be valid tag number, part ID, location ID, and quantity must be non-negative.
	Enter the count date. Optionally use the calendar feature.	Must be a valid date.
	Enter count date or select count date using calendar feature. System uses current date by default.	Must be a valid date.
End count	Optionally update part balances.	None
	Optionally choose to keep the count tags. If not chosen, count tags will be purged by the System.	
	Optionally choose to zero part locations without tags. System removes inventory for which no tags were printed and removes inventory for which user did not specify a count quantity.	None

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	Optionally unlock inventory that was locked at the beginning of the inventory count. System unlocks locked inventory.	None
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5.10 Shop Floor Control Screen Dialogues

5.10.1 Release Work Order to Shop Floor

These dialogues describe the process of releasing a Work Order to the floor and producing the paperwork that is typically prepared for various shop personnel.

OPERATION	DIALOGUE	VALIDATION
Retrieve Work Order to be released	Enter or search for a Work Order.	Work Order must exist and be a valid Work Order.
Change status to release	Change status to release.	None
	Optionally choose to change the status of subordinate materials and operations.	None
Print Work Order traveler	Enter the base ID, lot ID, split ID, and sub ID for the Work Order, or use the search feature. If the search feature is used, lot ID, split ID, and sub ID are automatically filled in by the System and the sub ID defaults to all legs of the Work Order.	Must be a valid Work Order.
	If printing travelers or Picking Lists for multiple Work Orders, user may optionally enter an earliest and/or latest date or use the calendar feature to constrain the range of release dates selected.	None
	Choose one of the following: 1. Print the travelers 2. View the travelers 3. Save the travelers to a file	None
	Optionally choose to print new releases only. System only prints Work Orders auto released by this printing.	None
	If (1), optionally choose to release firm Work Orders. System auto releases firmed Work Orders in the specified date range.	None
	If (1), optionally choose to auto release all details of each Work Order. System releases all operations, material requirements, and legs of an auto released Work Order.	None

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	Choose at least one of the following: 1. Traveler format 2. Picking List format If both are chosen, they will be processed by the System as two separate jobs.	None
	If (2), select a sort sequence of either piece number or location ID.	None
	If (1), optionally select the following printing options: 1. Print operation barcodes 2. Print Customer Order info 3. Print operation write-ins 4. Print part locations 5. Print part traceability info	
	If (3), enter the labels for the write-ins if defaults are not present. If the user wants to save these new write-ins as the defaults, choose to save them.	None
	If (2), optionally select the following printing options: Print material barcodes Print part locations Print part traceability info	
	Choose to print/view the travelers and/or the Picking Lists. The travelers and/or Picking Lists are either printed, viewed as a report, or saved to a file.	None
	If the user selected release firm Work Orders, System asks whether travelers printed correctly. <u>YES</u> , the Work Orders will be released. <u>NO</u> , the Work Orders will not be released.	None
Print requirements report	Enter the starting Work Order ID or search for one.	Must be a valid Work Order ID.
	Enter the ending Work Order ID or search for one.	Must be a valid Work Order ID.
	Enter the starting date or use the calendar feature.	Must be a valid date.
	Enter the ending date or use the calendar feature.	Must be a valid date.
	Choose one of the following information options: Un-purchased material required Un-issued material required	

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	If (1), System prints all requirements where the current issued quantity is less than the quantity required.	None
	If (2), System prints all requirements that do not have linked Purchase Orders.	None
	Choose one of the following sequence options: ☐ Sequence the report by Work Order want date ☐ Sequence the report by requirement date of material requirements on the Work Orders	None
	Optionally choose to include material with part IDs to print inventory materials. If not chosen, System reports only non-inventory materials.	None
	Choose one of the following: ☐ Print the report ☐ View the report ☐ Save the report to a file	None
	Choose to print/view the Work Order requirements report.	The report is either printed, viewed, or saved to a file.
	Print dispatch reports	
	Enter starting resource ID or search for one.	Must be a valid resource ID.
	Enter ending resource ID or search for one.	Must be a valid resource ID.
	Optionally choose any or all of the following resource types: ☐ Work center ☐ Individual/team ☐ Contractor	The selected types of resources will be included in the report.
	Optionally select the appropriate Work Order schedule filter. The user can choose to print only operations for Work Orders whose scheduled finish date is earlier or later than the want date by a specified number of days. If earlier is chosen, enter the number of days. If later is chosen, enter the number of days.	The number of days that the Work Order is scheduled to be late by must be non-negative if this option is chosen. The number of days that the Work Order is scheduled to be early by must be non-negative if this option is chosen.
	Select the status of operations to include in the report.	The status can be firmed, released, or both.
	Optionally choose to include projected throughput amounts.	None
	Choose one of the following: ☐ Print the report ☐ View the report ☐ Save the report to a file	None

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	User chooses to generate the report.	None
Print foreman's report	Enter starting resource ID or search for one.	Must be a valid resource ID.
	Enter ending resource ID or search for one.	Must be a valid resource ID.
	Enter the horizon in days.	Number of days must be non-negative.
	Optionally choose any or all of the following resource types: ☐ Work center ☐ Individual/team ☐ Contractor	None
	Select the status of operations to include in the report.	The status can be firmed, released, or both.
	Choose one of the following: ☐ Print the report ☐ View the report ☐ Save the report to a file	None
	User chooses to generate the report.	None
Print shop calendar	Select the schedule to print.	Must be a valid schedule defined in the system.
	Select the desired resource ID.	Must be a valid resource ID. The calendar generated will be for this resource.
	Enter the year for the calendar.	Must be a valid four-digit year. Defaults to the current year.
	Choose one of the following: ☐ Print the calendar ☐ View the calendar ☐ Save the calendar to a file	None
	User chooses to generate the calendar.	None

5.10.2 Check Work Order Status

As the Work Order progresses through the shop, shop personnel typically check the progress of a Work Order as updated by the collection of actual data.

OPERATION	DIALOGUE	VALIDATION
Retrieve specific Work Order	Enter or search for a Work Order. [this can be copied from the Work Order master definition section when it is done]	Work Order must exist and be a valid Work Order
View progress information		
View cost information		
View material detail to-date		
View labor detail to-date		
View service detail to-date		
Show Work Order in schedule		
Show Work Order scheduling audit trail		
Show material plan		

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View status of Customer		
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5.10.3 Check Shop Calendar Status

This dialogue is used to monitor the status of all activity on the shop floor and reflects the current priorities and progress of each activity.

OPERATION	DIALOGUE	VALIDATION
Select which schedule(s) to view	[use the scheduling window under tools for this dialog]	
Select which groups of resources to view		
View shop schedule		
Allow various views of the schedules components	[Discuss operations only capacity only zoom in zoom out]	

5.10.4 Manually Create a Labor Ticket

This dialogue is used when Labor Tickets are manually keyed into the system typically from paper forms.

OPERATION	DIALOGUE	VALIDATION
Optionally retrieve in process Labor Ticket	Choose to retrieve an in process Labor Ticket.	None
	Choose one of the following: ☐ Include all jobs ☐ Include only jobs prior to the current date	
	User selects the desired Labor Ticket. System returns selected Labor Ticket.	Transaction type, Work Order ID, operation sequence number, indirect ID, and General Ledger ID are disabled.
Enter source information	Enter the transaction date or use the calendar feature.	Must be a valid date. Defaults to the current date.
	Enter the employee ID or search for one. System returns department ID and earning code.	Must be a valid employee ID.
	Optionally modify department ID	Must be a valid department ID.
	Choose transaction type. Must be one of the following: 1. Setup 2. Run 3. Indirect	
	If (3), enter or search for an indirect ID. System returns indirect code and General Ledger account ID.	Must be a valid indirect ID.
	If (3), optionally modify or search for a different General Ledger account ID.	Must be a valid General Ledger account ID.
	If (1) or (2), enter the Work Order or search for one.	Must be a valid Work Order.

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	If (1) or (2), enter or search for an operation sequence number. If searching, a list of all available operation sequence numbers for this Work Order will be presented. System returns the resource ID.	Must be a valid operation sequence number.
	If (1) or (2), optionally modify the resource ID.	Must be a valid resource ID.
	Optionally modify the earning code or search for one. If searching, a list of earning codes will be presented.	Must be a valid earning code.
Enter actual data	Enter time. This can be done in the following ways: 1. Entering clock-in and clock-out times 2. Entering clock-in time and elapsed hours 3. Entering elapsed hours 4. Enter clock-in time and clock-out time as the same, and do not specify elapsed hours	
	If (1), user must enter a clock-in time and a clock-out time. System returns elapsed hours.	Must be valid times.
	If (2), user must enter a clock-in time and the number of elapsed hours. System automatically calculates Clock-out time.	Clock-in time must be a valid time. Elapsed hours must be non-negative.
	If (3), user must enter the number of elapsed hours. System will not record start and stop times.	Elapsed hours must be non-negative.
	If (4), user must enter the same time for clock-in time and clock-out time. System creates an in process ticket.	Must be valid times.
	Optionally, enter the number of hours spent on break. System automatically deducts the number of break hours from the elapsed time.	Number of hours on break must be non-negative.
	Optionally, enter a description for the Labor Ticket.	None

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	If transaction type is setup and this Labor Ticket completed setup, indicate that setup is complete.	None
	If transaction type is run, enter the number of pieces completed during the specified elapsed time. The system: ☐ Updates completion meters. ☐ Any resources marked automatic reporting have their quantity completed updated. ☐ Triggers auto issuing of material requirements. ☐ Closes completed operations if quantity required is met or exceeded.	Quantity completed must be non-negative.
	Enter any unusable pieces produced during the elapsed time.	Must be non-negative.
	If transaction type is run and the operation was completed during the elapsed time, user indicates that the run is complete. System closes the operation and closes any previous operations that use shop resources marked automatic reporting.	None
	Enter cost overrides	Must be non-negative.
Enter part trace parameters if required	Part traceability is required if the following conditions are true: ☐ Reporting against a Work Order for a fabricated part that is traceable ☐ ☐ Reporting labor for the Work Order operation that is marked begin traceability at this operation ☐ Reporting run labor (not setup) ☐ Reporting a quantity completed	
	Optionally override the trace quantity.	Quantity must be non-negative.
Save Labor Ticket	User chooses to save the Labor Ticket.	None
	System updates total hours for the	

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	session.	
Optionally recalculate overtime	Enter the last date of the week for which to recalculate overtime or use the calendar feature.	Must be a valid date.
	Enter multiplier and over values for premium one.	Must be non-negative.
	Enter multiplier for premium two and choose which days of the week to on which to use this multiplier.	Multiplier must be non-negative.
	Choose to recalculate overtime. System processes all time tickets for the specified week and determines new overtime multipliers.	None

5.10.5 Modify a Labor Ticket

Labor Tickets can be modified to correct any of the actual data contained on them. Labor Tickets are always created regardless of the method of data collection (manual, wedge, or remote).

OPERATION	DIALOGUE	VALIDATION
Select the Labor Ticket	Enter the employee ID or search for one.	Must be a valid employee ID.
	Choose to retrieve an in process Labor Ticket.	None
Correct source information as required	Optionally modify the transaction date.	Must be a valid date.
	Optionally modify the employee ID and department ID.	Must be valid employee ID and department ID.
	If the transaction type is indirect, optionally modify the indirect ID and General Ledger account ID.	Must be valid indirect ID and General Ledger ID.
Correct actual data as required	Optionally modify clock-in, clock-out, elapsed time, and break hours.	Clock-in and clock-out must be valid times. Elapsed time and break hours must be non-negative.
	Optionally modify quantity completed and quantity deviated. If quantity completed drops back below quantity required, the operation will automatically be re-released from the closed status.	Must be non-negative.
	Optionally modify hourly rate, multiplier, and unit rate.	Must be valid hourly rate. Multipliers must be positive. Unit rate must be non-negative.
Correct part trace parameters as required		
Recalculate overtime as required		
Save Labor Ticket	Choose to save the Labor Ticket.	Labor Ticket is updated.

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5.10.6 Export Time and Attendance for Payroll

Labor Ticket data can be exported for use in an external payroll system. No financial data is made part of the export, only time and attendance is included.

OPERATION	DIALOGUE	VALIDATION
Enter export parameters	Enter company ID.	Must be valid company ID.
	Enter the period begin date or use the calendar feature.	Must be valid date.
	Enter the period end date or use the calendar feature.	Must be valid date.
	Choose period type. Can be weekly, bi-weekly, semi-monthly, or monthly.	None
	Choose from where the pay rate should come. Either the Employee Master or from visual payroll.	None
	Choose one of the following export types: 1. Export in detail 2. Export in summary	
	If (1), each Labor Ticket is included in the export file.	None
	If (2), Labor Tickets will be summarized for each code and employee.	None
	If necessary, choose rounding criteria from the following: 1. None 2. Nearest 15 minute interval 3. Nearest 10 minute interval 4. Nearest 5 minute interval	
	If (2), (3), or (4), choose which type of rounding to be done. Rounding types are 4/5 rounding and any fraction rounding.	None
Establish overtime policy if Required	Choose to determine overtime.	None
	Enter multiplier, overtime hours per week, and overtime hours per day for premium one.	Must be non-negative.
	Enter the multiplier for premium two and choose which days of the week to apply it to.	Multiplier must be non-negative.
	Optionally choose to apply vacation, holiday, and sick time to the total regular hours.	None
	Vacation, holiday, and sick time are included with regular hours.	
Export data	Choose to export time and attendance.	None

5.11 Shipping Screen Dialogues

5.11.1 Ship a Customer Order

OPERATION	DIALOGUE	VALIDATION
Retrieve Customer Order to be shipped	Enter/search for order ID.	Order must have released status.
Enter header information	Review/enter actual ship date.	Must be a valid date.
	When first starting shipping entry function, date defaults to current date. After first entry, shipping date defaults to last actual ship date.	
	Review/modify shipping address.	Shipping address must be in system.
	Enter order specifications.	None
	Enter order notations.	None
	Modify FOB.	None
Optionally modify default header information from Customer Order	Enter Packing List notations	None
	Modify Ship Via.	None
	Modify ship status.	Status must be shipped, review 1, review 2, review 3, or approved
	Shipping Customer Orders 1. Line items with inventory parts 2. Line items without inventory parts	
Enter line information	If (1) or (2), optionally enter actual freight amount for each line item.	Two decimal places of precision. Must be entered in customer's currency.
	For (1), enter location ID. For (2), optionally enter location ID. System defaults to primary location for part, or first defined location if no primary location exists. If no location ID is assigned to warehouse, system will automatically set up location called shipping.	For (1), part must be assigned to location ID and not on hold for that location. For (2), none.
	For (1), user must enter warehouse ID. For (2), optionally enter warehouse ID.	Warehouse ID must be defined in system.
	Optionally enter cartons.	System rounds to whole integers.
	Optionally enter shipping weight.	Two decimal places of precision.
	Optionally enter weight of measure.	None
	Optionally enter National Motor Freight Codes.	Must be defined in system.
	Optionally enter package type.	Must be defined in system.
	Enter order line item specifications.	None

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	Enter ship-to ID number. This number will override ship-to address in header.	Shipping ID's must exist in system.
	user selects items to ship: 1. Shipping all remaining quantities for all lines. 2. To partially ship line items 3. To overship line items 4. To ship line items that have delivery schedule set up	Customer Order must be released.
Shipping line items	If (1), (2), (3), or (4), user can request system to show all shipped and unshipped lines on Customer Order. OR Only show lines that have remaining items to be shipped.	Customer Order must be released.
	If (1), user requests system to ship all. System fills each ship quantity with remaining quantity needed, and creates Packing List for the shipment. If shipment is successful, the Customer Order closes automatically.	Customer Order must be released.
	If (2), user manually enters ship quantity for each item. user can choose to: ☐ Close line item ☐ OR ☐ Leave order open (leaves Customer Order open so shipment can be completed on different Packing List at different time OR ☐ Copy remaining unshipped lines to a separate backorder. (System uses same order ID with addition of suffix, such as 4001-1) Ship quantity defaults to remaining quantity needed.	Two decimal places of precision.

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	If (3), user manually enters ship quantity for each item. user can choose to: ☐ Distribute extra shipped items to other lines in Customer Order for the same part ID. If there are no other lines, shipped quantity remains in original line ☐ OR ☐ Over ship on this line. Leaves ship quantity as manually entered. Ship quantity defaults to remaining quantity needed.	Two decimal places of precision.
	If (4), user selects item and requests delivery schedule. System populates fields for delivery schedule. user enters ship quantity and optionally enters ship-to ID. user can undership all lines. When last line is undershipped, user will receive choices as outlined in number 2 above. If user overships any line, user will receive choices as outlined in number 3 above.	Delivery schedule must be defined for line item.
	Enter Packing List specifications	None
	User must enter part traceability for parts designated as traceable: 1. Traceability has already begun at receiving or Labor Ticket entry 2. Traceability begins at shipping and lot number or serial number are automatically numbered by system 3. Traceability begins at shipping and lot number or serial number are manually assigned by user	Parts must be defined in system as traceable.
Enter part trace information if required	If (1), (2) or (3), user designates line with traceable part and checks the part traceability	Part must be defined in system as traceable.
	If (1), (2) or (3), user can change warehouse ID and location ID. If change, warehouse ID and location ID, will also need to assign values for defined fields for part traceability.	Warehouse ID and location ID must be defined in system. Can only designate one warehouse ID and location ID per transaction.
	If (1), serial/lot numbers are already created in system	Serial/lot number must be assigned in system.

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	If (2), system will automatically number serial or lot numbers. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Part must be traceable and set up as automatically numbered for serial or lot number.
	If (3), user enters serial number or lot number. If maximum lot size is defined in system, system will create enough lines for ship quantity divided by maximum lot size (designated in part profile maintenance). If there is not a maximum lot size designated, system will only have one line for total shipped quantity.	Can enter up to fifteen alphanumeric characters.
	System automatically fills in quantity fields to distribute total ship quantity across lot numbers. If (1), (2) or (3), user can modify ship quantity for a lot number. If quantity entered by user is different than original ship quantity, system will ask user if user wants to override old ship quantity with new entered ship quantity. This new ship quantity will not override shipping amount in general entry.	Four decimal places of precision
	If (2) or (3), enter properties that are defined by alpha property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	None
	If (2) or (3), enter properties that are defined by numeric property labels in part traceability. If these properties are defined in system as mandatory to trace, user must enter information.	Must be numeric.
	If (1), (2) or (3), optionally enter comments for each line.	None
	If (1), (2) or (3), review/modify expiration date.	Must be valid date.
	User requests system to save traceability information.	Required information set up in part traceability must be entered.
	user requests save. System generates Packing List.	Customer shipments must not be on hold.
	Save shipping transaction	Intrastat feature must be enabled

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	can review/modify data for shipping entry.	in system.
Optionally enter Intrastat information	Review/modify port of arrival.	Port of arrival must be defined in system.
	Review/modify port of transshipment.	Port of transshipment must be defined in system.
	Review/modify nature of transport.	Nature of transport must be defined in system.
	Review/modify mode of transport.	Mode of transport must be defined in system.
	Review/modify the country where the shipment is going.	Country must be defined in system as Intrastat country.
	Review/modify original country where goods were manufactured.	Country must be defined in system as Intrastat country.
	Review/modify country shipping the goods.	Country must be defined in system as Intrastat country.
	Review/modify region.	Region must be defined in system.
	Review/modify excise price.	Must be numeric.
	Review/modify tariff code.	Must be defined in system.
	User saves Intrastat information.	Entered fields must be defined in system.
	User enters pallet detail: 1. User has not enabled system feature to ask for pallet details on save or 2. User has enabled system to ask for pallet detail on save.	Packing List must be created (item must be shipped)
Optionally enter pallet details	If (1), user enters line number from Packing List. OR If (2), user selects line from Packing List from choices generated by system.	Line must exist on Packing List.
	If (1) or (2), enter pallet ID	None
	If (1) or (2), enter number of cartons	Must be whole integer.
	If (1) or (2), enter weight	Two decimal places of precision.
	If (1) or (2), enter package type	Package type must be defined in system.
	If (1) or (2), enter quantity per package	System rounds to two decimal places of precision after saving entry.
	User saves pallet details. Cartons will default to one and quantity per package will default to line's shipped quantity.	If (1), pallet ID and weight must be entered. If (2), pallet ID, weight and carton must be entered.
	User requests save of shipping entry.	Customer must not be "on hold status for shipments"
	System saves shipping entry.	
Save final entry	System commits shipment of Customer Order.	None

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Print Packing List	User requests System to print Bill of Lading.	Packing List must be created (item must be shipped)
Optionally enter Bill of Lading	If Bill of Lading ID is manually assigned, enter Bill of Lading ID, otherwise leave blank for auto numbering to populate OR Enter/search for current Bill of Lading number.	Validate that Bill of Lading ID does not currently exist if entered.
	Optionally enter advance shipping notice ID or leave blank and request system to populate with auto numbering (multiple bills of lading can have the same advance shipping notice ID, which is for use with EDI)	None
	Enter/search carrier ID.	Must exist in system.
	Review/modify ship date.	Defaults to current date.
	Review/modify shipping time.	Defaults to current time.
	Optionally enter expected delivery date.	Must be a valid date.
	Optionally enter expected delivery time.	Must be valid time. Can enter military time and will be converted to standard time.
	Enter/search for Packing List. user requests Packing List from system and system presents list of available Packing Lists. user can add multiple Packing Lists to one Bill of Lading (only one address per Bill of Lading)	Packing Lists must be in system and not referenced to another Bill of Lading.
	Enter the declared value of the shipment.	Two decimal places of precision.
	Enter COD status.	Must be not COD, COD/consignee or COD/Shipper.
	Enter COD amount (cash on delivery amount for the shipment)	Two decimal places of precision.
	Enter the carriers default COD fee.	Two decimal places of precision. Defaults from carrier table in system if defined.
	Select the freight terms for the shipment	Must be freight prepaid, freight billed, or freight collect.
	Enter/modify carrier's general shipping instructions.	None, defaults from carrier table in system if defined.
	Enter/modify carrier's delivery route.	None, defaults from carrier table in system if defined.
	Enter the number of the carrier's vehicle transporting the shipment.	None
	Enter National Motor Freight Code ID for the shipment.	Must exist in system.

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	Enter/modify weight of the shipment. Defaults from pallet information if entered. All the weights from the pallet detail will add together if same type of package, otherwise there are separate lines for each type of package.	System will round to two decimal places of precision when saved.
	Enter unit of measure of the shipment.	Must be defined in system.
	Enter/modify package type.	Must be defined in system. Defaults from pallet detail if entered.
	Enter count (number of packages in the shipment) Defaults from pallet information if entered. All the counts from the pallet detail will add together if same type of package. Otherwise there are separate lines for each type of package.	System will round to whole integer when saved.
	Enter designation if truck carrying the shipment is full.	None
	Review if shipment is hazardous. Defaults from system because of designation of National Motor Freight Code.	None
	Review article (classification of the NMFC) Defaults from system because of designation of National Motor Freight Code.	None
	Review sub (sub-classification of the article above) Defaults from system because of designation of National Motor Freight Code.	None
	Review rate class of the system. Defaults from system because of designation of National Motor Freight Code.	None
	Review description of the shipment. Defaults from system because of designation of National Motor Freight Code.	None
Optionally modify default header	Enter ship dimensions	None
	Can modify Ship-To name	None

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information for Bill of Lading from Customer Master	Can modify Ship-To address	None
	Can modify Ship-To state	None
Save Bill of Lading	User requests save. System generates Bill of Lading ID if automatically numbered. System generates ASN ID if requested by user and automatically numbered.	Packing List must be in system.
Print Bill of Lading	User requests system to print trace labels.	Packing List must exist in system and part must be defined as traceable in system.
Print trace labels	User selects standard label format or user defined format.	Format must be defined in system.
	User requests system to print labels.	Packing List must exist in system.
	User requests system to print shipping labels.	Packing List must exist in system.
Print shipping labels	User designates number of labels to print.	Must be whole integer.
	User selects standard label format or user defined format.	Format must be defined in system.
	User requests system to print labels.	Packing List must exist in system.

5.11.2 Contra Ship a Customer Order

OPERATION	DIALOGUE	VALIDATION
Retrieve existing Customer Order that contains item(s) to return	Enter/search Customer Order ID.	Must be a valid Customer Order.
	System returns list of order lines displaying quantity shipped to date.	
Return item(s)	Enter return date.	Must be a valid date in a currently open financial period.
	Enter quantity returned for each line.	Must be a positive number.
	Optionally enter location and warehouse for each returned line.	Location and warehouse must exist in warehouse / location master.
	If part is traceable, then select which serial/lot numbers are being returned.	Part must be defined in system as traceable.
	User requests save.	None
	If order is closed system asks user if order is to be reopened. User responds: 1. Yes 2. No	
	If (1), then Customer Order status is changed to released.	None

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	If (2), then system does not change order status.	None
	System creates new Shipper.	None

5.11.3 Ship a Repair Order (From an RMA)

A repair RMA is shipped back to the Customer using the same functionality as the original shipment used. Either the original Customer Order or a new one is used depending on the way the RMA was setup.

See § 5.11.1 Ship a Customer Order

5.12 Service and Repair Screen Dialogues

5.12.1 Create A Return Material Authorization

OPERATION	DIALOGUE	VALIDATION
Enter header information	Enter customer ID or search for one	Must be valid customer ID
	Enter Packing List ID or search for one	Must be valid Packing List ID. Returns customer ID and original order number.
	Enter original order number or search for one	Must be valid original order number. Returns customer ID.
	If original order is not known, create a new Customer Order	Returns customer ID
	Choose the appropriate RMA type from the following: 1. Credit 2. Repair 3. Replace	
	Change the RMA status to open	None
	Enter the reason for the RMA. Reasons are defined by the administrator during the implementation phase.	None
	If (1) or (3), optionally choose to return the RMA materials to the original order	The system creates a Credit Memo against the original order
	If (1) or (3), optionally choose to reship the RMA materials from the original order	None
	If (2), optionally choose to indicate that the materials being returned are under warranty	None
	If (3), optionally choose to ship replacement materials to the customer before receiving the RMA materials from the customer	None
Enter line return information	Enter the quantity of materials that the customer is allowed to return	Must be non-negative. Can not exceed quantity ordered.
Save RMA	Choose to save the Return Material Authorization	An RMA ID is assigned
Print RMA	Enter starting date or use the calendar feature	Must be valid date
	Enter the ending date or use the calendar feature	Must be valid date
	Choose to print the RMA's for one of the following: 1. The current RMA 2. All RMA's	

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	If (2), enter the starting RMA ID and ending RMA ID to be included	Must be valid RMA ID
	If (2), choose which types of RMA's to include in the report. Choices are credit, replacement, and repair.	None
	If (2), choose the status of the RMA's to be included. Choices are opened, received, closed, cancelled, and on hold.	None
	Choose one of the following: 1. Print the Return Material Authorizations 2. View the Return Material Authorizations 3. Save the Return Material Authorizations to a file	
	Choose the sequencing of the report. The report can be sequenced by either RMA ID or customer ID.	None
	Choose the type of report to generate. Can be either summary or detail.	None
	Choose to generate the report	None

5.12.2 Process A Return Material Authorization (Repair)

OPERATION	DIALOGUE	VALIDATION
Create/modify repair Work Order detail	Enter/search for Work Order	Work Order must exist
	System returns Work Order	
	Enter or modify detail using dialogue in § 5.3 Engineering and Job Definition Screen Dialogues	
	Release Work Order	
Enter actuals	Enter inventory transactions using dialogue in § 4.9.2 Issue Inventory to a Work Order	
	Enter Labor Tickets using dialogue in § 4.10.4 Create Labor Ticket	
Price repair order	Enter/search for RMA	RMA must exist
	Optionally enter hourly rate	Must be a positive number
	Optionally enter labor markup	Expressed as a positive percent
	Optionally enter material markup	Expressed as a positive percent
	Optionally enter burden markup	Expressed as a positive percent
	Optionally enter service markup	Expressed as a positive percent
	User requests price to be calculated System returns price for each RMA line	

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	User optionally overrides calculated price(s)	
	User requests shipment to be approved	
	System approves shipment and confirms to user	

5.12.3 Delete A Return Material Authorization

OPERATION	DIALOGUE	VALIDATION
Retrieve RMA to be deleted	Enter RMA ID or search for one	RMA must exist
Delete RMA	Choose to delete the RMA	The RMA is deleted from the database

5.13 Invoicing Screen Dialogues

5.13.1 Create Invoices from Shippers

This section explains how to create multiple Invoices from Shippers, how to create one Invoice, and how to reprint an Invoice.

OPERATION	DIALOGUE	VALIDATION
Generate Invoices for shipped Customer Orders	User requests Invoice forms option from system	None
	User enters Invoice through date to include Invoices up to designated date.	Must be valid date. System defaults to current date.
	Enter/select entity or designate all entities.	Entity must be defined in entity master.
Define format for printed Invoice	User requests options: 1. User requests draft. System prints draft and will not generate draft with saved Invoice ID or saved Invoice date. OR	System must have uninvoiced Customer Order that has been shipped or partially shipped.
	2. User requests system to create account receivable Invoice that integrates with financial system. user cannot print draft when using this option.	System must have uninvoiced Customer Order that has been shipped or partially shipped.
	3. User requests system to use pre-numbered forms. If (1), user enters number of form in system. System will not save that number. If (2), user enters number of form in system. System will then record that number as the Invoice number.	Number must not already exist in Invoice table.
	If (2), user may request system to use current exchange rates from order date or date printing Invoice.	System must be using multi-currency feature.
	If (1) or (2), user can request system to print part trace information on draft or Invoice.	Part must have traceable properties defined.
	If (1) or (2), user can request system to combine all Packing Lists for an order on one draft or Invoice.	Packing Lists must exist in system.
	User requests system to print sample Invoice. User can choose one sample or three samples.	Packing List must be eligible for printing.
	User selects print format. User selects standard for system or user defined options.	Must be standard for system or have additional user defined print formats.

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	User selects date setting: 1. Current date 2. Shipped date 3. Specified date	Must be valid date.
Optionally modify default information from Customer Order	Review or modify freight charges on Customer Order. User requests system to save changes.	Two decimal points of precision.
Print Invoice	User requests system to print 1. Draft 2. Invoice	Must be uninvoiced shipments in system.
	To print all uninvoiced shipments for (1) or (2), user requests system to print all Invoices.	Must be uninvoiced shipments in system.
	User requests system to print one Invoice. System shows user eligible Packing Lists. User selects Packing List.	Packing List must be in system.
	User requests system to print duplicate Invoice. System shows user table of Invoices that have previously been generated. User selects Invoices to reprint.	Invoice must be in system.

5.13.2 Create Credit Memos from Shippers

This section explains how to create a Credit Memo from an Invoiced shipment and how to reprint a Credit Memo.

OPERATION	DIALOGUE	VALIDATION
Generate Invoice credit for returned Customer Orders	User requests Invoice forms option from system	None
	User enters Invoice through date to include credit up to designated date.	System defaults to current date.
	Enter/select entity or designate all entities.	Entity must be defined in entity master.
Define format for printed Invoice (Credit Memo)	User requests options: 1. Requests draft. System prints draft and will not generate draft with saved Invoice ID (Credit Memo) or saved Invoice (Credit Memo) date OR	System must have returned Customer Order that has not been Invoiced.
	2. Requests system to create account receivable Invoice (Credit Memo) that integrates with financial system. Can not print draft when using this option.	System must have returned Customer Order that has not been Invoiced.

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	User requests system to use pre-numbered forms.	Number must not already exist in Invoice table.
	If (1), user enters number of form in system. System will not save that number.	
	If (2), user enters number of form in system. System will then record that number as the Invoice (Credit Memo) number.	
	If (2), user may request system to use current exchange rates from order date or date printing Invoice.	System must be using multi-currency feature.
	If (1) or (2), user can request system to print part trace information on draft or final Invoice (Credit Memo)	Part must have traceable properties defined.
	If (1) or (2), user can request system to combine all Packing Lists for an order on one draft or credit	Packing Lists must exist in system.
	User requests system to print sample Invoice (Credit Memo). User can choose one sample or three samples.	Packing List must be eligible for printing.
	User selects print format. User selects standard for system or user defined options.	Must be standard for system or have additional user defined print formats.
Optionally modify default information from Customer Order	User selects date setting: ☐ Current date ☐ Shipped date ☐ Specified date	Must be valid date.
	Review or modify freight charges on customer Invoice (Credit Memo). System will not automatically put credit for freight on Credit Memo. User requests system to save changes.	Two decimal points of precision.
Print Invoice	user requests system to print: 1. Draft 2. Invoice (Credit Memo)	Must be uninvoiced credits for shipments in system.
	To print all uninvoiced credits for (1) or (2), user requests system to print all Invoices.	Must be uninvoiced credits for shipments in system.
	User requests system to print one credit. System shows user eligible Packing List. User selects Packing List.	Packing List must be in system.

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	User requests system to print duplicate Invoice (Credit Memo). System shows user table of Invoices that have previously been generated. User selects Invoices to reprint.	Invoice (Credit Memo) must be in system.
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5.13.3 Print Progress Billing Invoices

OPERATION	DIALOGUE	VALIDATION
Generate Invoices for progress billing	User requests print option from progress billing option.	None
	Enter/select entity or designate all entities.	Entity must be defined in entity master.
Define format for printed Invoice	User requests options: 1. User requests print only option without saving Invoice numbers. System prints draft and will not generate draft with saved Invoice ID or saved Invoice date. OR 2. User requests system to create account receivable Invoice that integrates with financial system. Cannot print draft when using this option.	Event must have triggered and specified action occurred.
	User requests system to use pre-numbered forms. If (1), user enters number of form in system. System will not save that number. If (2), user enters number of form in system. System will then record that number as the Invoice number.	Event must have triggered and specified action occurred. Invoice number must not already exist in Invoice table.
	If (2), user may request system to use current exchange rates from order date or date printing Invoice.	System must be using multi-currency feature.
	User requests system to print sample Invoice. User can choose one sample or three samples.	Event must have triggered and specified action occurred.
	User selects print format. User selects standard for system or user defined options.	Must be standard for system or have additional user defined print formats.
	User selects date setting: ☐ Current date ☐ Event date ☐ Specified date	Must be valid date.

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Print Invoice or print duplicate Invoice	User requests system to print progress billing Invoice.	Event must have triggered and specified action occurred.
	User requests system to print one Invoice. The system shows user eligible progress billing Invoices. User chooses Invoice.	Progress billing Invoice must be in system.
	User requests system to print duplicate Invoice. The system shows user table of progress billing Invoices that have previously been generated. User selects Invoices to reprint.	Progress billing Invoice must be in system.

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5.14 Manufacturing Costing Screen Dialogues

5.14.1 Cost Inventory Transactions

OPERATION	DIALOGUE	VALIDATION
Set costing options	Optionally choose to run receipt transaction costing (Work Orders)	None
	Optionally choose to run inventory transaction costing.	None
Run inventory transaction costing	Choose to run the selected costing options.	None

5.14.2 Prepare Journals for Posting

OPERATION	DIALOGUE	VALIDATION
Set posting date	Enter posting date or use calendar feature.	Must be valid date. Defaults to last fiscal period's ending date. If posting date is a current period date, the prior period must be closed.
Set journal preparation options	Optionally choose to prepare purchase journal transactions.	None
	Optionally choose to prepare WIP/FG journal transactions.	None
	Optionally choose to prepare shipments journal transactions.	None
	Optionally choose to prepare part adjustment journal transactions.	None
	Optionally choose to prepare indirect journal transactions.	None
Run journal preparation	Choose to run the selected journal preparation options.	None

5.14.3 Repair Invalid Transactions

OPERATION	DIALOGUE	VALIDATION
Check cost transaction detail to ledger	[include here the six costs]	
Recalculate inventory transactions		
Recalculate standard costs	User selects a part or parts for which to recalculate the standard cost.	
	User enters start date and end date of the receipt period. System uses the receipts of the chosen part(s) during this time period to recalculate the part's standard cost.	Must be valid dates.

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	Optionally, the user chooses to use the latest receipt if no receipts occurred in the date range.	None
	User chooses to recalculate the selected parts.	None
	System recalculates the standard costs for the selected parts.	
	System displays the new costs.	None
	Optionally, the user chooses to save the new costs.	None
Recalculate WIP balances	User enters starting and ending base ID.	Must be valid base ID.
	User enters posting date.	Must be valid date.
	User chooses to recalculate WIP balances.	None
	System recalculates WIP balances.	
Recalculate inventory balances	User enters starting and ending part ID.	Must be valid part ID.
	User enters posting date.	Must be valid date. Period must be open. Period must be fully costed.
	User chooses to recalculate inventory balances.	None
	System recalculates inventory balances.	

5.15 Work Flow Messages Screen Dialogues

5.15.1 Create A Message Event

OPERATION	DIALOGUE	VALIDATION
Enter event header	If modifying an existing message event, user enters event ID or searches for one.	Must be valid event ID.
	User selects the class of event to create. The following options are available: Status change, line item change, operation change requirement change, update, insert, delete, query, deadline event, and recurring event.	None
	user chooses which action to take when this event occurs. Can be: e-mail, hold, print, popup, or execute.	None
	user sets the status of this event. Can be: active, completed, suspended, or canceled.	None
	user selects the type of document that the system will monitor for changes. Can be one of the following document types: all documents, Customer Order, Purchase Order, Work Order, Engineering Master, shipment, receipt, Service Dispatch, Accounts Receivable Invoice, Accounts Payable Invoice, quotation, or part.	None
	User enters the base ID if appropriate.	Must be valid base ID.
	For Engineering Masters, Quote Masters, and Work Orders only, user enters a lot ID and a split ID.	Must be valid lot ID and split ID. Limits triggering to specific documents.
	user selects the appropriate number of times the system will process this event. Choose from the following: 1. Permanent 2. Repeat a given number of times 3. Do until given date.	
	If (1), the system will process this event indefinitely.	Not available when the event class is set to deadline event or recurring event.
	If (2), user enters the number of times visual will process this event.	Number must be non-negative. Not available when the event class is set to deadline event or recurring event.

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	If (3), user enters the date on which the system will process this event or use the calendar feature.	Must be valid date. If the class of this event is a deadline event, this is the date that the system will use for the deadline. If the class of this event is recurring event, the system will process the event on the date specified here and once a day thereafter.
	User enters the name of the user who created the event.	None
	User enters the mail recipient who is to receive the message or search for one.	Must be valid mail recipient. Not available if the action is set to print.
	Optionally, user enters the subject of the message.	None
Enter message	User enters a descriptive message for the triggered event. Can be used to execute a query, which performs an action on the database.	The message may contain placeholders or tokens.
Optionally enter data	User enters or pastes binary data, pictures, bitmaps, or text documents.	Must be valid binary data, pictures, bitmaps, or text documents.
Optionally enter query	User enters a SQL query	Must be valid SQL query.
Enter tokens	If any placeholder tokens were used in the message, user enters a query that fills them in.	All queries must be valid SQL statements.
Save	User chooses to save the event message.	Must be valid event message.
	System saves the event message.	

5.15.2 Process Automatic Events

OPERATION	DIALOGUE	VALIDATION
Set automatic triggering parameters		
Messages surface as events are triggered	[the user needs to respond to these..]	

5.15.3 Manually Review Events

OPERATION	DIALOGUE	VALIDATION
Display event summary	user selects the status of events to be displayed from the following: 1. New 2. Hold 3. Completed 4. Error System returns a list of events for chosen status.	None

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	If (1), user processes any new events that the system has not yet processed	None
	If (2), user processes any events that the system is holding	None
	If (3), user processes any events that are already completed	None
	If (4), user reviews any events where errors occurred and optionally goes back and fixes those errors. This is usually a query error.	None
Generate deadline/recurring events		
Process any events.	User selects any or all events from the list.	None
	Optionally, user prints event(s). System prints selected event(s).	None
	Optionally, user e-mails event(s). System opens default e-mail application. User enters or selects the recipient of the message, then sends the message. System mails selected event(s).	External e-mail application must be MAPI compliant.
	Optionally, user deletes event(s). System deletes selected event(s).	None

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5.16 Electronic Data Interchange (EDI) Screen Dialogues

5.16.1

OPERATION	DIALOGUE	VALIDATIONS

5.17 Enterprise Information System (EIS) Screen Dialogues

5.17.1 Configure EIS

OPERATION	DIALOGUE	VALIDATIONS
Establish security	User selects user ID.	User ID must be a valid user.
	Optionally, user chooses to make accessible any of the following: ☐ Sales ☐ Purchases ☐ Production ☐ Financials	None
Setup automatic data purging	Optionally, user modifies the days of detail for each data class.	Days of detail must be non-negative.
	Optionally, user modifies the days of summary for each data class.	Days of summary must be non-negative.
Set viewing preferences	Optionally, user chooses to use the default window size and location.	None
	Optionally, user chooses to show the toolbar.	None
	Optionally, user chooses to use the fiscal calendar starting on a specified date.	Must be valid date.
	Optionally, user specifies which day is the first day of the week.	Must be valid day of the week.
	Optionally, user specifies the date format from the following: Long date Short date	None

5.17.2 Create EIS Data Manually

OPERATION	DIALOGUE	VALIDATIONS
Manually build data	User enters run start date or uses calendar feature.	Must be a valid date.
	User enters run end date or uses calendar feature.	Must be a valid date.
	User chooses to manually build EIS data.	None
Optionally reset currency exchange rate data	[Host...this is under options]	

5.17.3 Create EIS Data Automatically

OPERATION	DIALOGUE	VALIDATIONS
Setup build parameters	User chooses one from the following: ☐ Do not auto build ☐ Auto build once per day ☐ Auto build once per week ☐ Auto build one time	

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	If (1), system will not auto build EIS data.	None
	If (2), user enters the time of day that the system should auto build EIS data. System automatically builds EIS data once per day.	Must be valid time.
	If (3), user enters the time of day that the system should auto build EIS data. System automatically builds EIS data once per week.	Must be valid time.
	If (4), user enters the date and the time of day that the system should auto build EIS data. System automatically builds EIS on the specified date at the specified time.	Must be valid date. Must be valid time.
	User specifies the last date on which to automatically build EIS data.	Must be valid date.
Run automatic build	User chooses to enable automatic building of EIS data.	None
	System automatically builds EIS data until the date specified by user during setup has passed.	None

5.17.4 Display Analysis

OPERATION	DIALOGUE	VALIDATIONS
Display sales data	[Describe each of the data views available and the various modes]	
Display purchasing data		
Display production data		
Display financials data		

5.18 Operations Parameters Screen Dialogues

5.18.1 Logging into VISUAL Manufacturing

Users accessing VISUAL Manufacturing must first have a user ID and Password. Multiple databases may be available. However, only one database should be logged into at a time. user IDs and Passwords are specific to each database. A default log in profile, containing any or all entry, is specific to each workstation. All program security is at the module level. For each module that the user does not have security access to, the menu item for that module is hidden.

OPERATION	DIALOGUE	VALIDATIONS
Log in requested	User requests to login into system	
	System prompts for database name, user ID, and password.	
	User verifies and/or enters information	Validate against user list
	If login successful system returns main menu with items available to user based on security	

5.18.2 Program Security per Functional Module

Users can only access VISUAL Manufacturing modules after logging into VISUAL Manufacturing. Each module has its own program security access of yes, no, and read only set for each user based on the user ID and is specific to the database logged into. Modules with multiple functions will have additional profile and component access selections.

OPERATION	DIALOGUE	VALIDATIONS
Module entry requested by selection from main menu or launching individual windows application.	If module is selected from main menu, system launches the module and connects it to the same database and user ID as the main screen	Validate user program security. access allowed. For access denied screens, the screen's menu choice does not show on the main menu.
	If any module's program is launched directly, they default to database=VMFG, user=SYSADM and password=SYSADM.	If this database/user/password of "VMFG/SYSADM/SYSADM" is valid, then access is allowed as SYSADM to VMFG database. Regardless of any other database, the user maybe logged into, or user security given.
	Access is either granted or denied.	If the above is not valid, then the standard log in screen prompt is shown. (see § 5.19.1 Logging into the system) After the log in is validated, then validate user program security for the module being logged into.

5.19 Purging Screen Dialogues

5.19.1 Purge History

OPERATION	DIALOGUE	VALIDATIONS
Collect archive file information	User enters archive file name.	Must be a valid file name.
	Optionally choose to append to an existing file.	Archive file must exist.
Enter date information	User enters date.	Must be a valid date.
Choose action	User selects type of action: 1. Count 2. Count/Archive 3. Archive/Purge	None
	If (1), then records available to purge will be counted.	None
	If (2), then records available to purge will be counted and archived.	None
	If (3), then records available to purge will be archived and purged.	None
Select type of information to count/archive/purge	Optionally choose to count/archive/purge all types.	None
	Optionally choose to count/archive/purge Receivers.	None
	Optionally choose to count/archive/purge Shippers.	None
	Optionally choose to count/archive/purge Customer Orders.	None
	Optionally choose to count/archive/purge Purchase Orders.	None
	Optionally choose to count/archive/purge Work Orders.	None
	Optionally choose to count/archive/purge Labor Tickets.	None
	Optionally choose to count/archive/purge inventory transactions.	None
	Optionally choose to count/archive/purge A/R Invoices.	None
	Optionally choose to count/archive/purge A/R checks.	None
	Optionally choose to count/archive/purge A/P invoices.	None
	Optionally choose to count/archive/purge A/P checks.	None

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Count/archive/purge process	User starts the process. System displays results, and a generated report of count/archive/purge information can be viewed or printed	None
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6. Glossary

-A-

Accums

Accredited Standards Committee X12 (ASC X12)

The committee that defines the structure of EDI transaction sets in the United States.

Actual Cost

A cost system that gathers material, labor, burden, and outside service costs from their actual source. The source is usually an Invoice from a vendor or a payment to an employee through payroll.

Advance ship notice (ASN)

-B-

Bar Coding

A method of encoding data using bar code for fast and accurate readability.

Bill of Lading (BOL)

A carrier's contract and receipt for goods the carrier agrees to transport from one place to another and to deliver to a designated person. In case of loss, damage, or delay, the Bill of Lading is the basis for filing freight claims.

-C-

Carrier

The specific company that will transport goods for shipment to a Customer.

Cash on delivery (COD)

Payment for goods is to be made by the Customer upon delivery to the carrier which acts as an agent for the company.

Commodity Code

A classification scheme that can be used to categorize part numbers based on common attributes. The scheme is not pre-determined in *VISUAL Manufacturing* and is of free-form format.

Concurrent Engineering

Configure to Order

A manufacturing process that has predefined configurations. The manufacture of the final product configuration is not made until the Customer Order is actually placed.

Consumable

Supplies or materials that are consumed or exhausted in the production or sale of a product or service.

-D-

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Dimensional Inventory

A specific type of inventory that allows the dimensions of the part along with the quantity to be stored in the inventory records. Particularly useful in stocking random sized material lengths, and sheets.

-E-

EDI Integration

The sharing of data between applications through application files to eliminate the need for repetitive data entry and reduce errors.

EDIFACT

An EDI Standard developed in Europe and typically used outside the United States.

Electronic Data Interchange (EDI)

The paperless (electronic) exchange of trading documents, such as Purchase Orders, shipment authorizations, advanced shipment notices, and Invoices, using standardized document formats.

EDI Data Element

The smallest unit of information in the standard, representing a single piece of information. According to the standards, each data element is assigned a reference number, a name, description, data type and the min/max length.

EDI Maps or File Overlays

Maps link the third party EDI software to the system for connection to the database. In order to create integration, one map must be created for each trading partner/transaction set combination.

EDI Transaction Set

An electronic document whose format is defined by ASC X12. A transaction Set consists of an ST header segment, one or more data segments in a specific order, and an SE trailer segment. Each set is assigned a numeric identifier. (e.g. 810 = an Invoice)

Engineering Change Notice (ECN)

A revision to a blueprint or design released by engineering to modify or correct a part. The request for the change can be from a Customer or from production quality control or another department.

Engineering Master

The complete definition for the manufacture of a product. Includes the routing, Bill of Material, schedule of outside services, and costing information.

Entity

An autonomous business unit from a financial perspective, with each entity maintaining its own financial records.

Estimate

A definition that is the basis for the cost of project for a customer or prospect.

Executive Information System (EIS)

A system that is used by senior managers to view operational metrics of the company. Typically the system can be set up to alert a manager of parameters that fall outside of predefined control limits.

Exchange Rate

The multiplier used to convert one country's currency into another country's currency. The exchange rate generally fluctuates on a regular basis so the system must be able to accommodate exchange rate by date.

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-F-

Free on Board (FOB)

The terms of sale that identify where title passes to the buyer.

Functional Group

As part of an Electronic Data Interchange (EDI), a Functional Group consists of a GS Header Segment, one or more transaction Sets of the same type, and a GE Trailer Segment.

-G-

General and Administrative (G&A)

The category of business expenses that is attributed to non-manufacturing related activity such as accounting, office expense, senior management, and sometimes support functions for manufacturing.

General Ledger (G/L)

-I-

Interchange

A group of one or more types of EDI documents that are bound for transmission to a single trading partner.

Inventory

In the theory of constraints, inventory is defined as those items purchased for resale and includes finished goods, Work in Process, and raw materials. Inventory is always valued at purchase price and includes no value-added costs, as opposed to the traditional cost accounting practice of adding direct labor and allocating overhead as Work in Process progresses through the production process.

-M-

Manufactured

Master Product Configurator

Master Production Schedule (MPS)

The result of the master scheduling process. The Master Schedule is a presentation of demand, forecast, backlog, the MPS, the projected-on-hand inventory, and the available-to-promise quantity.

Master Requirements Planning (MRP)

-N-

National Motor Freight Code (NMFC)

-P-

Packing List

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A document that itemizes in detail the content of a particular package, carton, pallet, or container for shipment to a Customer. The detail includes a description of the items, the Shipper's or Customer's part number, the quantity shipped, and the stock Keeping unit (SKU) of the items shipped.

Part Master

Part Trace

Product Code

Perpetual Inventory

An inventory record keeping system where each transaction in and out is recorded and a new balance is computed.

Product Configurator

A listing of all upper level configurations contained in an end-item product family. Its application is most useful when there are multiple end-item configurations in the same product family. It is used to provide a transition linkage between the end-item level and a two-level Master Production Schedule. It also provides a correlation between the various units of upper level product definition.

Purchase Order (PO)

The purchaser's authorization used to formalize a purchase transaction with a supplier. A Purchase Order, when given to a supplier, should contain statements of the name, part number, quantity, description, and price of the goods or services ordered; agreed-to terms as to payment, discounts, date of performance, and transportation; and all other agreements pertinent to the purchase and its execution by the supplier.

-Q-

Quoting

A statement of price, terms of sale, and description of goods or services offered by a supplier to a prospective purchaser; a bid. When given in response to an inquiry, it is usually considered an offer to sell.

Quote Master

-R-

Receiver

A document used to record the receipt of an item, both inventoried and non-inventoried, that has been ordered using a Purchase Order. The document is used for subsequent processing such as updating inventory records and Accounts Payable.

Receiving

The function encompassing the physical receipt of material, the inspection of the shipment for conformance with the Purchase Order (quality and damage), the identification and delivery to destination, and the preparation of receiving Reports.

Request for Quote (RFQ)

Router

Information detailing the method of manufacture of a particular item. It includes the operations to be performed, their sequence, the various work centers involved, and the standards for setup and run. In some

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companies, the routing also includes information on tooling, operator skill levels, inspection operations, and testing requirements.

-S-

Sales Representative

Employee authorized to accept a Customer's order for a product. Sales representatives usually go to the customer's location when industrial products are being marketed.

Segment (EDI)

A segment consists of a segment identifier, one or more related data elements in a defined sequence, and a segment terminator.

Standard Cost

A cost system that uses cost units determined before production. For management purposes, the standards are compared to actual costs, and variances are computed.

Statistical Process Control (SPC)

The application of statistical techniques to monitor and adjust an operation.

Statistical Sales Forecasting

Stocked

Stored products or service parts ready for sale, as distinguished from stores, which are usually components or raw materials.

Sub Work Order (leg)

-T-

Technical Estimating

Terms

All the provisions and agreements of a contract.

Territory

Trading Partner (EDI)

Someone with whom you trade electronic documents.

-U-

Unit of Measure (UM)

The unit used to purchase an item. This may or may not be the same unit of measure used in the internal systems. For example, purchasing buys steel by the ton, but it may be issued and used in square inches.

-V-

Value Added Network (VAN)

An "electronic post office" whose responsibilities include providing a "mailbox" to which your partners send your documents, and to collect and distribute the documents that you send.

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-X-

X12

See *Accredited Standards Committee X12 (ASC X12)*

7. Appendices

7.1 U.S Patents

7.1.1 U.S Patent 5,787,000

Method and apparatus for scheduling Work Orders in a manufacturing process

Abstract

A computerized system is provided for scheduling a plurality of Work Orders in a manufacturing process. Each Work Order to be scheduled specifies a set of operations to be performed using a plurality of resources and materials. Data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information is received and stored in a computer. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The operations information includes the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform the operation. The materials information includes the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation. Resource capacity and a start date/time and a finish date/time are assigned to each operation based upon the resource availability information, the material availability information, and the Work Order information. The assigned resource-capacity, the assigned start date/time, and the assigned finish date/time for each operation are displayed on a computer screen in a graphical format.

Inventors: **Lilly; Richard T.** (Hampton Falls, NH); **Layne; David V.** (Litchfield, NH)

Assignee: **Lilly Software Associates, Inc.** (Hampton, NH)

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Primary Examiner: Grant; William

Assistant Examiner: Robinson; Victoria

Attorney, Agent or Firm: Testa, Hurwitz & Thibault, LLP

Parent Case Text

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 08/250,179, filed May 27, 1994, now U.S. Pat. No. 5,787,000, issued Jul. 28, 1998.

Claims

1. A computerized method for scheduling a plurality of Work Orders for manufacturing products in a manufacturing process, each Work Order comprising a set of operations to be performed using a plurality of resources and materials, the method comprising:

monitoring the availability of each resource used in the manufacturing process;

monitoring the availability of each material used in the manufacturing process;

inputting Work Order information for each Work Order to be scheduled, comprising (1) a release date and a want date for the Work Order, (2) operations information, and (3) material requirements information;

assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that both the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for

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each operation in a graphical format.

2. The method according to claim 1 wherein the resource availability monitoring step comprises monitoring for each operation the idEntity of each resource used in the manufacturing process, the available capacity for the resource, the dates when the resource capacity is available, and the capacity for the resource that has been assigned to previously scheduled operations.

3. The method according to claim 1 wherein the material availability monitoring step comprises monitoring for each operation the idEntity of the material, the dates when the material becomes available, and the quantity of the material available on each date.

4. The method according to claim 1 wherein the operations information comprises the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation.

5. The method according to claim 1 wherein the material requirements information comprises the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation.

6. The method according to claim 1 wherein the Work Order information further comprises at least one of the idEntity of the product to be manufactured, the quantity of the product to be manufactured, and a relative priority for each Work Order.

7. The method according to claim 1 further comprising the step of displaying on a computer screen selected Work Order information.

8. The method according to claim 1 wherein the operations information comprises at least one of the time needed to set up the resources needed to perform each operation and the time needed to run each operation per unit of output from the operation.

9. The method according to claim 1 wherein the operations information further comprises at least one of the time needed to transfer the output from each operation to the next operation in the sequence and the minimum quantity of output units required to be completed before beginning the next operation in the sequence.

10. The method according to claim 1 wherein the operations information further comprises at least one of the yield of output units per unit of input for the operation and the quantity of output units per unit of input that will be discarded as scrap.

11. The method according to claim 1 wherein the operations information further comprises a minimum resource capacity that could be used to perform the operation and the maximum resource capacity is assigned to the operation if the maximum resource capacity is available, and if the maximum resource capacity is not available, then a resource capacity not less than the minimum resource capacity is assigned to the operation.

12. The method according to claim 1 wherein the material requirements information further comprises at least one of the quantity of material that will be discarded as scrap during issuance of material to the Work Order and the rate at which material will be discarded as scrap during performance of the operation for which the material is needed.

13. The method according to claim 1 further comprising at least one of (a) the step of revising and storing the resource availability information based upon the assigned resource capacity, the assigned start date/time, and the assigned finish date/time, and (b) the step of revising and storing the material availability information based upon the material requirements information for the scheduled operation.

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14. The method according to claim 1, wherein the Work Order information further comprises a relative priority for each Work Order and the operations for each Work Order are scheduled in the order of the Work Order priority.

15. The method according to claim 1, wherein the material availability information is determined by the following steps:

- (1) determining a first total quantity of a material needed to perform all operations that have been scheduled prior to a given date;
- (2) determining a second total quantity of the material that will be received in inventory on the date; and
- (3) determining the difference between the first total quantity and the second total quantity.

16. The method according to claim 1, wherein the process of assigning a start date/time and a finish date/time to an operation based upon the material availability information comprises the steps of:

- (1) determining a proposed start date/time for the operation;
- (2) for each material required for the operation,
 - (a) determining a first total quantity of the material needed to perform all operations that have been scheduled prior to the proposed start date/time;
 - (b) determining a second total quantity of the material that will be in inventory on the proposed start date/time; and
 - (c) computing the difference between the first total quantity and the second total quantity; and
- (3) comparing the difference to the material requirement for the operation.

17. The method according to claim 16, further comprising the steps of:

- (4) where the difference equals or exceeds the material requirement for the operation, assigning the proposed start date/time as the start date/time; and
- (5) where the difference is less than the material requirement for the operation, assigning a start date/time based upon the proposed start date/time and the time required to obtain an additional quantity of the material needed for the operation.

18. The method according to claim 1 wherein the assigning step further comprises traversing the operations of each Work Order in at least one of the forward direction or the backward direction.

19. A computerized system for scheduling a plurality of Work Orders for manufacturing products in a manufacturing process, each Work Order comprising a set of operations to be performed using a plurality of resources and materials, the system comprising:

means for monitoring the availability of each resource used in the manufacturing process;

means for monitoring the availability of each material used in the manufacturing process;

means for inputting Work Order information for each Work Order to be scheduled, the Work Order information comprising (1) a release date and a want date for the Work Order, (2) operations information, and (3) material requirements information;

means for assigning resource capacity and a start date/time and a finish date/time to each operation based

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upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that both the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

means for outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for each operation in a graphical format.

20. The system according to claim 19 wherein the resource availability information comprises, for each resource used in the manufacturing process, the idEntity of the resource, the available capacity for the resource, the dates when the resource capacity is available, and the capacity for the resource that has been assigned to previously scheduled operations.

21. The system according to claim 19 wherein the material availability information comprises, for each material used in the manufacturing process, the idEntity of the material, the dates when the material becomes available, and the quantity of the material available on each date.

22. The system according to claim 19 wherein the operations information comprises the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation.

23. The system according to claim 19 wherein the material requirements information comprises the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation.

24. The system according to claim 19 further comprising means for displaying on a computer screen selected Work Order information.

25. The system according to claim 19 wherein the Work Order information further comprises at least one of the idEntity of the product to be manufactured, the quantity of the product to be manufactured, and a relative priority for each Work Order.

26. The system according to claim 19 wherein the operations information comprises at least one of the time needed to set up the resources needed to perform each operation and the time needed to run each operation per unit of output from the operation.

27. The system according to claim 19 wherein the operations information further comprises at least one of the time needed to transfer the output from each operation to the next operation in the sequence and the minimum quantity of output units required to be completed before beginning the next operation in the sequence.

28. The system according to claim 19 wherein the operations information further comprises at least one of the yield of output units per unit of input for the operation and the quantity of output units per unit of input that will be discarded as scrap.

29. The system according to claim 19 wherein the operations information further comprises a minimum resource capacity that could be used to perform the operation and the assigning means comprises means for assigning the maximum resource capacity to the operation if the maximum resource capacity is available, and means for assigning a resource capacity not less than the minimum resource capacity to the operation if the minimum resource capacity is not available.

30. The system according to claim 19 wherein the material requirements information further comprises at least one of the quantity of material that will be discarded as scrap during issuance of material to the Work Order and the rate at which material will be discarded as scrap during performance of the operation for which the material is needed.

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31. The system according to claim 19 further comprising at least one of: (a) means for revising and storing the resource availability information based upon the assigned resource capacity, the assigned start date/time, and the assigned finish date/time, and (b) means for revising and storing the material availability information based upon the material requirements information for the scheduled operation.

32. The system according to claim 19 wherein the Work Order information further comprises a relative priority for each Work Order, and the assigning means comprises means for scheduling the operations for each Work Order in the order of the Work Order priority.

33. The system according to claim 19 wherein the displaying means comprises means for displaying resource capacity, the assigned start dates/times, and the assigned finish dates/times in the form of a bar graph.

34. A computerized method for scheduling a plurality of Work Orders, each comprising a set of operations to be performed using a plurality of resources and materials, for manufacturing products in a manufacturing process, the method comprising:

monitoring the availability of each resource and each material used in the manufacturing process;

inputting for each Work Order to be scheduled Work Order information including a release date, a want date, operations information, and material requirements information;

assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for each operation in a graphical format.

Description

BACKGROUND OF THE INVENTION

The present invention relates to a computerized system for scheduling Work Orders for manufacturing products in a manufacturing process.

Prior to the introduction of computerized scheduling systems, the scheduling of Work Orders in a manufacturing facility was performed manually. The person responsible for determining the work schedule manually assigned the work to be performed to specific dates. The manual scheduling process involved determining what work has to be performed and the time, materials, and resources (i.e., machines, workers, tools, etc.) required to perform it, as well as other information which influenced the schedule, such as which work was more important than other work. This process is costly, very tedious and often inaccurate. The frequency with which the scheduling process must be performed contributes to the difficulty of obtaining timely, accurate manual scheduling.

As commercial computer systems became available, manufacturers began using computerized systems that assisted in the storage and retrieval of information relevant to the scheduling of work in a manufacturing facility. In the late 1950's and during the 1960's, efforts were made to implement Material Requirements Planning or MRP. MRP was limited in scope to dealing only with material requirements (i.e., which parts or materials were needed and when). These early computerized systems were not capable of scheduling operations based upon the availability of materials or resource capacity.

During the 1970's and 1980's, many commercially available systems were created which provided more

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comprehensive MRP, and it was eventually renamed Manufacturing Resource Planning. The new MRP dealt with additional problems, such as forecasting, inventory management, shop floor control, engineering, and change management. Some of these systems dealt with the capacity of the plant to perform the work. One such approach was called rough-cut capacity planning and, as the name suggests, it provided a crude estimate of the capacity needed to satisfy work requirements. Rough-cut capacity planning determined the capacity needed, but was not capable of scheduling Work Orders based on capacity limits.

Other systems for scheduling Work Orders in a manufacturing facility relied on a method of scheduling that compared the total hours of capacity to the total hours of load from operations. Such systems were not capable of "event-oriented" scheduling, i.e., assigning a particular event or operation to a particular resource for a particular time period.

It was not until the mid-1980's that a computerized event-oriented scheduling system was developed that was capable of scheduling Work Orders and the operations required to carry out the Work Orders, taking into account the finite capacity of the various resources needed for the manufacturing process, i.e., finite scheduling. ProfitKey, a New Hampshire-based company, developed one of the first such finite scheduling systems available to the market. Using the ProfitKey Scheduler, a manufacturer could determine the start and finish date of Work Orders and their operations based upon resource capacity and availability. A similar system was developed by Lilly Software Associates, Inc. and marketed as part of the VISUAL Manufacturing.TM. system beginning in early 1993.

However, neither the ProfitKey system nor the early 1993 version of the VISUAL Manufacturing.TM. system was capable taking the availability of materials into account in determining the scheduling of Work Orders. In addition, the ProfitKey system and the early 1993 version of the VISUAL Manufacturing.TM. were both limited to a single resource capacity calendar for all resources in the system, and neither system was capable of generating multiple schedules based on different assumptions regarding resource capacity for individual resources. Further, the ProfitKey system was not capable of scheduling multiple dissimilar resources concurrently based upon user specifications.

Other scheduling systems include Microsoft Project.TM. and Norton's Timeline from Symantec. These programs are capable of storing and retrieving information about a project defined by the user using a method consistent with Critical Path Method (CPM) theory. These tools are designed to handle projects that have definable events that are interdependent, similar to a single Work Order in a manufacturing process. These systems are not, however, capable of managing hundreds of Work Orders at a time as is typical in most manufacturing plants.

No prior art system. is capable of scheduling a plurality of Work Orders or operations in a manufacturing facility, using a finite, event-oriented scheduling process with the added feature of taking into account the availability of materials that are used in the manufacturing process.

OBJECTS OF THE INVENTION

Therefore, it is an object of the present invention to provide a computerized system for performing accurate and timely scheduling of Work Orders in a manufacturing facility.

It is a further object of the invention to provide a method and means for scheduling Work Orders for manufacturing products in a manufacturing process, wherein each operation in the Work Order is assigned resource capacity, a start date/time, and a finish date/time based upon the resource and material requirements of the operation and the availability of resource capacity and materials in the manufacturing facility.

It is still a further object of the invention to provide a method and means for determining the best fit of the operations of each Work Order in the schedule based upon both resource availability and material availability.

It is still a further object of the invention to provide a scheduling system which includes a method and

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means for defining variable resource capacity as a function of the dates and times in the calendar individually for each resource used in the manufacturing facility.

It is still a further object of the invention to provide a scheduling system which includes a method and means for creating multiple schedules based on different resource capacity calendars for comparison purposes.

It is still a further object of the invention to provide a scheduling system which includes a method and means for scheduling operations at more than one dissimilar resource simultaneously.

It is still a further object of the invention to provide a scheduling system which includes a method and means for allowing the user to specify a minimum and maximum resource capacity needed to perform each operation being scheduled, in order to optimize utilization of each resource in the manufacturing facility.

These and other objects and advantages of the invention will be apparent from the following detailed description of the invention and drawings.

SUMMARY OF THE INVENTION

In accordance with the present invention, a computerized system is provided for scheduling a plurality of Work Orders in a manufacturing process. Each Work Order to be scheduled specifies a set of operations to be performed using a plurality of resources and materials. The method of the invention includes receiving data in a computer, the data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The operations information includes the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation. The materials information includes the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation. The method of the invention further includes the steps of assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability information, the material availability information, and the Work Order information. The method of the invention also includes the step of displaying on a computer screen the assigned resource capacity, the assigned start date/time, and the assigned finish date/time for each operation in a graphical format.

The system of the invention includes means for receiving data in a computer, the data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The system of the invention further includes means for assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability information, the material availability information, and the Work Order information. The system of the invention also includes means for displaying on a computer screen the assigned resource capacity, the assigned start date/time, and the assigned finish date/time for each operation. A graphical format.

DEFINITIONS

A "Work Order" order is a request to manufacture one or more distinct parts in a manufacturing facility. Such parts may be consumed either by the Customer who ordered the parts or by other Work Orders within the manufacturing facility, as in the case of a subassembly.

A "part" is any distinct unit that can be manufactured as an end product or an intermediate product or subassembly.

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An "operation" is a step in the process for manufacturing a distinct part according to a Work Order. Each operation in a Work Order is sequenced so that it follows a preceding operation (or is the first), and comes before a succeeding operation (or is the last).

A "material" is any material or part that is consumed by the manufacturing process or added to the part being manufactured during the manufacturing process. A material may be a subassembly which is an intermediate product used in the manufacturing process. A material may be identified by an inventory part number.

A "resource" is something that is needed to perform an operation, but which is not directly consumed in the performance of the operation. Examples of a resource include workers, machines, and tools. A resource may be internal or external to the manufacturing facility. An external resource would be, for example, an outside Vendor or an outside service provider.

A "date/time" is a specification of a date (month, day, and year) and a time of day.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the software components used to implement a preferred embodiment of the scheduling system, as they relate to each other;

FIG. 2 is a block diagram of particular routines within the scheduling system and their relationship to each other;

FIG. 3 illustrates a preferred embodiment of a screen display showing a multiple level Work Order;

FIG. 4 is a graphical representation of a multiple level Work Order, omitting the material requirements;

FIG. 5 is a graphical representation of a capacity vector;

FIG. 6 is a graphical representation of a load vector; and

FIG. 7 illustrates a preferred embodiment of a screen display showing a schedule generated by the scheduling system of the invention.

FIG. 8-12 are flow charts showing the steps for implementing the scheduling system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The scheduling system of the present invention may be used in any manufacturing facility. The system may be most useful in a facility for manufacturing discrete products, such as a facility that manufactures products according to individualized Customer specifications.

The scheduling system may be used to schedule all Work Orders that have been accepted by the manufacturer. The system may also be used to determine a proposed schedule and/or a proposed delivery date for a potential Work Order in response to an inquiry from a Customer or other interested person.

The scheduling system of the present invention may be implemented using a variety of personal computers. According to a preferred embodiment of the invention, the scheduling system is implemented using an IBM-compatible computer having not less than 8 megabytes of random access memory (RAM), a 486DX or higher Intel.RTM. microprocessor running at 33 megahertz or higher, and sufficient hard disk space to store the software programs used to implement the invention, the output from the scheduling program, as well as the input data such as the resource availability information, material availability information, Work Order information, operations information, and material requirements information.

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The scheduling system of the present invention may be implemented using a variety of programming languages and operating systems. According to a preferred embodiment of the invention, the scheduling system is implemented as a Windows Dynamic Link Library using Gupta Corporation's SQLWindows.TM. Client-Server Application Development System and Microsoft Visual C++.TM., both of which run on a Microsoft.RTM. Windows.TM. Version 3.1-based IBM-compatible computer system. FIG. 1 illustrates in a graphical format the relationship between the software components used to implement a preferred embodiment of the scheduling system of the invention. As illustrated in FIG. 1, a preferred embodiment of the invention interfaces with a manufacturing information system, which exchanges certain data with the scheduling system, such as material availability information.

The capabilities and implementation of the aforementioned programming languages and operating systems are explained in the following texts and manuals, which are hereby incorporated by reference: SQL Windows Technical Reference Manual, Volumes 1 and 2, Gupta Corporation, 20-1205-1003, 20-1206-1001; SQL Windows Function Reference Manual Volumes 1 and 2, Gupta Corporation, 20-2215-1003, 20-2217-1001; Slobbers Language Reference Manual, Gupta Corporation, 20-2107-1002; SQL Base C Application Programming Interface Reference Manual, Gupta Corporation, 20-2111-1002; Microsoft Windows 3.1 Programmer's Reference, Volumes 1, 2, 3 and 4, Microsoft Corporation; Microsoft Visual C++ Programmer's Guide, Microsoft Corporation; and Microsoft Visual C++ Reference, Volumes 1 and 2, Microsoft Corporation. Additional references which may be helpful are listed bibliographically in the foregoing texts and manuals.

According to the scheduling system of the present invention, certain data required to schedule a Work Order is received in a computer. This data includes resource availability information, material availability information, Work Order information, operations information, and material requirements information. Each of these types of data is described in detail below:

"Resource availability information" includes the idEntity of each resource used in the manufacturing process, a calendar specifying the quantity of each resource that is available for use at a particular date/time independent of previously scheduled operations (the "resource capacity calendar"), and the capacity for each resource that has been assigned to previously scheduled operations (also referred to as "load"). The resource availability information is updated each time that an operation is scheduled by the system in order to reflect the load on each resource imposed by the scheduled operation.

"Material availability information" includes the idEntity of each material used in the manufacturing process, the dates when each material is available, and the quantity of each material available on each date. The material availability information may also include the lead time necessary to obtain an additional quantity of each material. The material availability information is updated each time that an operation is scheduled by the system in order to reflect the material demand in the time period the material is needed for the scheduled operation. In a preferred embodiment of the invention, selected material availability information is displayed on a computer screen.

"Work Order information" includes the release date for the Work Order (i.e., when work should commence) and the want date for the Work Order (i.e., when work must be complete). Work Order information also includes certain operations information and material requirements information. Work Order information may also include the idEntity of the part to be manufactured, the quantity of the part to be manufactured, and a relative priority for the work to be performed. In a preferred embodiment of the invention, selected Work Order information is displayed on a computer screen, preferably in the form of an acyclic directed graph. FIG. 3 illustrates a preferred embodiment of a screen display showing selected Work Order information.

"Operations information" includes the idEntity of the operations defined by a Work Order, the sequence in which the operations are to be performed, the idEntity of the resource(s) at which each operation is to be performed, and a minimum resource capacity needed to perform each operation. The resources identified for each operation include a main resource, and optionally two auxiliary resources, namely a setup resource and a run resource. The "operations information" also includes the period of time needed to perform the operation, which may include the period of time need to set up the resource(s) needed to perform the

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operation ("setup time") and the period of time needed to run the operation, preferably expressed per unit of output from the operation or as a number of output units in a given period of time ("run time"). The "operations information" may also include the scrap or yield from the operation, preferably expressed as the number of output units from the operation per unit of input in percent; a fixed quantity of scrap that will be discarded from the operation; a minimum quantity of output units required to be completed before beginning the next operation; the period of time required to physically transfer the output units to the next succeeding operation ("transfer time"); and/or a minimum resource capacity that could be used to perform the operation, if such capacity were available.

The sequence of operations defined by a Work Order may be single or multiple level. A single level Work Order has a linear sequence of operations. A multiple level Work Order has a branched sequence of operations, whereby each branch of the sequence contains a subset of operations for manufacturing an intermediate product or subassembly that is used to manufacture the final product. FIG. 3 shows a graphical illustration of a multiple level Work Order, including end product 31, material requirement 32, operation 33, and intermediate products (or subassemblies) 34 and 35. Each subset of operations is referred to as a "leg" of the Work Order. For example, the Work Order shown in FIG. 3 has legs 36 and 37. For multiple level Work Orders, the "operations information" includes, as part of the sequence of operations, the leg of the Work Order to which each operation belongs. In a preferred embodiment of the scheduling system, operations that belong to separate legs of a multiple level Work Order may be scheduled concurrently. For example, FIG. 4 shows a graphical representation of a multilevel Work Order, omitting the material requirements for the Work Order. The top part of FIG. 4 illustrates the concurrent scheduling of operations in a multiple level Work Order. In addition, even with a single level Work Order, the user may specify that two or more operations be scheduled concurrently.

"Material requirements information" includes the idEntity of the materials needed for an operation and the quantity of the material needed for an operation. The quantity of the materials needed for an operation is preferably expressed either per unit of input to the operation or per unit of output from the operation. The materials information may also include a scrap rate (in addition to the scrap imposed by the operation definition), a fixed quantity of scrap (in addition, to the scrap imposed by the operation definition), the dimensions of a material part needed for an operation, and/or the Unit of Measure for the quantity expression (which may need to be converted to another Unit of Measure).

Ultimately, the various quantity expressions are reduced to a specific quantity, in the stock keeping Unit of Measure, of the part which is required.

The scheduling system of the present invention assigns resource capacity, a start date/time, and a finish date/time to each operation in the Work Order being scheduled based upon the resource availability information, the material availability information, and the Work Order information. The system schedules an operation for a date and time when both the necessary resource capacity is available and the necessary materials are available. The preferred means for implementing the assignment of resource capacity, start date/time, and finish date/time is described in detail below:

Resources can have one or more units of capacity. Each unit of capacity corresponds to a worker, machine, tool, or other item or device which performs work on an operation. According to the invention, the system user can define the capacity of each resource that is used in the manufacturing process as a function of the dates and times in a calendar. This is called the "resource capacity calendar." If, for example, the resource is machine operators, the user may define the capacity as being one or more machine operators for a given time period. The "resource capacity calendar" is independent of load (i.e., the capacity that has been assigned to scheduled operations). When scheduling an operation, however, the system takes into account both the resource capacity calendar and the load from previously scheduled operations.

As part of the Work Order, the user specifies the resource capacity that is required to perform a particular operation. If more than one person or machine is required to work on the same operation at the same time, a minimum resource capacity of more than one unit of capacity may be specified for a given operation. If it would be desirable, but not necessary, for more than one person or machine to work on the same operation at the same time, then a maximum resource capacity may also be specified. In that event, the maximum

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resource capacity will be assigned to the operation, if such capacity is available. Thus, by specifying a maximum resource capacity, the user may shorten the overall time required to perform an operation by utilizing more than the minimum capacity.

According to a preferred embodiment of the scheduling system of the invention, the resource capacity calendar is divided into distinct units of time called notches. A notch is a specific length of time, for example, ten minutes or six notches per hour. The system uses a "capacity vector" to represent the time frame of the resource capacity calendar. FIG. 5 shows a graphical representation of a capacity vector. The capacity vector is divided into notches 51. For example, a two-year time frame contains 17,520 hours or 105,120 notches. Associated with each notch in the capacity vector is a designation of the capacity of the resource that is available during the time period represented by the notch, i.e., the number of simultaneous operations that may be scheduled in the notch. A constant, for example, 255 (the maximum integer represented by a single byte), designates a shutdown notch. A shutdown notch represents a time period, during which the resource is not being operated, for example, because the manufacturing plant is closed. All other values designate a running notch. A running notch can be available or unavailable. An available notch is one which has available capacity, and an unavailable notch is one which has no available capacity.

For example, FIG. 5 shows a portion of a capacity vector for machine operators. The first six notches 52 are shutdown notches, indicating that the machine operators are not working during the hour represented by these notches. The next eighteen notches 53 in the capacity vector are running notches. Twelve of these notches 54 each have five units of available capacity, and six of these notches 55 each have three units of available capacity. In other words, there are five machine operators available during the two hours represented by the middle twelve notches in the capacity vector, and three machine operators available during the one hour represented by the last six notches in the capacity vector.

According to a preferred embodiment of the scheduling system of the invention, the capacity vector does not reflect the capacity that has been assigned to previously scheduled operations. Rather, the system records usage of capacity or load in the form of a "load vector" which includes a list of operations that have been scheduled at each resource. FIG. 6 shows a graphical representation of a load vector. Each number 61 along the y-axis in FIG. 6 indicates a particular unit of capacity, e.g., a particular machine operator. Time is represented along the x-axis. Each bar 62 in FIG. 6 represents the time assigned to scheduled operations, and the arrows 63 between each bar 62 represent unassigned time. The space to the left of the last bar 62 for a given unit of capacity also represents unassigned time. Thus, the left end 64 of each bar 62 represents the start date/time for an operation, while the right end 65 of each bar 62 represents the finish date/time for an operation.

According to a preferred embodiment of the scheduling system of the invention, an operation is scheduled in a given set of notches only if all notches in the set are both adjacent and available. Two notches are considered adjacent if they are separated by zero or more shutdown notches, but not if they are separated by an unavailable notch. A notch is available if there is at least one unit of capacity which has not been previously assigned to another operation. In order to determine whether a notch is available, the system consults both the capacity vector (FIG. 5) and the load vector (FIG. 6). Units of capacity to which no operation has been assigned are available for assignment to subsequently scheduled operations requiring that resource.

In addition to resource capacity, the scheduling system of the present invention also checks material availability when scheduling an operation. According to a preferred embodiment of the scheduling system of the present invention, material availability is expressed in terms of supply and demand for each material used in the manufacturing process. Supply is an expression of when a material will be received in inventory, and how much or how many, in terms of the stock Unit of Measure, will be received. Thus, supply is a list of quantities and dates listed, for example, in sequence by date. Demand is an expression of when a material is needed to perform scheduled operations, and how much or how many, in terms of the stock Unit of Measure, is/are needed. Thus, demand is a list of quantities and dates listed, for example, in sequence by date. Material availability is determined by netting the demand and supply lists. In a preferred embodiment of the scheduling system, the system first determines a proposed start date for an operation. The system then nets the supply and demand for the material(s) required for the operation in order to

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determine the quantity of the material(s) available on the proposed start date/time. If this quantity satisfies the material requirement for the operation, then the operation may be scheduled for the proposed start date/time. If, on the other hand, this quantity does not satisfy the material requirement for the operation, then additional material must be obtained, and the start date/time may be rescheduled, taking into account the lead time necessary to obtain an additional quantity of the material. If the lead time is greater than the difference between the current date/time and the proposed start date/time, then the system adds the excess to the proposed start date/time to determine the start date/time. If on the other hand, the lead time is less than or equal to the difference between the current date/time and the proposed start date/time, then the operation is scheduled for the proposed start date/time.

According to a preferred embodiment of the invention, the scheduling system may operate in at least two different modes: sequential scheduling and global scheduling. In the sequential scheduling mode, the system schedules each Work Order as it is entered in the system, leaving the assigned resource capacities, the assigned start dates/times, and the assigned finish dates/times for all previously entered Work Orders in place. In this mode, each successively entered order is de facto given the lowest priority. In the global scheduling mode, on the other hand, the system reschedules all previously entered Work Orders in order of priority each time that a new Work Order is entered in the system. All Work Orders are automatically assigned the same priority when entered, unless the user sets a different priority. Thus, in the global scheduling mode, all Work Orders in the system are rescheduled in the order of (1) Work Order want date, if no Work Order priority is specified; or (2) Work Order priority and want date within the same priority level, if a Work Order priority is specified. The sequence in which Work Orders are scheduled ultimately determines the schedule. Available capacity is assigned to the first Work Order in the sequence. Any remaining capacity is assigned to the second Work Order in the sequence, and so on. Thus, the global scheduling mode results in the optimum schedule because Work Orders are scheduled in order of want date and/or priority.

According to a preferred embodiment of the scheduling system of the invention, after the sequence in which Work Orders will be scheduled is determined, the system processes each Work Order one at a time in the determined sequence. Within each Work Order, the operations are scheduled in the backward direction, starting with the last or latest-in-time operation and/or in the forward direction, starting with the first or earliest-in time operation. For example, the sequence of operations in the forward direction for the multiple level Work Order shown in FIG. 4 would be:

10(4), 10(2), 10(1), 20(1), 10(3), 10(0), 20(0), 30(0), 40(0), and

the sequence of operations in the backward direction would be:

40(0), 30(0), 20(0), 10(0), 10(3), 20(1), 10(1), 10(2), 10(4),

where the first numeral designates the operation and the numeral in parentheses designates the leg of the Work Order to which the operation belongs.

According to a preferred embodiment of the invention, the scheduling system initially schedules all operations of a Work Order in the backward direction. If backward scheduling results in a schedule in which no operations are scheduled prior to the current date, then the resulting schedule is saved and displayed. If the result of backward scheduling exceeds the current date, then forward scheduling is performed. After scheduling the operations of a Work Order in the forward direction, the system differentiates between "determinate" and "non-determinate" operations and reschedules the non-determinate operations, if possible. FIG. 2 is a block diagram illustrating these scheduling routines and their relationship to each other.

In a single level Work Order, all operations are determinate. A multiple level Work Order, on the other hand, has both determinate and non-determinate operations. A determinate operation is one that is on the path of operations which define the longest series of operations, in terms of the length of time from the earliest start date/time to the latest finish date/time, in view of the start dates/times and finish dates/times of all operations in the Work Order as presently scheduled. This is similar to the concept of a critical path. A

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sequence of operations may become determinant when one or more operations in the sequence is delayed by the unavailability of resource capacity. In a preferred embodiment of the scheduling system of the invention, after forward scheduling, the system reschedules all non-determinate operations, assigning the latest possible start date/time to each operation. The purpose of this rescheduling is to achieve an optimum schedule which minimizes Work in Process.

The logical steps contained in a computer program for implementing a preferred embodiment of the scheduling system of the invention are described in detail below with reference to the flow charts set forth in FIGS. 8-12:

SCHEDULING A SINGLE WORK ORDER (FIG. 8)

1. LOAD THE WORK ORDER INTO MEMORY (FIG. 8, BLOCK 81)
2. IF USER SPECIFIES ONLY FORWARD SCHEDULING, SKIP TO STEP 5 (FIG. 8, BLOCK 82)
3. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION (FIG. 8, BLOCK 83) (see further explanation below)
4. IF STEP 3 RESULTS IN A SCHEDULE IN WHICH NO OPERATION IS SCHEDULED PRIOR TO THE CURRENT DATE, THEN GO TO STEP 8 (FIG. 8, BLOCK 84)
5. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE FORWARD DIRECTION (FIG. 8, BLOCK 85) (see further explanation below)
6. DETERMINE WHICH OPERATIONS OF THE WORK ORDER ARE NON-DETERMINANT; TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION AND RESCHEDULE ONLY THE NON-DETERMINANT OPERATIONS (FIG. 8, BLOCK 86)
7. SAVE THE RESULTS (FIG. 8, BLOCK 87)

STEP 3 (BACKWARD SCHEDULING) CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 9):

- a. LOCATE AND PROCESS EACH OPERATION, STARTING WITH THE LAST OPERATION AND ENDING WITH THE FIRST OPERATION, EXECUTING THE FOLLOWING STEPS FOR EACH ONE (FIG. 9, BLOCK 91):
 - b. CHECK THAT THE RESOURCE CAPACITY INFORMATION HAS BEEN LOADED FOR EACH RESOURCE REQUIRED FOR THE OPERATION; IF NOT, READ THE CAPACITY VECTOR INTO MEMORY AND INITIALIZE THE LOAD VECTOR (FIG. 9, BLOCKS 92,93)
 - c. DETERMINE A PROPOSED FINISH DATE/TIME FOR THE OPERATION (FIG. 9, BLOCK 94)
 - (1) for the last operation, the proposed finish date is the want date of the Work Order
 - (2) for each preceding operation, the proposed finish date is the start date of the succeeding operation, unless a minimum move quantity is specified for the operation
 - (3) if a minimum move quantity is specified for the operation, then the proposed finish date is the earlier of (a) the start date for the succeeding operation plus the time necessary to complete the operation for the minimum move quantity and (b) the finish date for the succeeding operation less the time necessary to complete the operation for the minimum move quantity
 - d. DETERMINE A PROPOSED START DATE/TIME FOR THE OPERATION (FIG. 9, BLOCK 95)

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(1) determine whether there is sufficient available capacity to complete the operation during an uninterrupted time period, consulting both the capacity vector(s) and the load vector(s) for the resource(s) needed to perform the operation

(2) in order for an operation to be scheduled, a sequence of one or more notches must be available which have no intervening running notches with insufficient capacity to satisfy the minimum capacity specified by the Work Order for the main resource for the operation

(3) each operation has, optionally, two auxiliary resources for the setup and run phases of the operation; if specified, the setup resource must be available in the same notch as the main resource during the setup phase; also, if specified, the run resource must be available in the same notch as the main resource during the run phase

e. DETERMINE WHETHER THE MATERIAL NEEDED FOR THE OPERATION IS AVAILABLE (FIG. 9, BLOCK 96)

(1) by netting supply and demand, determine whether sufficient material is available on the proposed start date to satisfy the material requirement for the operation

(2) if sufficient material is available, then the proposed start date becomes the start date

(3) if sufficient material is not available, backward scheduling (STEP 3) is aborted and forward scheduling (STEP 5) must be performed

STEP 5 (FORWARD SCHEDULING) CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 10):

a. LOCATE AND PROCESS EACH OPERATION, STARTING WITH THE FIRST OPERATION AND ENDING WITH THE LAST OPERATION,--EXECUTING THE FOLLOWING STEPS FOR EACH ONE (FIG. 10, BLOCK 101):

b. CHECK THAT THE RESOURCE CAPACITY INFORMATION HAS BEEN LOADED FOR EACH RESOURCE REQUIRED FOR THE OPERATION; IF NOT, READ THE CAPACITY VECTOR INTO MEMORY AND INITIALIZE THE LOAD VECTOR (FIG. 10, BLOCKS 102,103)

c. DETERMINE A PROPOSED START DATE/TIME FOR THE OPERATION (FIG. 10, BLOCK 104)

(1) for the first operation, the proposed start date is the release date for the Work Order or the current date, whichever is later

(2) for each succeeding operation, the proposed start date is the finish date of the preceding operation, unless a minimum move quantity is specified for the preceding operation

(3) if a minimum move quantity is specified for the preceding operation (either in the same leg or in an immediately preceding leg of the Work Order), then the proposed start date is determined by the following steps:

(a) determine a proposed start date by adding the amount of time necessary to complete the preceding operation for the minimum move quantity to the start date for the preceding operation

(b) determine a calculated finish date for the current operation by adding the run time for the current operation to the proposed start date

(c) compare the calculated finish date for the current operation with the finish date (determined in step e.) for the preceding operation

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(d) if the calculated finish date for the current operation is earlier than the finish date for the preceding operation, then subtract the run time for the current operation from the finish date for the preceding operation to determine the proposed start date; otherwise, use the proposed start date determined in step (3)(a)

d. DETERMINE WHETHER THE MATERIAL NEEDED FOR THE OPERATION IS AVAILABLE (FIG. 10, BLOCKS 105,106)

(1) by netting supply and demand, determine whether sufficient material is available on the proposed start date to satisfy the material requirement for the operation

(2) if sufficient material is available, then the proposed start date becomes the start date

(3) if sufficient material is not available, then load the lead time for obtaining additional material into memory

(4) if the lead time is greater than the difference between the current date and the proposed start date, then add the excess to the proposed start date to determine the start date

(5) if the lead time is less than or -equal to the difference between the current date and the proposed start date, then the proposed start date becomes the start date

e. DETERMINE A FINISH DATE/TIME FOR THE OPERATION (FIG. 10, BLOCK 107)

(1) determine whether there is sufficient available capacity to complete the operation during an uninterrupted time period, consulting both the capacity vector(s) and the load vector(s) for the resource(s) needed to perform the operation

(2) in order for an operation to be scheduled, a sequence of one or more notches must be available which have no intervening running notches with insufficient capacity to satisfy the minimum capacity specified by the Work Order for the main resource for the operation

(3) each operation has, optionally, -two auxiliary resources for the setup and run phases of the operation; if specified, the setup resource must be available in the same notches as the main resource during the setup phase; also, if specified, the run resource must be available in the same notches as the main resource during the run phase

STEP 7 IS BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 11):

a. LOCATE AND PROCESS THE NON-DETERMINANT OPERATIONS, STARTING WITH THE LAST NONDETERMINANT OPERATION AND ENDING WITH THE FIRST, EXECUTING THE FOLLOWING STEP FOR EACH ONE (FIG. 11, BLOCKS 111, 112):

(1) a non-determinant operation is one that is not on the determinant (or critical) path.

b. IF POSSIBLE, SHIFT THE OPERATION TO THE LATEST AVAILABLE NOTCH USING THE SAME UNIT OF CAPACITY (FIG. 11, BLOCKS 113,114)

SCHEDULING A SINGLE OPERATION

The process of determining a start date (STEP 3.d.) or a finish date (STEP 5.e.) for an operation will now be explained in greater detail.

The process of determining a start date or finish date for an operation assumes the availability, in the memory of the computer, of a capacity vector and a load vector for the main resource, the setup resource, and the run resource; the proposed finish date (STEP 3) or proposed start date (STEP 5) for the operation;

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the units of capacity required at each resource; and the run time, setup time, and transfer time, in minutes, for the operation.

DETERMINING A START DATE/TIME WHEN TRAVERSING THE WORK ORDER IN THE BACKWARD DIRECTION--STEP 3.d CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 12):

1. CONVERT THE PROPOSED FINISH DATE/TIME TO A RELATIVE NOTCH

(i.e., THE n.sup.th notch from beginning of capacity vector, which starts at midnight on the current date)--THIS BECOMES THE "CURRENT NOTCH;" CONVERT TIME PERIODS TO NOTCHES (FIG. 12, BLOCK 121)

2. STARTING FROM THE "CURRENT NOTCH," SKIP NOTCHES FOR THE TRANSFER TIME--THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCK 122)

3. SEARCH BACKWARD FROM THE "CURRENT NOTCH" FOR THE FIRST RUNNING (NON-SHUTDOWN) NOTCH FOR THE MAIN RESOURCE; NOTE THIS NOTCH AS THE "COULD END NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCKS 123,124,125)

4. SEARCH BACKWARD FROM THE "CURRENT NOTCH" FOR THE FIRST AVAILABLE RUNNING NOTCH FOR ALL RESOURCES REQUIRED; NOTE THIS NOTCH AS THE "ACTUAL END NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCKS 126, 127,128)

5. SEARCH BACKWARD FROM THE "CURRENT NOTCH" COUNTING ALL AVAILABLE NOTCHES FOR THE MAIN RESOURCE; VERIFY THAT THE SAME NOTCH IS AVAILABLE FOR THE SETUP AND RUN RESOURCES, IF APPLICABLE; WHEN THE NUMBER OF NOTCHES SPECIFIED BY THE SETUP TIME AND RUN TIME MATCHES THE NUMBER OF NOTCHES ASSIGNABLE, END THE SEARCH; NOTE THIS NOTCH AS THE "ACTUAL START NOTCH" (FIG. 12, BLOCKS 129, 130, 131, 132)

6. CONVERT ALL NOTCHES TO DATES/TIMES (FIG. 12, BLOCK 133)

7. RETURN RESULT OF SCHEDULE (FIG. 12, BLOCK 134)

8. IF AT ANY TIME THE BOUNDARIES OF THE SCHEDULE (i.e., the current date) ARE EXCEEDED, ABORT THE SCHEDULING ROUTINE AND REPORT THE APPROPRIATE RESULT

DETERMINING A FINISH DATE/TIME WHEN TRAVERSING THE WORK ORDER IN THE FORWARD DIRECTION--STEP 5.e CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS:

1. CONVERT PROPOSED START DATE/TIME TO A RELATIVE NOTCH (i.e., the n.sup.th notch from beginning of capacity vector, which starts at midnight on the current date)--THIS BECOMES THE "CURRENT NOTCH." CONVERT TIME PERIODS TO NOTCHES

2. SEARCH FORWARD FROM THE "CURRENT NOTCH" FOR THE FIRST RUNNING (NON-SHUTDOWN) NOTCH FOR THE MAIN RESOURCE; NOTE THIS NOTCH AS THE "COULD START NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH"

2. SEARCH FORWARD FROM THE "CURRENT NOTCH" FOR THE FIRST AVAILABLE RUNNING NOTCH FOR ALL RESOURCES REQUIRED; NOTE THIS NOTCH AS THE "ACTUAL START NOTCH"--THIS BE COMES THE NEW "CURRENT NOTCH"

4. SEARCH FORWARD FROM THE "CURRENT NOTCH" COUNTING ALL AVAILABLE NOTCHES FOR THE MAIN RESOURCE; VERIFY THAT THE SAME NOTCH IS AVAILABLE FOR THE SETUP AND RUN RESOURCES, IF APPLICABLE; WHEN THE NUMBER OF NOTCHES

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SPECIFIED BY THE SETUP TIME AND RUN TIME MATCHES THE NUMBER OF NOTCHES ASSIGNABLE, END THE SEARCH

5. SKIP NOTCHES FOR THE TRANSFER TIME; NOTE THIS NOTCH AS THE "ACTUAL END NOTCH"

6. CONVERT ALL NOTCHES TO DATES/TIMES

7. RETURN RESULT OF SCHEDULE

8. IF AT ANY TIME THE BOUNDARIES OF THE SCHEDULE ARE EXCEEDED, ABORT THE SCHEDULING ROUTINE AND REPORT THE APPROPRIATE RESULT

DETERMINATION OF RUN TIME AND MATERIAL REQUIREMENTS FOR EACH OPERATION

As explained above, the run time, the quantity of materials needed for each operation, and the scrap or yield rates are preferably expressed as a function of the number of units of input to the operation or the number of units of output from the operation. According to a preferred embodiment of the scheduling system of the invention, prior to scheduling the operations of a Work Order, the run time and material requirement for each operation in the Work Order are calculated in absolute terms using the input or output quantities for each operation. Based upon the quantity specified by the Work Order and the scrap or yield definitions, the input or output quantities and material requirement for each operation are determined by the following process prior to scheduling:

1. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION, EXECUTING THE FOLLOWING STEPS FOR EACH ONE:

2. DETERMINE AN OUTPUT QUANTITY

- a. for the last operation, the Work Order quantity is the output quantity
- b. for each preceding operation, the output quantity is the input quantity-for the succeeding operation

3. DETERMINE AN INPUT QUANTITY

- a. the start quantity is a quantity which when reduced by the scrap rate and scrap amounts yields the input quantity for the operation

4. DETERMINE MATERIAL REQUIREMENT

- a. the absolute quantity of each material needed for an operation is determined by multiplying the material requirement (a quantity per unit of input or output) by the input or output quantity determined in step 2 or 3, plus any scrap rate and/or amount specified by the user; (this scrap rate/amount is independent of the scrap rate/amount used in step 3)

The preferred embodiment of the scheduling system of the invention determines the following information: (1) start date and finish date for each operation, ignoring any capacity limitations; (2) start date and finish date for each operation, taking into account all capacity limitations; and (3) idEntity of the assigned main resource, setup resource, and run resource. The assigned start date, assigned finish date and assigned resource capacity are displayed on a computer screen in a graphical format. In a preferred embodiment of the invention, this information is displayed in the form a bar graph.

FIG. 7 illustrates a preferred embodiment of a screen display showing a schedule generated by the scheduling system of the invention. The current month and days of the month are shown along the x-axis in FIG. 7, and the various resources that are used in the manufacturing process are shown along the y-axis. Only those resources at which operations have been scheduled are included in the screen display. The time

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frame that is displayed on the computer screen may be varied. For example, the user may elect to display all operations scheduled during a one week period or, alternatively, an operations scheduled during a one month period.

A preferred embodiment of the scheduling system of the invention is capable of displaying more than one schedule on a single screen. Multiple schedules may be created by the system based on different resource capacity calendars defined by the user. For example, a first schedule could be created based upon the availability of three machine operators working in a particular shift, and a second schedule could be created based upon the availability of five machine operators in that shift. The scheduling advantage of this increase in machine operator capacity could be evaluated by displaying the first and second schedules on a computer screen simultaneously.

While a preferred embodiment of the invention has been disclosed in detail, it will be appreciated by those skilled in the art that other embodiments of the invention within the scope of the following claims may be developed based on the principles disclosed herein.

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7.1.2 U.S Patent 6,088,626

Method and apparatus for scheduling Work Orders in a manufacturing process

Abstract

A computerized system is provided for scheduling a plurality of Work Orders in a manufacturing process. Each Work Order to be scheduled specifies a set of operations to be performed using a plurality of resources and materials. Data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information is received and stored in a computer. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The operations information includes the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform the operation. The materials information includes the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation. Resource capacity and a start date/time and a finish date/time are assigned to each operation based upon the resource availability information, the material availability information, and the Work Order information. The assigned resource-capacity, the assigned start date/time, and the assigned finish date/time for each operation are displayed on a computer screen in a graphical format.

Inventors: **Lilly; Richard T.** (Hampton Falls, NH); **Layne; David V.** (Litchfield, NH)

Assignee: **Lilly Software Associates, Inc.** (Hampton, NH)

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Primary Examiner: Grant; William

Assistant Examiner: Robinson; Victoria

Attorney, Agent or Firm: Testa, Hurwitz & Thibault, LLP

Parent Case Text

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation of U.S. patent application Ser. No. 08/250,179, filed May 27, 1994, now U.S. Pat. No. 5,787,000, issued Jul. 28, 1998.

Claims

1. A computerized method for scheduling a plurality of Work Orders for manufacturing products in a manufacturing process, each Work Order comprising a set of operations to be performed using a plurality of resources and materials, the method comprising:

monitoring the availability of each resource used in the manufacturing process;

monitoring the availability of each material used in the manufacturing process;

inputting Work Order information for each Work Order to be scheduled, comprising (1) a release date and a want date for the Work Order, (2) operations information, and (3) material requirements information;

assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that both the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for each operation in a graphical format.

2. The method according to claim 1 wherein the resource availability monitoring step comprises monitoring for each operation the idEntity of each resource used in the manufacturing process, the available capacity for the resource, the dates when the resource capacity is available, and the capacity for the resource that has been assigned to previously scheduled operations.

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3. The method according to claim 1 wherein the material availability monitoring step comprises monitoring for each operation the idEntity of the material, the dates when the material becomes available, and the quantity of the material available on each date.
4. The method according to claim 1 wherein the operations information comprises the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation.
5. The method according to claim 1 wherein the material requirements information comprises the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation.
6. The method according to claim 1 wherein the Work Order information further comprises at least one of the idEntity of the product to be manufactured, the quantity of the product to be manufactured, and a relative priority for each Work Order.
7. The method according to claim 1 further comprising the step of displaying on a computer screen selected Work Order information.
8. The method according to claim 1 wherein the operations information comprises at least one of the time needed to set up the resources needed to perform each operation and the time needed to run each operation per unit of output from the operation.
9. The method according to claim 1 wherein the operations information further comprises at least one of the time needed to transfer the output from each operation to the next operation in the sequence and the minimum quantity of output units required to be completed before beginning the next operation in the sequence.
10. The method according to claim 1 wherein the operations information further comprises at least one of the yield of output units per unit of input for the operation and the quantity of output units per unit of input that will be discarded as scrap.
11. The method according to claim 1 wherein the operations information further comprises a minimum resource capacity that could be used to perform the operation and the maximum resource capacity is assigned to the operation if the maximum resource capacity is available, and if the maximum resource capacity is not available, then a resource capacity not less than the minimum resource capacity is assigned to the operation.
12. The method according to claim 1 wherein the material requirements information further comprises at least one of the quantity of material that will be discarded as scrap during issuance of material to the Work Order and the rate at which material will be discarded as scrap during performance of the operation for which the material is needed.
13. The method according to claim 1 further comprising at least one of (a) the step of revising and storing the resource availability information based upon the assigned resource capacity, the assigned start date/time, and the assigned finish date/time, and (b) the step of revising and storing the material availability information based upon the material requirements information for the scheduled operation.
14. The method according to claim 1, wherein the Work Order information further comprises a relative priority for each Work Order and the operations for each Work Order are scheduled in the order of the Work Order priority.
15. The method according to claim 1, wherein the material availability information is determined by the following steps:

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(1) determining a first total quantity of a material needed to perform all operations that have been scheduled prior to a given date;

(2) determining a second total quantity of the material that will be received in inventory on the date; and

(3) determining the difference between the first total quantity and the second total quantity.

16. The method according to claim 1, wherein the process of assigning a start date/time and a finish date/time to an operation based upon the material availability information comprises the steps of:

(1) determining a proposed start date/time for the operation;

(2) for each material required for the operation,

(a) determining a first total quantity of the material needed to perform all operations that have been scheduled prior to the proposed start date/time;

(b) determining a second total quantity of the material that will be in inventory on the proposed start date/time; and

(c) computing the difference between the first total quantity and the second total quantity; and

(3) comparing the difference to the material requirement for the operation.

17. The method according to claim 16, further comprising the steps of:

(4) where the difference equals or exceeds the material requirement for the operation, assigning the proposed start date/time as the start date/time; and

(5) where the difference is less than the material requirement for the operation, assigning a start date/time based upon the proposed start date/time and the time required to obtain an additional quantity of the material needed for the operation.

18. The method according to claim 1 wherein the assigning step further comprises traversing the operations of each Work Order in at least one of the forward direction or the backward direction.

19. A computerized system for scheduling a plurality of Work Orders for manufacturing products in a manufacturing process, each Work Order comprising a set of operations to be performed using a plurality of resources and materials, the system comprising:

means for monitoring the availability of each resource used in the manufacturing process;

means for monitoring the availability of each material used in the manufacturing process;

means for inputting Work Order information for each Work Order to be scheduled, the Work Order information comprising (1) a release date and a want date for the Work Order, (2) operations information, and (3) material requirements information;

means for assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that both the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

means for outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for each operation in a graphical format.

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20. The system according to claim 19 wherein the resource availability information comprises, for each resource used in the manufacturing process, the idEntity of the resource, the available capacity for the resource, the dates when the resource capacity is available, and the capacity for the resource that has been assigned to previously scheduled operations.
21. The system according to claim 19 wherein the material availability information comprises, for each material used in the manufacturing process, the idEntity of the material, the dates when the material becomes available, and the quantity of the material available on each date.
22. The system according to claim 19 wherein the operations information comprises the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation.
23. The system according to claim 19 wherein the material requirements information comprises the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation.
24. The system according to claim 19 further comprising means for displaying on a computer screen selected Work Order information.
25. The system according to claim 19 wherein the Work Order information further comprises at least one of the idEntity of the product to be manufactured, the quantity of the product to be manufactured, and a relative priority for each Work Order.
26. The system according to claim 19 wherein the operations information comprises at least one of the time needed to set up the resources needed to perform each operation and the time needed to run each operation per unit of output from the operation.
27. The system according to claim 19 wherein the operations information further comprises at least one of the time needed to transfer the output from each operation to the next operation in the sequence and the minimum quantity of output units required to be completed before beginning the next operation in the sequence.
28. The system according to claim 19 wherein the operations information further comprises at least one of the yield of output units per unit of input for the operation and the quantity of output units per unit of input that will be discarded as scrap.
29. The system according to claim 19 wherein the operations information further comprises a minimum resource capacity that could be used to perform the operation and the assigning means comprises means for assigning the maximum resource capacity to the operation if the maximum resource capacity is available, and means for assigning a resource capacity not less than the minimum resource capacity to the operation if the minimum resource capacity is not available.
30. The system according to claim 19 wherein the material requirements information further comprises at least one of the quantity of material that will be discarded as scrap during issuance of material to the Work Order and the rate at which material will be discarded as scrap during performance of the operation for which the material is needed.
31. The system according to claim 19 further comprising at least one of: (a) means for revising and storing the resource availability information based upon the assigned resource capacity, the assigned start date/time, and the assigned finish date/time, and (b) means for revising and storing the material availability information based upon the material requirements information for the scheduled operation.
32. The system according to claim 19 wherein the Work Order information further comprises a relative

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priority for each Work Order, and the assigning means comprises means for scheduling the operations for each Work Order in the order of the Work Order priority.

33. The system according to claim 19 wherein the displaying means comprises means for displaying resource capacity, the assigned start dates/times, and the assigned finish dates/times in the form of a bar graph.

34. A computerized method for scheduling a plurality of Work Orders, each comprising a set of operations to be performed using a plurality of resources and materials, for manufacturing products in a manufacturing process, the method comprising:

monitoring the availability of each resource and each material used in the manufacturing process;

inputting for each Work Order to be scheduled Work Order information including a release date, a want date, operations information, and material requirements information;

assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability, the material availability and the Work Order information by selecting a start date/time for each operation based upon a determination that the resource capacity and the material required for that operation are concurrently available on such start date/time, to provide a schedule; and

outputting the assigned resource capacity, the assigned start date/time and the assigned finish date/time for each operation in a graphical format.

Description

BACKGROUND OF THE INVENTION

The present invention relates to a computerized system for scheduling Work Orders for manufacturing products in a manufacturing process.

Prior to the introduction of computerized scheduling systems, the scheduling of Work Orders in a manufacturing facility was performed manually. The person responsible for determining the work schedule manually assigned the work to be performed to specific dates. The manual scheduling process involved determining what work has to be performed and the time, materials, and resources (i.e., machines, workers, tools, etc.) required to perform it, as well as other information which influenced the schedule, such as which work was more important than other work. This process is costly, very tedious and often inaccurate. The frequency with which the scheduling process must be performed contributes to the difficulty of obtaining timely, accurate manual scheduling.

As commercial computer systems became available, manufacturers began using computerized systems that assisted in the storage and retrieval of information relevant to the scheduling of work in a manufacturing facility. In the late 1950's and during the 1960's, efforts were made to implement Material Requirements Planning or MRP. MRP was limited in scope to dealing only with material requirements (i.e., which parts or materials were needed and when). These early computerized systems were not capable of scheduling operations based upon the availability of materials or resource capacity.

During the 1970's and 1980's, many commercially available systems were created which provided more comprehensive MRP, and it was eventually renamed Manufacturing Resource Planning. The new MRP dealt with additional problems, such as forecasting, inventory management, shop floor control, engineering, and change management. Some of these systems dealt with the capacity of the plant to perform the work. One such approach was called rough-cut capacity planning and, as the name suggests, it provided a crude estimate of the capacity needed to satisfy work requirements. Rough-cut capacity planning determined the capacity needed, but was not capable of scheduling Work Orders based on capacity limits.

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Other systems for scheduling Work Orders in a manufacturing facility relied on a method of scheduling that compared the total hours of capacity to the total hours of load from operations. Such systems were not capable of "event-oriented" scheduling, i.e., assigning a particular event or operation to a particular resource for a particular time period.

It was not until the mid-1980's that a computerized event-oriented scheduling system was developed that was capable of scheduling Work Orders and the operations required to carry out the Work Orders, taking into account the finite capacity of the various resources needed for the manufacturing process, i.e., finite scheduling. ProfitKey, a New Hampshire-based company, developed one of the first such finite scheduling systems available to the market. Using the ProfitKey Scheduler, a manufacturer could determine the start and finish date of Work Orders and their operations based upon resource capacity and availability. A similar system was developed by Lilly Software Associates, Inc. and marketed as part of the VISUAL Manufacturing.TM. system beginning in early 1993.

However, neither the ProfitKey system nor the early 1993 version of the VISUAL Manufacturing.TM. system was capable taking the availability of materials into account in determining the scheduling of Work Orders. In addition, the ProfitKey system and the early 1993 version of the VISUAL Manufacturing.TM. were both limited to a single resource capacity calendar for all resources in the system, and neither system was capable of generating multiple schedules based on different assumptions regarding resource capacity for individual resources. Further, the ProfitKey system was not capable of scheduling multiple dissimilar resources concurrently based upon user specifications.

Other scheduling systems include Microsoft Project.TM. and Norton's Timeline from Symantec. These programs are capable of storing and retrieving information about a project defined by the user using a method consistent with Critical Path Method (CPM) theory. These tools are designed to handle projects that have definable events that are interdependent, similar to a single Work Order in a manufacturing process. These systems are not, however, capable of managing hundreds of Work Orders at a time as is typical in most manufacturing plants.

No prior art system is capable of scheduling a plurality of Work Orders or operations in a manufacturing facility, using a finite, event-oriented scheduling process with the added feature of taking into account the availability of materials that are used in the manufacturing process.

OBJECTS OF THE INVENTION

Therefore, it is an object of the present invention to provide a computerized system for performing accurate and timely scheduling of Work Orders in a manufacturing facility.

It is a further object of the invention to provide a method and means for scheduling Work Orders for manufacturing products in a manufacturing process, wherein each operation in the Work Order is assigned resource capacity, a start date/time, and a finish date/time based upon the resource and material requirements of the operation and the availability of resource capacity and materials in the manufacturing facility.

It is still a further object of the invention to provide a method and means for determining the best fit of the operations of each Work Order in the schedule based upon both resource availability and material availability.

It is still a further object of the invention to provide a scheduling system which includes a method and means for defining variable resource capacity as a function of the dates and times in the calendar individually for each resource used in the manufacturing facility.

It is still a further object of the invention to provide a scheduling system which includes a method and means for creating multiple schedules based on different resource capacity calendars for comparison purposes.

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It is still a further object of the invention to provide a scheduling system which includes a method and means for scheduling operations at more than one dissimilar resource simultaneously.

It is still a further object of the invention to provide a scheduling system which includes a method and means for allowing the user to specify a minimum and maximum resource capacity needed to perform each operation being scheduled, in order to optimize utilization of each resource in the manufacturing facility.

These and other objects and advantages of the invention will be apparent from the following detailed description of the invention and drawings.

SUMMARY OF THE INVENTION

In accordance with the present invention, a computerized system is provided for scheduling a plurality of Work Orders in a manufacturing process. Each Work Order to be scheduled specifies a set of operations to be performed using a plurality of resources and materials. The method of the invention includes receiving data in a computer, the data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The operations information includes the idEntity and sequence of operations to be performed for the Work Order, the idEntity of the resources needed to perform each operation, a minimum resource capacity needed to perform each operation, and the time needed to perform each operation. The materials information includes the idEntity of the materials needed to perform each operation and the quantity of each material needed for the operation. The method of the invention further includes the steps of assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability information, the material availability information, and the Work Order information. The method of the invention also includes the step of displaying on a computer screen the assigned resource capacity, the assigned start date/time, and the assigned finish date/time for each operation in a graphical format.

The system of the invention includes means for receiving data in a computer, the data including resource availability information for each resource used in the manufacturing process, material availability information for each material used in the manufacturing process, and Work Order information. The Work Order information includes a release date for the Work Order, a want date for the Work Order, operations information, and material requirements information. The system of the invention further includes means for assigning resource capacity and a start date/time and a finish date/time to each operation based upon the resource availability information, the material availability information, and the Work Order information. The system of the invention also includes means for displaying on a computer screen the assigned resource capacity, the assigned start date/time, and the assigned finish date/time for each operation. A graphical format.

DEFINITIONS

A "Work Order" order is a request to manufacture one or more distinct parts in a manufacturing facility. Such parts may be consumed either by the Customer who ordered the parts or by other Work Orders within the manufacturing facility, as in the case of a subassembly.

A "part" is any distinct unit that can be manufactured as an end product or an intermediate product or subassembly.

An "operation" is a step in the process for manufacturing a distinct part according to a Work Order. Each operation in a Work Order is sequenced so that it follows a preceding operation (or is the first), and comes before a succeeding operation (or is the last).

A "material" is any material or part that is consumed by the manufacturing process or added to the part being manufactured during the manufacturing process. A material may be a subassembly which is an

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intermediate product used in the manufacturing process. A material may be identified by an inventory part number.

A "resource" is something that is needed to perform an operation, but which is not directly consumed in the performance of the operation. Examples of a resource include workers, machines, and tools. A resource may be internal or external to the manufacturing facility. An external resource would be, for example, an outside Vendor or an outside service provider.

A "date/time" is a specification of a date (month, day, and year) and a time of day.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the software components used to implement a preferred embodiment of the scheduling system, as they relate to each other;

FIG. 2 is a block diagram of particular routines within the scheduling system and their relationship-To each other;

FIG. 3 illustrates a preferred embodiment of a screen display showing a multiple level Work Order,;

FIG. 4 is a graphical representation of a multiple level Work Order, omitting the material requirements;

FIG. 5 is a graphical representation of a capacity vector;

FIG. 6 is a graphical representation of a load vector; and

FIG. 7 illustrates a preferred embodiment of a screen display showing a schedule generated by the scheduling system of the invention.

FIG. 8-12 are flow charts showing the steps for implementing the scheduling system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The scheduling system of the present invention may be used in any manufacturing facility. The system may be most useful in a facility for manufacturing discrete products, such as a facility that manufactures products according to individualized Customer specifications.

The scheduling system may be used to schedule all Work Orders that have been accepted by the manufacturer. The system may also be used to determine a proposed schedule and/or a proposed delivery date for a potential Work Order in response to an inquiry from a Customer or other interested person.

The scheduling system of the present invention may be implemented using a variety of personal computers. According to a preferred embodiment of the invention, the scheduling system is implemented using an IBM-compatible computer having not less than 8 megabytes of random access memory (RAM), a 486DX or higher Intel.RTM. microprocessor running at 33 megahertz or higher, and sufficient hard disk space to store the software programs used to implement the invention, the output from the scheduling program, as well as the input data such as the resource availability information, material availability information, Work Order information, operations information, and material requirements information.

The scheduling system of the present invention may be implemented using a variety of programming languages and operating systems. According to a preferred embodiment of the invention, the scheduling system is implemented as a Windows Dynamic Link Library using Gupta Corporation's SQLWindows.TM. Client-Server Application Development System and Microsoft Visual C++.TM., both of which run on a Microsoft.RTM. Windows.TM. Version 3.1-based IBM-compatible computer system. FIG. 1 illustrates in a graphical format the relationship between the software components used to implement a preferred

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embodiment of the scheduling system of the invention. As illustrated in FIG. 1, a preferred embodiment of the invention interfaces with a manufacturing information system, which exchanges certain data with the scheduling system, such as material availability information.

The capabilities and implementation of the aforementioned programming languages and operating systems are explained in the following texts and manuals, which are hereby incorporated by reference: SQL Windows Technical Reference Manual, Volumes 1 and 2, Gupta Corporation, 20-1205-1003, 20-1206-1001; SQL Windows Function Reference Manual Volumes 1 and 2, Gupta Corporation, 20-2215-1003, 20-2217-1001; Slobbers Language Reference Manual, Gupta Corporation, 20-2107-1002; SQL Base C Application Programming Interface Reference Manual, Gupta Corporation, 20-2111-1002; Microsoft Windows 3.1 Programmer's Reference, Volumes 1, 2, 3 and 4, Microsoft Corporation; Microsoft Visual C++ Programmer's Guide, Microsoft Corporation; and Microsoft Visual C++ Reference, Volumes 1 and 2, Microsoft Corporation. Additional references which may be helpful are listed bibliographically in the foregoing texts and manuals.

According to the scheduling system of the present invention, certain data required to schedule a Work Order is received in a computer. This data includes resource availability information, material availability information, Work Order information, operations information, and material requirements information. Each of these types of data is described in detail below:

"Resource availability information" includes the idEntity of each resource used in the manufacturing process, a calendar specifying the quantity of each resource that is available for use at a particular date/time independent of previously scheduled operations (the "resource capacity calendar"), and the capacity for each resource that has been assigned to previously scheduled operations (also referred to as "load"). The resource availability information is updated each time that an operation is scheduled by the system in order to reflect the load on each resource imposed by the scheduled operation.

"Material availability information" includes the idEntity of each material used in the manufacturing process, the dates when each material is available, and the quantity of each material available on each date. The material availability information may also include the lead time necessary to obtain an additional quantity of each material. The material availability information is updated each time that an operation is scheduled by the system in order to reflect the material demand in the time period the material is needed for the scheduled operation. In a preferred embodiment of the invention, selected material availability information is displayed on a computer screen.

"Work Order information" includes the release date for the Work Order (i.e., when work should commence) and the want date for the Work Order (i.e., when work must be complete). Work Order information also includes certain operations information and material requirements information. Work Order information may also include the idEntity of the part to be manufactured, the quantity of the part to be manufactured, and a relative priority for the work to be performed. In a preferred embodiment of the invention, selected Work Order information is displayed on a computer screen, preferably in the form of an acyclic directed graph. FIG. 3 illustrates a preferred embodiment of a screen display showing selected Work Order information.

"Operations information" includes the idEntity of the operations defined by a Work Order, the sequence in which the operations are to be performed, the idEntity of the resource(s) at which each operation is to be performed, and a minimum resource capacity needed to perform each operation. The resources identified for each operation include a main resource, and optionally two auxiliary resources, namely a setup resource and a run resource. The "operations information" also includes the period of time needed to perform the operation, which may include the period of time need to set up the resource(s) needed to perform the operation ("setup time") and the period of time needed to run the operation, preferably expressed per unit of output from the operation or as a number of output units in a given period of time ("run time"). The "operations information" may also include the scrap or yield from the operation, preferably expressed as the number of output units from the operation per unit of input in percent; a fixed quantity of scrap that will be discarded from the operation; a minimum quantity of output units required to be completed before beginning the next operation; the period of time required to physically transfer the output units to the next

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succeeding operation ("transfer time"); and/or a minimum resource capacity that could be used to perform the operation, if such capacity were available.

The sequence of operations defined by a Work Order may be single or multiple level. A single level Work Order has a linear sequence of operations. A multiple level Work Order has a branched sequence of operations, whereby each branch of the sequence contains a subset of operations for manufacturing an intermediate product or subassembly that is used to manufacture the final product. FIG. 3 shows a graphical illustration of a multiple level Work Order, including end product 31, material requirement 32, operation 33, and intermediate products (or subassemblies) 34 and 35. Each subset of operations is referred to as a "leg" of the Work Order. For example, the Work Order shown in FIG. 3 has legs 36 and 37. For multiple level Work Orders, the "operations information" includes, as part of the sequence of operations, the leg of the Work Order to which each operation belongs. In a preferred embodiment of the scheduling system, operations that belong to separate legs of a multiple level Work Order may be scheduled concurrently. For example, FIG. 4 shows a graphical representation of a multilevel Work Order, omitting the material requirements for the Work Order. The top part of FIG. 4 illustrates the concurrent scheduling of operations in a multiple level Work Order. In addition, even with a single level Work Order, the user may specify that two or more operations be scheduled concurrently.

"Material requirements information" includes the idEntity of the materials needed for an operation and the quantity of the material needed for an operation. The quantity of the materials needed for an operation is preferably expressed either per unit of input to the operation or per unit of output from the operation. The materials information may also include a scrap rate (in addition to the scrap imposed by the operation definition), a fixed quantity of scrap (in addition, to the scrap imposed by the operation definition), the dimensions of a material part needed for an operation, and/or the Unit of Measure for the quantity expression (which may need to be converted to another Unit of Measure).

Ultimately, the various quantity expressions are reduced to a specific quantity, in the stock keeping Unit of Measure, of the part which is required.

The scheduling system of the present invention assigns resource capacity, a start date/time, and a finish date/time to each operation in the Work Order being scheduled based upon the resource availability information, the material availability information, and the Work Order information. The system schedules an operation for a date and time when both the necessary resource capacity is available and the necessary materials are available. The preferred means for implementing the assignment of resource capacity, start date/time, and finish date/time is described in detail below:

Resources can have one or more units of capacity. Each unit of capacity corresponds to a worker, machine, tool, or other item or device which performs work on an operation. According to the invention, the system user can define the capacity of each resource that is used in the manufacturing process as a function of the dates and times in a calendar. This is called the "resource capacity calendar." If, for example, the resource is machine operators, the user may define the capacity as being one or more machine operators for a given time period. The "resource capacity calendar" is independent of load (i.e., the capacity that has been assigned to scheduled operations). When scheduling an operation, however, the system takes into account both the resource capacity calendar and the load from previously scheduled operations.

As part of the Work Order, the user specifies the resource capacity that is required to perform a particular operation. If more than one person or machine is required to work on the same operation at the same time, a minimum resource capacity of more than one unit of capacity may be specified for a given operation. If it would be desirable, but not necessary, for more than one person or machine to work on the same operation at the same time, then a maximum resource capacity may also be specified. In that event, the maximum resource capacity will be assigned to the operation, if such capacity is available. Thus, by specifying a maximum resource capacity, the user may shorten the overall time required to perform an operation by utilizing more than the minimum capacity.

According to a preferred embodiment of the scheduling system of the invention, the resource capacity calendar is divided into distinct units of time called notches. A notch is a specific length of time, for

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example, ten minutes or six notches per hour. The system uses a "capacity vector" to represent the time frame of the resource capacity calendar. FIG. 5 shows a graphical representation of a capacity vector. The capacity vector is divided into notches 51. For example, a two-year time frame contains 17,520 hours or 105,120 notches. Associated with each notch in the capacity vector is a designation of the capacity of the resource that is available during the time period represented by the notch, i.e., the number of simultaneous operations that may be scheduled in the notch. A constant, for example, 255 (the maximum integer represented by a single byte), designates a shutdown notch. A shutdown notch represents a time period, during which the resource is not being operated, for example, because the manufacturing plant is closed. All other values designate a running notch. A running notch can be available or unavailable. An available notch is one which has available capacity, and an unavailable notch is one which has no available capacity.

For example, FIG. 5 shows a portion of a capacity vector for machine operators. The first six notches 52 are shutdown notches, indicating that the machine operators are not working during the hour represented by these notches. The next eighteen notches 53 in the capacity vector are running notches. Twelve of these notches 54 each have five units of available capacity, and six of these notches 55 each have three units of available capacity. In other words, there are five machine operators available during the two hours represented by the middle twelve notches in the capacity vector, and three machine operators available during the one hour represented by the last six notches in the capacity vector.

According to a preferred embodiment of the scheduling system of the invention, the capacity vector does not reflect the capacity that has been assigned to previously scheduled operations. Rather, the system records usage of capacity or load in the form of a "load vector" which includes a list of operations that have been scheduled at each resource. FIG. 6 shows a graphical representation of a load vector. Each number 61 along the y-axis in FIG. 6 indicates a particular unit of capacity, e.g., a particular machine operator. Time is represented along the x-axis. Each bar 62 in FIG. 6 represents the time assigned to scheduled operations, and the arrows 63 between each bar 62 represent unassigned time. The space to the left of the last bar 62 for a given unit of capacity also represents unassigned time. Thus, the left end 64 of each bar 62 represents the start date/time for an operation, while the right end 65 of each bar 62 represents the finish date/time for an operation.

According to a preferred embodiment of the scheduling system of the invention, an operation is scheduled in a given set of notches only if all notches in the set are both adjacent and available. Two notches are considered adjacent if they are separated by zero or more shutdown notches, but not if they are separated by an unavailable notch. A notch is available if there is at least one unit of capacity which has not been previously assigned to another operation. In order to determine whether a notch is available, the system consults both the capacity vector (FIG. 5) and the load vector (FIG. 6). Units of capacity to which no operation has been assigned are available for assignment to subsequently scheduled operations requiring that resource.

In addition to resource capacity, the scheduling system of the present invention also checks material availability when scheduling an operation. According to a preferred embodiment of the scheduling system of the present invention, material availability is expressed in terms of supply and demand for each material used in the manufacturing process. Supply is an expression of when a material will be received in inventory, and how much or how many, in terms of the stock Unit of Measure, will be received. Thus, supply is a list of quantities and dates listed, for example, in sequence by date. Demand is an expression of when a material is needed to perform scheduled operations, and how much or how many, in terms of the stock Unit of Measure, is/are needed. Thus, demand is a list of quantities and dates listed, for example, in sequence by date. Material availability is determined by netting the demand and supply lists. In a preferred embodiment of the scheduling system, the system first determines a proposed start date for an operation. The system then nets the supply and demand for the material(s) required for the operation in order to determine the quantity of the material(s) available on the proposed start date/time. If this quantity satisfies the material requirement for the operation, then the operation may be scheduled for the proposed start date/time. If, on the other hand, this quantity does not satisfy the material requirement for the operation, then additional material must be obtained, and the start date/time may be rescheduled, taking into account the lead time necessary to obtain an additional quantity of the material. If the lead time is greater than the difference between the current date/time and the proposed start date/time, then the system adds the excess

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to the proposed start date/time to determine the start date/time. If on the other hand, the lead time is less than or equal to the difference between the current date/time and the proposed start date/time, then the operation is scheduled for the proposed start date/time.

According to a preferred embodiment of the invention, the scheduling system may operate in at least two different modes: sequential scheduling and global scheduling. In the sequential scheduling mode, the system schedules each Work Order as it is entered in the system, leaving the assigned resource capacities, the assigned start dates/times, and the assigned finish dates/times for all previously entered Work Orders in place. In this mode, each successively entered order is de facto given the lowest priority. In the global scheduling mode, on the other hand, the system reschedules all previously entered Work Orders in order of priority each time that a new Work Order is entered in the system. All Work Orders are automatically assigned the same priority when entered, unless the user sets a different priority. Thus, in the global scheduling mode, all Work Orders in the system are rescheduled in the order of (1) Work Order want date, if no Work Order priority is specified; or (2) Work Order priority and want date within the same priority level, if a Work Order priority is specified. The sequence in which Work Orders are scheduled ultimately determines the schedule. Available capacity is assigned to the first Work Order in the sequence. Any remaining capacity is assigned to the second Work Order in the sequence, and so on. Thus, the global scheduling mode results in the optimum schedule because Work Orders are scheduled in order of want date and/or priority.

According to a preferred embodiment of the scheduling system of the invention, after the sequence in which Work Orders will be scheduled is determined, the system processes each Work Order one at a time in the determined sequence. Within each Work Order, the operations are scheduled in the backward direction, starting with the last or latest-in-time operation and/or in the forward direction, starting with the first or earliest-in time operation. For example, the sequence of operations in the forward direction for the multiple level Work Order shown in FIG. 4 would be:

10(4), 10(2), 10(1), 20(1), 10(3), 10(0), 20(0), 30(0), 40(0), and

the sequence of operations in the backward direction would be:

40(0), 30(0), 20(0), 10(0), 10(3), 20(1), 10(1), 10(2), 10(4),

where the first numeral designates the operation and the numeral in parentheses designates the leg of the Work Order to which the operation belongs.

According to a preferred embodiment of the invention, the scheduling system initially schedules all operations of a Work Order in the backward direction. If backward scheduling results in a schedule in which no operations are scheduled prior to the current date, then the resulting schedule is saved and displayed. If the result of backward scheduling exceeds the current date, then forward scheduling is performed. After scheduling the operations of a Work Order in the forward direction, the system differentiates between "determinate" and "non-determinate" operations and reschedules the non-determinate operations, if possible. FIG. 2 is a block diagram illustrating these scheduling routines and their relationship to each other.

In a single level Work Order, all operations are determinate. A multiple level Work Order, on the other hand, has both determinate and non-determinate operations. A determinate operation is one that is on the path of operations which define the longest series of operations, in terms of the length of time from the earliest start date/time to the latest finish date/time, in view of the start dates/times and finish dates/times of all operations in the Work Order as presently scheduled. This is similar to the concept of a critical path. A sequence of operations may become determinant when one or more operations in the sequence is delayed by the unavailability of resource capacity. In a preferred embodiment of the scheduling system of the invention, after forward scheduling, the system reschedules all non-determinate operations, assigning the latest possible start date/time to each operation. The purpose of this rescheduling is to achieve an optimum schedule which minimizes Work in Process.

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The logical steps contained in a computer program for implementing a preferred embodiment of the scheduling system of the invention are described in detail below with reference to the flow charts set forth in FIGS. 8-12:

SCHEDULING A SINGLE WORK ORDER (FIG. 8)

1. LOAD THE WORK ORDER INTO MEMORY (FIG. 8, BLOCK 81)
2. IF USER SPECIFIES ONLY FORWARD SCHEDULING, SKIP TO STEP 5 (FIG. 8, BLOCK 82)
3. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION (FIG. 8, BLOCK 83) (see further explanation below)
4. IF STEP 3 RESULTS IN A SCHEDULE IN WHICH NO OPERATION IS SCHEDULED PRIOR TO THE CURRENT DATE, THEN GO TO STEP 8 (FIG. 8, BLOCK 84)
5. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE FORWARD DIRECTION (FIG. 8, BLOCK 85) (see further explanation below)
6. DETERMINE WHICH OPERATIONS OF THE WORK ORDER ARE NON-DETERMINANT; TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION AND RESCHEDULE ONLY THE NON-DETERMINANT OPERATIONS (FIG. 8, BLOCK 86)
7. SAVE THE RESULTS (FIG. 8, BLOCK 87)

STEP 3 (BACKWARD SCHEDULING) CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 9):

a. LOCATE AND PROCESS EACH OPERATION, STARTING WITH THE LAST OPERATION AND ENDING WITH THE FIRST OPERATION, EXECUTING THE FOLLOWING STEPS FOR EACH ONE (FIG. 9, BLOCK 91):

b. CHECK THAT THE RESOURCE CAPACITY INFORMATION HAS BEEN LOADED FOR EACH RESOURCE REQUIRED FOR THE OPERATION; IF NOT, READ THE CAPACITY VECTOR INTO MEMORY AND INITIALIZE THE LOAD VECTOR (FIG. 9, BLOCKS 92,93)

c. DETERMINE A PROPOSED FINISH DATE/TIME FOR THE OPERATION (FIG. 9, BLOCK 94)

(1) for the last operation, the proposed finish date is the want date of the Work Order

(2) for each preceding operation, the proposed finish date is the start date of the succeeding operation, unless a minimum move quantity is specified for the operation

(3) if a minimum move quantity is specified for the operation, then the proposed finish date is the earlier of (a) the start date for the succeeding operation plus the time necessary to complete the operation for the minimum move quantity and (b) the finish date for the succeeding operation less the time necessary to complete the operation for the minimum move quantity

d. DETERMINE A PROPOSED START DATE/TIME FOR THE OPERATION (FIG. 9, BLOCK 95)

(1) determine whether there is sufficient available capacity to complete the operation during an uninterrupted time period, consulting both the capacity vector(s) and the load vector(s) for the resource(s) needed to perform the operation

(2) in order for an operation to be scheduled, a sequence of one or more notches must be available which have no intervening running notches with insufficient capacity to satisfy the minimum capacity specified

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by the Work Order for the main resource for the operation

(3) each operation has, optionally, two auxiliary resources for the setup and run phases of the operation; if specified, the setup resource must be available in the same notch as the main resource during the setup phase; also, if specified, the run resource must be available in the same notch as the main resource during the run phase

e. DETERMINE WHETHER THE MATERIAL NEEDED FOR THE OPERATION IS AVAILABLE (FIG. 9, BLOCK 96)

(1) by netting supply and demand, determine whether sufficient material is available on the proposed start date to satisfy the material requirement for the operation

(2) if sufficient material is available, then the proposed start date becomes the start date

(3) if sufficient material is not available, backward scheduling (STEP 3) is aborted and forward scheduling (STEP 5) must be performed

STEP 5 (FORWARD SCHEDULING) CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 10):

a. LOCATE AND PROCESS EACH OPERATION, STARTING WITH THE FIRST OPERATION AND ENDING WITH THE LAST OPERATION,--EXECUTING THE FOLLOWING STEPS FOR EACH ONE (FIG. 10, BLOCK 101):

b. CHECK THAT THE RESOURCE CAPACITY INFORMATION HAS BEEN LOADED FOR EACH RESOURCE REQUIRED FOR THE OPERATION; IF NOT, READ THE CAPACITY VECTOR INTO MEMORY AND INITIALIZE THE LOAD VECTOR (FIG. 10, BLOCKS 102,103)

c. DETERMINE A PROPOSED START DATE/TIME FOR THE OPERATION (FIG. 10, BLOCK 104)

(1) for the first operation, the proposed start date is the release date for the Work Order or the current date, whichever is later

(2) for each succeeding operation, the proposed start date is the finish date of the preceding operation, unless a minimum move quantity is specified for the preceding operation

(3) if a minimum move quantity is specified for the preceding operation (either in the same leg or in an immediately preceding leg of the Work Order), then the proposed start date is determined by the following steps:

(a) determine a proposed start date by adding the amount of time necessary to complete the preceding operation for the minimum move quantity to the start date for the preceding operation

(b) determine a calculated finish date for the current operation by adding the run time for the current operation to the proposed start date

(c) compare the calculated finish date for the current operation with the finish date (determined in step e.) for the preceding operation

(d) if the calculated finish date for the current operation is earlier than the finish date for the preceding operation, then subtract the run time for the current operation from the finish date for the preceding operation to determine the proposed start date; otherwise, use the proposed start date determined in step (3)(a)

d. DETERMINE WHETHER THE MATERIAL NEEDED FOR THE OPERATION IS AVAILABLE

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(FIG. 10, BLOCKS 105,106)

- (1) by netting supply and demand, determine whether sufficient material is available on the proposed start date to satisfy the material requirement for the operation
- (2) if sufficient material is available, then the proposed start date becomes the start date
- (3) if sufficient material is not available, then load the lead time for obtaining additional material into memory
- (4) if the lead time is greater than the difference between the current date and the proposed start date, then add the excess to the proposed start date to determine the start date
- (5) if the lead time is less than or -equal to the difference between the current date and the proposed start date, then the proposed start date becomes the start date

e. DETERMINE A FINISH DATE/TIME FOR THE OPERATION (FIG. 10, BLOCK 107)

- (1) determine whether there is sufficient available capacity to complete the operation during an uninterrupted time period, consulting both the capacity vector(s) and the load vector(s) for the resource(s) needed to perform the operation
- (2) in order for an operation to be scheduled, a sequence of one or more notches must be available which have no intervening running notches with insufficient capacity to satisfy the minimum capacity specified by the Work Order for the main resource for the operation
- (3) each operation has, optionally, -two auxiliary resources for the setup and run phases of the operation; if specified, the setup resource must be available in the same notches as the main resource during the setup phase; also, if specified, the run resource must be available in the same notches as the main resource during the run phase

STEP 7 IS BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 11):

a. LOCATE AND PROCESS THE NON-DETERMINANT OPERATIONS, STARTING WITH THE LAST NONDETERMINANT OPERATION AND ENDING WITH THE FIRST, EXECUTING THE FOLLOWING STEP FOR EACH ONE (FIG. 11, BLOCKS 111, 112):

- (1) a non-determinant operation is one that is not on the determinant (or critical) path.

b. IF POSSIBLE, SHIFT THE OPERATION TO THE LATEST AVAILABLE NOTCH USING THE SAME UNIT OF CAPACITY (FIG. 11, BLOCKS 113,114)

SCHEDULING A SINGLE OPERATION

The process of determining a start date (STEP 3.d.) or a finish date (STEP 5.e.) for an operation will now be explained in greater detail.

The process of determining a start date or finish date for an operation assumes the availability, in the memory of the computer, of a capacity vector and a load vector for the main resource, the setup resource, and the run resource; the proposed finish date (STEP 3) or proposed start date (STEP 5) for the operation; the units of capacity required at each resource; and the run time, setup time, and transfer time, in minutes, for the operation.

DETERMINING A START DATE/TIME WHEN TRAVERSING THE WORK ORDER IN THE BACKWARD DIRECTION--STEP 3.d CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS (FIG. 12):

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1. CONVERT THE PROPOSED FINISH DATE/TIME TO A RELATIVE NOTCH

(i.e., THE n.sup.th notch from beginning of capacity vector, which starts at midnight on the current date)-- THIS BECOMES THE "CURRENT NOTCH;" CONVERT TIME PERIODS TO NOTCHES (FIG. 12, BLOCK 121)

2. STARTING FROM THE "CURRENT NOTCH," SKIP NOTCHES FOR THE TRANSFER TIME-- THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCK 122)

3. SEARCH BACKWARD FROM THE "CURRENT NOTCH" FOR THE FIRST RUNNING (NON-SHUTDOWN) NOTCH FOR THE MAIN RESOURCE; NOTE THIS NOTCH AS THE "COULD END NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCKS 123,124,125)

4. SEARCH BACKWARD FROM THE "CURRENT NOTCH" FOR THE FIRST AVAILABLE RUNNING NOTCH FOR ALL RESOURCES REQUIRED; NOTE THIS NOTCH AS THE "ACTUAL END NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH" (FIG. 12, BLOCKS 126, 127,128)

5. SEARCH BACKWARD FROM THE "CURRENT NOTCH" COUNTING ALL AVAILABLE NOTCHES FOR THE MAIN RESOURCE; VERIFY THAT THE SAME NOTCH IS AVAILABLE FOR THE SETUP AND RUN RESOURCES, IF APPLICABLE; WHEN THE NUMBER OF NOTCHES SPECIFIED BY THE SETUP TIME AND RUN TIME MATCHES THE NUMBER OF NOTCHES ASSIGNABLE, END THE SEARCH; NOTE THIS NOTCH AS THE "ACTUAL START NOTCH" (FIG. 12, BLOCKS 129, 130, 131, 132)

6. CONVERT ALL NOTCHES TO DATES/TIMES (FIG. 12, BLOCK 133)

7. RETURN RESULT OF SCHEDULE (FIG. 12, BLOCK 134)

8. IF AT ANY TIME THE BOUNDARIES OF THE SCHEDULE (i.e., the current date) ARE EXCEEDED, ABORT THE SCHEDULING ROUTINE AND REPORT THE APPROPRIATE RESULT

DETERMINING A FINISH DATE/TIME WHEN TRAVERSING THE WORK ORDER IN THE FORWARD DIRECTION--STEP 5.e CAN BE BROKEN DOWN INTO THE FOLLOWING STEPS:

1. CONVERT PROPOSED START DATE/TIME TO A RELATIVE NOTCH (i.e., the n.sup.th notch from beginning of capacity vector, which starts at midnight on the current date)--THIS BECOMES THE "CURRENT NOTCH." CONVERT TIME PERIODS TO NOTCHES

2. SEARCH FORWARD FROM THE "CURRENT NOTCH" FOR THE FIRST RUNNING (NON-SHUTDOWN) NOTCH FOR THE MAIN RESOURCE; NOTE THIS NOTCH AS THE "COULD START NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH"

2. SEARCH FORWARD FROM THE "CURRENT NOTCH" FOR THE FIRST AVAILABLE RUNNING NOTCH FOR ALL RESOURCES REQUIRED; NOTE THIS NOTCH AS THE "ACTUAL START NOTCH"--THIS BECOMES THE NEW "CURRENT NOTCH"

4. SEARCH FORWARD FROM THE "CURRENT NOTCH" COUNTING ALL AVAILABLE NOTCHES FOR THE MAIN RESOURCE; VERIFY THAT THE SAME NOTCH IS AVAILABLE FOR THE SETUP AND RUN RESOURCES, IF APPLICABLE; WHEN THE NUMBER OF NOTCHES SPECIFIED BY THE SETUP TIME AND RUN TIME MATCHES THE NUMBER OF NOTCHES ASSIGNABLE, END THE SEARCH

5. SKIP NOTCHES FOR THE TRANSFER TIME; NOTE THIS NOTCH AS THE "ACTUAL END NOTCH"

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6. CONVERT ALL NOTCHES TO DATES/TIMES

7. RETURN RESULT OF SCHEDULE

8. IF AT ANY TIME THE BOUNDARIES OF THE SCHEDULE ARE EXCEEDED, ABORT THE SCHEDULING ROUTINE AND REPORT THE APPROPRIATE RESULT

DETERMINATION OF RUN TIME AND MATERIAL REQUIREMENTS FOR EACH OPERATION

As explained above, the run time, the quantity of materials needed for each operation, and the scrap or yield rates are preferably expressed as a function of the number of units of input to the operation or the number of units of output from the operation. According to a preferred embodiment of the scheduling system of the invention, prior to scheduling the operations of a Work Order, the run time and material requirement for each operation in the Work Order are calculated in absolute terms using the input or output quantities for each operation. Based upon the quantity specified by the Work Order and the scrap or yield definitions, the input or output quantities and material requirement for each operation are determined by the following process prior to scheduling:

1. TRAVERSE THE OPERATIONS OF THE WORK ORDER IN THE BACKWARD DIRECTION, EXECUTING THE FOLLOWING STEPS FOR EACH ONE:

2. DETERMINE AN OUTPUT QUANTITY

a. for the last operation, the Work Order quantity is the output quantity

b. for each preceding operation, the output quantity is the input quantity-for the succeeding operation

3. DETERMINE AN INPUT QUANTITY

a. the start quantity is a quantity which when reduced by the scrap rate and scrap amounts yields the input quantity for the operation

4. DETERMINE MATERIAL REQUIREMENT

a. the absolute quantity of each material needed for an operation is determined by multiplying the material requirement (a quantity per unit of input or output) by the input or output quantity determined in step 2 or 3, plus any scrap rate and/or amount specified by the user; (this scrap rate/amount is independent of the scrap rate/amount used in step 3)

The preferred embodiment of the scheduling system of the invention determines the following information: (1) start date and finish date for each operation, ignoring any capacity limitations; (2) start date and finish date for each operation, taking into account all capacity limitations; and (3) idEntity of the assigned main resource, setup resource, and run resource. The assigned start date, assigned finish date and assigned resource capacity are displayed on a computer screen in a graphical format. In a preferred embodiment of the invention, this information is displayed in the form a bar graph.

FIG. 7 illustrates a preferred embodiment of a screen display showing a schedule generated by the scheduling system of the invention. The current month and days of the month are shown along the x-axis in FIG. 7, and the various resources that are used in the manufacturing process are shown along the y-axis. Only those resources at which operations have been scheduled are included in the screen display. The time frame that is displayed on the computer screen may be varied. For example, the user may elect to display all operations scheduled during a one week period or, alternatively, an operations scheduled during a one month period.

A preferred embodiment of the scheduling system of the invention is capable of displaying more than one schedule on a single screen. Multiple schedules may be created by the system based on different resource

VISUAL *Manufacturing*[®] Functional Specification

capacity calendars defined by the user. For example, a first schedule could be created based upon the availability of three machine operators working in a particular shift, and a second schedule could be created based upon the availability of five machine operators in that shift. The scheduling advantage of this increase in machine operator capacity could be evaluated by displaying the first and second schedules on a computer screen simultaneously.

While a preferred embodiment of the invention has been disclosed in detail, it will be appreciated by those skilled in the art that other embodiments of the invention within the scope of the following claims may be developed based on the principles disclosed herein.

VISUAL *Manufacturing*[®] Functional Specification

7.2 Industry Standards

7.2.1 UPC/EAN/UCC/ALAG Bar Code Standards Functional Specification

The specification follows this page.

VISUAL *Manufacturing*[®] Functional Specification

7.3 Delta Functional Specifications

7.3.1 Automated Material Tracking System

The specification follows this page.

VISUAL/Automated Material Tracking System
Functional Specification

VISUAL/AMTS

Jim Pantas
Software Developer
1998
InfoLina Solutions
Lilly Software Associates

Proprietary and Confidential Information

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1.0 Introduction

This document is the Functional Specification for the VISUAL/Automated Material Tracking System (*VISUAL/AMTS*™). The VISUAL/AMTS software application and this Functional Specification are properties of Lilly Software Associates containing proprietary and confidential information about the VISUAL/AMTS.

VISUAL/AMTS Overview

VISUAL/AMTS is a sophisticated software application intended to support manufacturing and distribution companies manage materials through the use of barcode hardware.

VISUAL/AMTS is designed to operate with Lilly Software and Associates' VISUAL/Supply Chain™ ERP product suite, including VISUAL/Manufacturing and VISUAL/Distribution Center Management System (VISUAL/dcms).

General features supported by the VISUAL/AMTS are:

- Graphical User Interface (GUI) for label design and printing
- Simple DOS based reader applet for use on many different Barcode reader platforms
- ODBC Compliant connections to any and all databases
- Standard industry compliant labels and thermal label printers
- Completely customizable user interface for a variety of reader formats

The major functional areas of VISUAL/AMTS include:

- Purchase Receipt Entry
- Material Movement within Facilities
- Issue of Raw materials to Workorders
- Receipt of Finished Goods to Inventory
- Physical Inventory and Cycle Counting

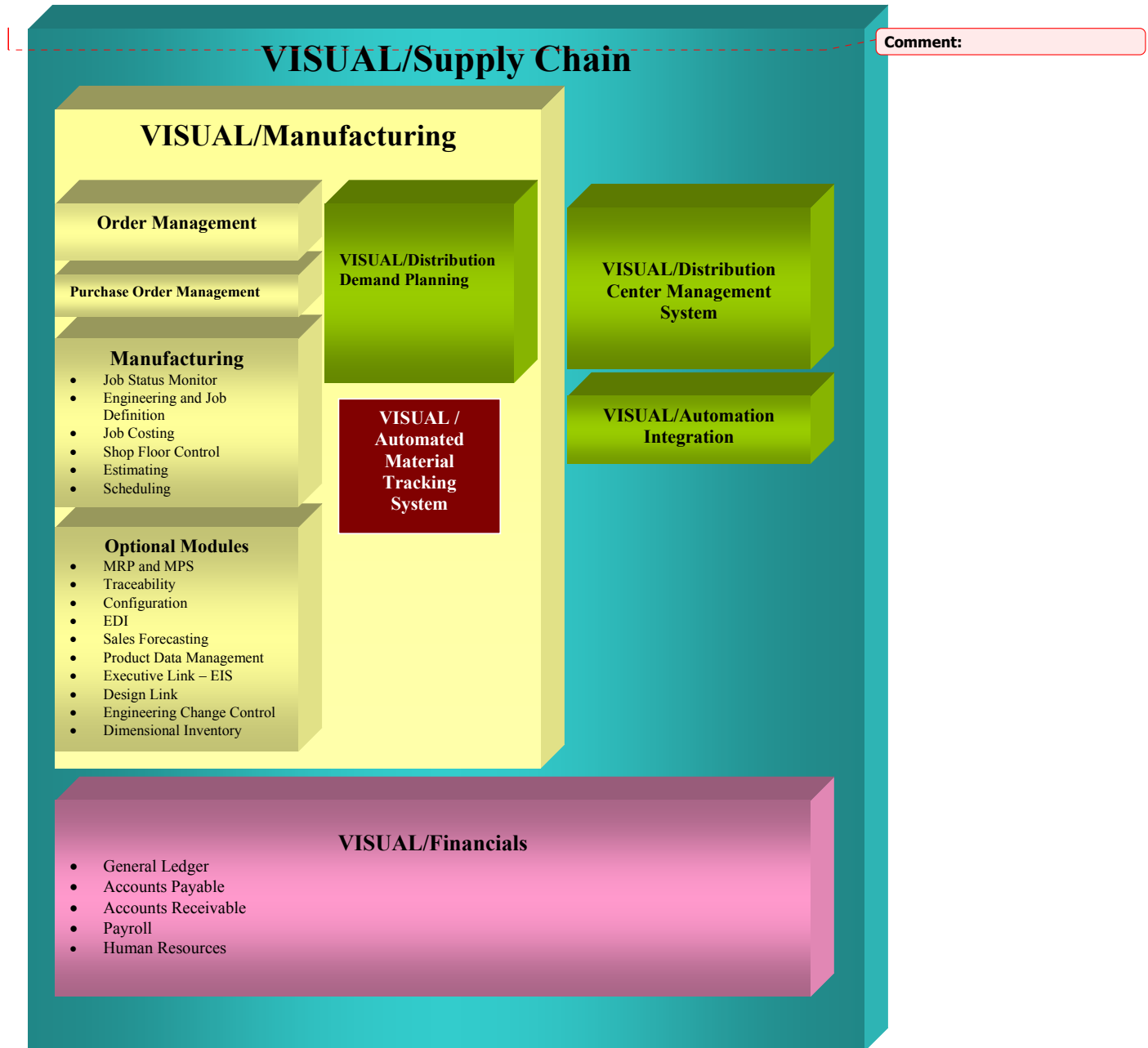
1.1 VISUAL/AMTS Product Evolution

VISUAL/AMTS development efforts are evolutionary in that the first release focusing on critical basic Material Movement and Tracking functions. The functions in and of themselves are purely barcode related; they lay the groundwork for future enhancements that make Lilly Software Associates' Barcoding and other high-tech, throughput enhancing interfaces distinctive in the marketplace.

1.2 VISUAL/AMTS™ within the Enterprise

The VISUAL/Automated Material Tracking System enables the enterprise to manage material movements and inventory position within their facilities utilizing the latest technologies.

The following is a schematic representing VISUAL/AMTS™ within the VISUAL/Supply Chain™ suite:



The figure clearly shows differing suites of applications, principally by color and or platform. However, VISUAL/AMTS is on the same platform as Visual Manufacturing, implying the functions are enterprise related, not execution related as is the Visual/dcms and Visual/ai applications. Further, VISUAL/AMTS typically would be used by Lilly Software Associates' clients with a strong distribution requirement. Therefore, VISUAL/AMTS is considered a part of the Visual/Distribution suite even though the application is integrated within Visual Manufacturing.

VISUAL/AMTS would always be used directly by warehouse operations personnel.

1.3 VISUAL/AMTS Scope

The four major functional capabilities of VISUAL/AMTS are:

- Basic Inventory Transactions
- Lot/Serial Traceability
- Physical Inventory / Cycle Counting
- Barcode Label printing

In addition to the above functional areas, interfaces (replication) with Visual/dcms and the integration of information within Visual/Manufacturing is of major consequence.

To the user, VISUAL/AMTS will appear as functions within the Visual/Manufacturing ERP application suite. Its mission is to interact with material handling personnel during daily operations, providing real-time inventory position(s) for forecasting/planning. Its basic functionality increases throughput of material handling personnel through the use of advanced barcoding technologies.

VISUAL/AMTS's item (SKU) availability data is closely maintained by the information processed using barcode readers. In doing so, the inventory dispositions within a company's supply chain reflect the actual SKU balances and activities of the distribution operations. This data is available in a real-time fashion through interfaces. Additional data interaction with VISUAL/AMTS includes shipping, and purchase receiving. These interactions are maintained through the relational database within the Visual Manufacturing® application.

2.0 VISUAL/AMTS Systems Overview

The following subsystems provide an overview of the VISUAL/AMTS functions.

2.1 AMTS-BI Basic Inventory Transactions

These transactions are for tracking basic material movement within a facility. They are the core of the VISUAL/AMTS system for real-time inventory tracking. This module allows tracking of inventory from the point that it enters a facility, through processing and out the shipping dock. These transactions can be used independently and can be restarted at will depending on the Visual Manufacturing Database server.

Odyssey Software's API-Fusion®

Central to this process is the inventory control table maintaining the on-hand available amounts by item #, warehouse and location. The inventory control table's on-hand values are maintained through interfaces with an ODBC application, Odyssey Software's API-Fusion ODBC Agent. In doing so, the values represented to the customer ordering the items are actual based upon facility operations personnel activities, not systemically derived through batch updates at a later time.

2.2 AMTS-LT Lot/Serial Traceability

All of the transactions within the VISUAL/AMTS-BI module have the ability to track Lot/Serial Traceability. Any item within Visual Manufacturing's® system which has been determined to be a Lot/Serial Traceable Item can be traced within VISUAL/AMTS. Only the items that have Lot/Traceability set, will scanning prompts appear for the appropriate Lot/Serial properties. Any required Lot/Serial

Traceability properties will be required scanning within VISUAL/AMTS to update the necessary properties.

2.3 AMTS-PC Physical Inventory / Cycle Counting

These transactions are similar in scope and provide the same interface for either one. The standard Visual Manufacturing® Physical Inventory window is used and the readers replace the data entry required to enter the counts of the inventory from the tags and/or sheets.

2.4 AMTS-LP Label Print Utility

This utility allows the user to design and define labels within specific categories. These categories allow the definitions to produce labels based on their usage and data requirements. The label categories are as follows:

- Raw Materials and/or Received Materials Labels
- Parts Labels
- Traceability Labels
- Finished Goods Labels
- Shipping Labels
- Warehouse/Location Labels

These categories allow for a structure to better determine the data sources as well as segmentation of the printing duties into their respective areas. Therefore, the scope of application interaction is between VISUAL/AMTS, and VISUAL/Manufacturing's Order Management, Work Order Management and Purchase Order Management Systems, and the VISUAL/Distribution Center Management System (VISUAL/dcms).

Loftware®

Loftware® is a label design and print utility for barcode thermal printers that is a cornerstone to the label print utility. Through the use of Loftware® we are able to shortcut the process of specific label designs and printer intricacies. Through the use of the ActiveX® control we are leveraging their printing abilities and setting the groundwork for future development using the Microsoft COM/DCOM techniques.

Label Matrix®

Label Matrix® is another barcode label print utility that provides an alternative to Loftware®. This utility however has fewer features than Loftware® and could be used as a low cost option. The technology involved requires less training of personnel and can be used with little or no special training.

3.0 Process Flow Charts

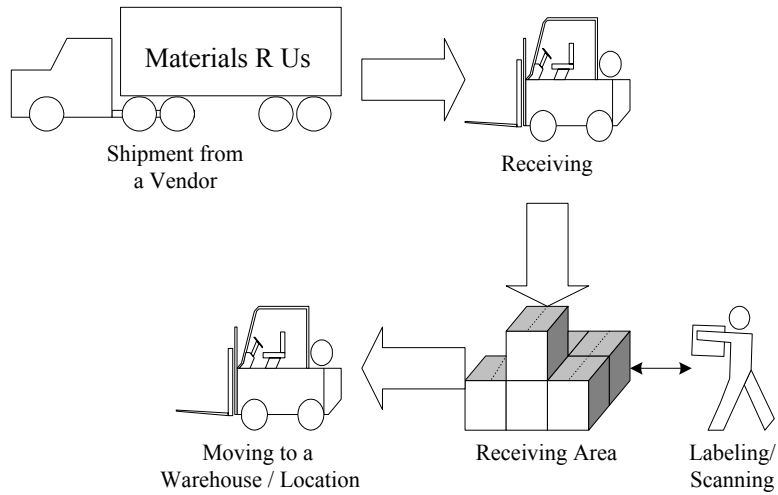
This section presents a high level flow of processes and information between Visual Manufacturing and the Visual/dcms products using the functions in VISUAL/AMTS.

The following process flow charts are:

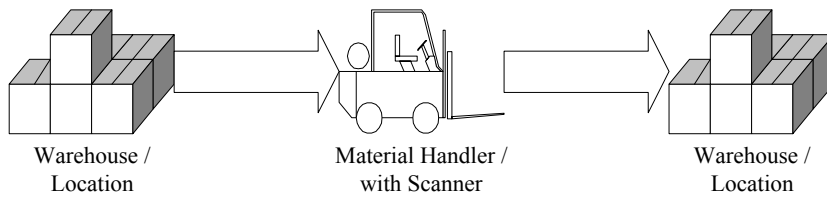
- Purchase Receipt Entry
- Material Movements
- Material Issue to a Work Order
- Receipt of Finished Goods from a Work Order
- Shipping Orders

Each of these is fundamentally critical to understanding the flow of materials within a facility.

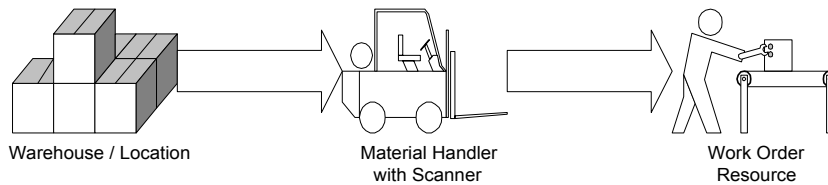
Purchase Receipt Entry



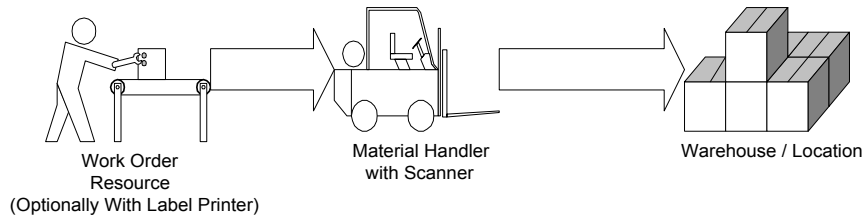
Material Movement



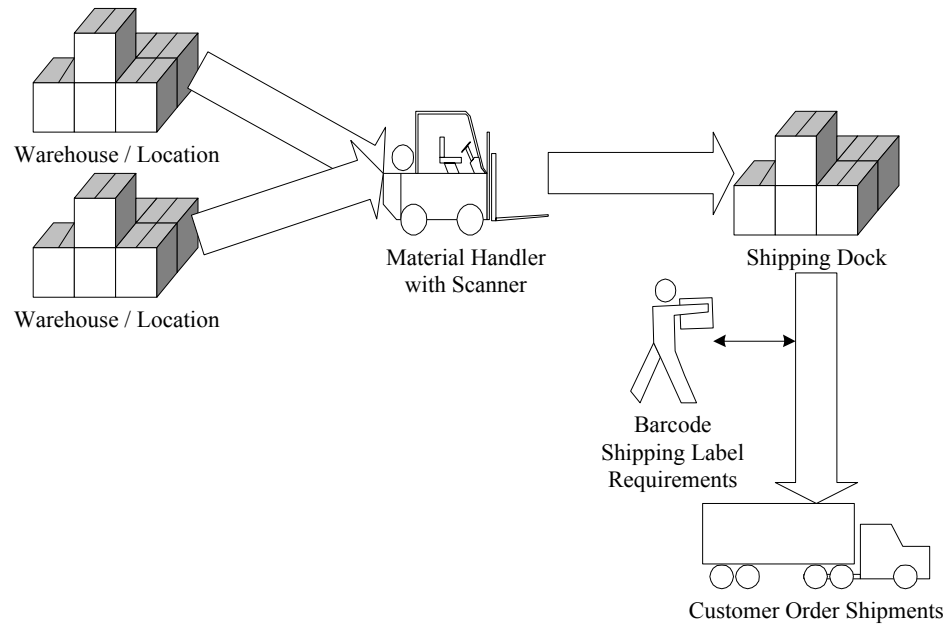
Issue to a Work Order



Receive Finished Goods to Inventory



Ship a Customer Order



4.0 Transaction Level Briefs

This section reviews the parameters and the transactions, logically grouped. While these transaction level briefs do not detail the systems screens and user interaction, they do specify the behavior of the transactions' functions.

4.1 Purchase Receipt Entry

The receipts of raw materials on a Purchase Order are a fundamental transaction that provides an excellent starting point for all the material barcode transactions. Any material correctly labeled can be easily received into the facility and the status of the Purchase Order is instantly updated. The flow of this transaction is to allow a materials handler to sufficiently receive materials and update the quantities of a purchase order from paperwork or the package labels.

The chain of events would be similar to the following:

- ☐ Material Arrives at the Dock
 - (Optional) Raw Material Labels are printed and applied to material
- ☐ Purchase Order is Determined and scanned
- ☐ Material is scanned to relieve Purchase Order
- ☐ Material is Located (and location is scanned)

Raw Material Labeling Requirements

In order for material to flow nicely through a facility, it should be sufficiently labeled with barcodes. These barcode labels vary in size shape and available information. There are however standard compliance labels that provide the necessary information. Visual/AMTS will need to interact with many label types and provide suitable means to receive materials via any of these various label types and scenarios.

4.2 Material Movement

For release 1.0 of VISUAL/AMTS, Material movement will consist of the following:

- ☐ Any Warehouse/Location to Any Warehouse/Location
 - Primary Warehouse/Location to Any Warehouse/Location
 - Any Warehouse/Location to Auto-Issue Warehouse/Location
 - Any Warehouse/Location to Inspection Warehouse/Location

Any Warehouse/Location to Any Warehouse/Location

This transaction will move material from any warehouse/location to any other warehouse/location. It is the core of the following transactions, which provides all the basic functionality of the AMTS-BI module.

Primary Warehouse/Location to Any Warehouse/Location

This transaction will move material from the Primary warehouse/location defined for the part to any other warehouse/location. It provides a shorthand method to move material with less scans required, as it will assume the From warehouse/location. It will prompt for a warehouse/location if there isn't a primary warehouse/location defined.

Any Warehouse/Location to Auto-Issue Warehouse/Location

This transaction will move material from any warehouse/location to the Auto-Issue warehouse/location defined for that part. It provides a shorthand method, which will require less scanning for the transaction. It will prompt for a warehouse/location if there isn't one defined as the Auto-issue Warehouse/Location in the part master.

Any Warehouse/Location to Inspection Warehouse/Location

This transaction will move material from any warehouse/location to the Inspection warehouse/location defined for that part. It provides a shorthand method, which will require less scanning for the transaction.

It will prompt for a warehouse/location if there isn't one defined as the Inspection Warehouse/Location in the part master.

4.3 Issue to a Work Order

Materials issued to Work Order(s) are a key element in relieving inventory. The Visual/AMTS system will allow instantaneous material positions in both inventory and work-in-process. This constant accurate material issues to workorders provide up-to-date information at all times.

The chain of events would be similar to the following:

- ☐ WorkOrder Pick List is printed
- ☐ Material is Located (and location is scanned)
- ☐ Material is moved to a production area
- ☐ Material is scanned to relieve Inventory and applied to Work Order

4.4 Finished Goods Receipt into Inventory

Finished Goods received into inventory from a Work Order can be easily tracked using Visual/AMTS. This method of tracking final production inventory provides instant inventory positions. As finished goods are scanned into inventory the status of the workorder is updated to show production throughput.

The chain of events would be similar to the following:

- ☐ Finished Goods Last Operation is performed
 - (optional) Finished Goods labels are printed
- ☐ Material is moved to a Warehouse/Location storage area
- ☐ Material is scanned to update Inventory and applied to Work Order Totals

Finished Goods Labels

Finished goods labels could be added as a part of the last operation. Once applied these labels provide the necessary information for scanning. They can be produced as a part of an operation or when other paperwork is produced for the work order.

4.5 Shipping Packlist Entry

The ability to ship goods from inventory can be tremendously improved through barcode scanning. Goods can be shipped to any order from any location and the final packlist printed within the standard Visual Manufacturing® Shipping Entry window.

The chain of events would be similar to the following:

- ☐ Pack List is printed
- ☐ Material is located within Warehouse/Location
 - (optional) Shipping labels are printed
- ☐ Material is placed on delivery system
- ☐ Material is scanned to update Inventory and applied to Shipping Totals for Customer Order

Shipping Labels

Shipping labels are useful for shipping transactions as well as providing compliance labeling for customers. These provide a method for tracking inventory as it leaves a facility.

4.6 Physical Inventory / Cycle Counting

Physical Inventory can be greatly facilitated through the use of barcodes. The standard Visual Manufacturing® windows provide an excellent method for locking inventory and printing the necessary paperwork for a Physical Inventory and/or Cycle Count.

VISUAL/Financials™

Functional Specification

Richard Carignan, CPA
Product Manager – Financials
Lilly Software Associates
1998

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1 - VISUAL Multi-Currency & The Euro

1.1 General Discussion

To handle the currency needs of our customers with an international focus is a challenge in its own right. When we add Euro complexity into the fold the difficulty becomes compounded. Euro creates an environment where companies need to be able to see themselves in two potential system currencies at the same time.

On January 1, 1999 the EMU will irrevocably set the exchange rates for all participating (see section 7 for the of member countries) countries. In fact they may go as far as irrevocably setting the exchange rates for the countries intending to become part of the EMU at some future date. These countries are identified in section 7 as well.

All transactions for EMU countries will need to be tracked in both currencies. EMU countries should have the ability to report in the Euro or the Native currency at the users choice. All amounts for conversion should be converted using 'Triangulation'. Consolidations should be able to roll up non-Euro financial statements into Euro statements and vice-versa.

One major challenge for Euro compliance is in the area of conversion and rounding. The EMU has established standards for conversion of EMU companies and what to do about rounding differences. These are covered in section 4.

The Madrid European Council mandated on how the world should view national currencies of the respective member countries. On January 1, 1999 for member countries their NATIONAL currency ceases to exist from a legal standpoint. These currencies will be allowed a phase out period to January 1, 2002 at which point they are no longer legal.

1.2 Contractual Considerations

Lilly Software Associates has made contractual considerations related to multi-currency aspects. Namely they have

1. We will be able to handle multi currency consolidations even if the account structures and numbers are not the same.
2. Need to be able to post to the G/L in more than one currency. Specific G/L accounts will be in specific currencies.

In addition the System should:

- 1) Currently the system works such that we have only one currency per vendor/customer. Need to be able to choose default currency for vendor/customer but allow transaction currency starting at the PO/CO level. Need to be able to define at the time of invoicing if no order is associated
- 2) We also want to be able to bypass system currency. We need to be able to convert a transaction directly from francs to lira. Of course the system currency record should be required as part of the posting entry.
- 3) Need the ability to purchase in one currency yet pay the invoice in another.
- 4) In Italy, a company has there own G/L accounts and structure, but when they report to the government, they need to use specific account ID labels and it may be possible that the account structure could be different. Need the ability to treat the same account ID as if it has multiple account ID's. For the mandated chart of accounts 'Plan De Contable' in France, Belgium, Italy and Columbia VISUAL needs to be able to produce financial statements in the mandated structure while the company mandated account structure is different.

- 5) In addition, VISUAL needs to have the ability to consolidate entities and databases with different account structures and of different system currencies
- 6) VISUAL needs to provide account code descriptions up to 120 characters in length. Some countries where Pyrotek does business require account descriptions of up to this length.

1.3 *Impact on Lilly Software (VISUAL Financials)*

At all costs Lilly Software Associates must be in compliance with the rounding and conversion rules for the Euro as set forth by the Madrid Council. Additionally we must be able to provide documentation when needed (sales opportunities and Compliance reviews), to discuss how we are going to manage the complete changeover from an enterprises national currency to the Euro (i.e. Euro replaces the national currency at the system level).

In order for VISUAL to handle the Euro aspects of that requirement we need to handle two concurrent transaction currencies during the phase in period.

What we do here is crucial to the long-term success of multi-currency within visual. I have tried to structure the enhancement in such a way that we will be positioned to adapt to future requirements with little reprogramming changes.

The other major area of impact to VISUAL is the ability to handle consolidations of databases with unlike currencies at the system level. The difficulty in consolidated reporting lies in converting accounts where historical balances prevail for accounts. Historical transactions require the reporting amount to be accumulated based on the original exchange rate when the transaction took place. In effect you need to track every transactions exchange rate to determine the historical value.

After considering all factors I believe the best approach is to allow the accumulation of a “reporting currency” value in each database, at the customers request. A reporting currency would allow us to trap “Reporting” currency transactions at their historical rate. Once we have the historical rate we can provide a facility (revaluation) to allow customers to revalue selected accounts to the “Current” rate. In addition the revaluation routines would be used to set account balances to reflect the appropriate values for “system” as well as “reporting” and “Euro” currency. Current currency accounts (i.e. Current Assets or Current Liabilities) should be adjusted to reflect the proper reporting/system/Euro value based on the spot rate supplied at the time of the revaluation.

Therefore, given to the two primary objects set forth above I believe VISUAL needs to have the ability to simultaneously hold transactional information for up to two transaction currencies rates (two currency requirement needed for Euro compliance).

Note: New customers with Euro concerns should be encouraged to set the system currency as the Euro and transact business in the national currency. This may prove to be difficult in some circumstance since customers may not have unit pricing to the Euro level and wish to change over at a later time when companies become more reliant on transactions in Euro units.

Every transaction must balance in transaction, system and reporting currency. We need to come up with a mechanism to ensure each transaction balances in each required currency.

A/R, A/P and Bank transactions need to store the transaction currency ID and the translated system value(s). If necessary those values will also need to be tracked in the required currency.

2 - Foreign Currency Reporting / Database Consolidation

2.1 *Reporting Foreign Operations*

FASB 52 and IAS 21 have issued specific instructions on how to report foreign operations (i.e. converting G/L's of different currencies into an organization's 'reporting currency'). Both governing bodies classify foreign operations into one of two types, 1) Foreign operations integral to the operations of the reporting entity or 2) Foreign operations which are not integral to the operations of a reporting entity.

The first type is the one VISUAL needs to be concerned with for the initial release. It basically deals with a company that has significant influence and/or control over the other. An example of such a relationship is where you have a Parent/Child relationship. The parent company can exercise significant control (if they choose to) over how the 'Child Company' conducts business.

The second type address the issue of where a company owns a significant investment in another company (i.e. owns a large share of a companies stock), but does not have any kind of influence over how that company conducts business. These types of relationships are such that the amount of investment in a foreign company determines the reporting method. The investment level determines whether an organization can report the investment as a component of a holding companies balance sheet (i.e. as a component of marketable securities) or must report their ratio of investment on a financial statement line item basis as part of their own financial statements.

For VISUAL we need to address both types of consolidations. However, the most important type to address first is the first type.

2.2 *Integral Foreign Operations*

Foreign operations integral to the operations of the reporting entity should be translated based on the premise that the transactions are substantially the transactions of the reporting entity itself. The requirements for translating the financial statements of such an operation are as follows:

1. Foreign currency monetary assets and liabilities should be reported using the closing (spot) rate. Any differences should be reported as income or expense in the period in which they arise. If the asset is a result of a net investment in a foreign operation then any exchange differences should be categorized as a separate component of Equity on the reporting entities financial statements.
2. Foreign currency non-monetary assets and liabilities should be reported at historical costs.
3. Foreign currency non-monetary assets and liabilities when carried at fair market values (e.g. property, plant and equipment under the allowed alternative treatment method (IAS 16) should be reported using the exchange rates when the FMV was determined. This treatment also extends to depreciation of PPE to which the alternative treatment method was applied.
4. All income and expense items should be translated at the dates of transactions. In practice, a rate that approximates the actual rate is used. For income and expense items this usually is an average rate based on month-end exchange rates. This does not apply to depreciation. Depreciation is translated at the original (purchase) exchange rate, or if carried at FMV the exchange rate that existed to determine the FMV.
5. Inventories should be translated at historical rates unless carried at lower of cost or market. If lower of cost or market then the rate applied to determine the LCM rate should apply. IAS 21 requires inventories of a foreign operation (who is an integral part of the reporting entity) be carried at LCM for reporting purposes. If the translation to the reporting entities financial statements would result in an adjustment lower than the current cost carried on books then it should be carried at the lower translation value, otherwise translate at the historical rate.

2.3 Consolidated Reporting

1. Need to be able to consolidate multiple databases for reporting purposes. At the same time we need the ability to revalue the appropriate accounts for restatement. Revalue prior to creating export file.
2. Ability to consolidate databases with unlike chart of accounts (Account groups)
3. Ability to record manual cash payments and receipts to cash with the offset to any account of my choosing (vendor, customer, misc. income, etc.)
4. Ability to apply cash to invoices at a later date. For both Customers and Vendors.
5. Consolidation should be capable of uploading system currencies. A revaluation routine should be able to handle the translation to reporting currency.
6. Each Entity should have a separate currency. All transactions are converted and held in that currency.

Chris and Darrin, I think we need to hold account currencies, entity currency and transaction currency. I believe the consolidation routine should be modified to upload a company's chart of accounts (automatically creating accounts one the upload list that are not on Consolidated database), by each tracking currency. Entities in a single database should be combined into the system currency for that database. Therefore each system currency would upload into its own entity, with its own chart of accounts. These entities can then be revalued to set the proper reporting values. Then reports can be generated. Short of this we would need the ability to report and revalue across multiple databases. This would probably require all databases to reside on the same machine.

2.4 Unlike Chart of Accounts

For now I think the current method of consolidation will need to be maintained. However, the consolidation entry should be based off a "Consolidated" account as opposed to the local account that could be quite different. If we had the ability to create a summary type of account which could represent the consolidated "Parent" account code as opposed to the local account and the user could base the consolidation entry off the value in these accounts that would be beneficial.

- ♦ The users would need to have the ability assign an account as a consolidated account. Assign local subordinate accounts to the "Parent / Consolidated" account code. And generate consolidated entries based on the consolidation account code.
- ♦ **One issue we need to correct is the size of the account descriptions. These need to be able to be 120 characters in length. This is required in France and Belgium.**

By addressing reporting currency at the G/L level the only thing we need to concern ourselves with here is the ability to:

- Modify the Import / Export to build a construction file in Reporting / Tracking currencies.
- When exporting, each tracking currency value should be included in the consolidation entry.
- Account currency for the ALL accounts
- Import facility should check for existing accounts in the consolidation database, add any accounts that are not there while at the same time produce a report on the accounts added during the sequence
- If possible for release 6.0, if we can enhance to the export facility to allow users to have the on to produce the export entry as it currently does or alternatively produce it based on period movement (net change) on the accounts in the general ledger. This would limit the consolidated transaction size to be imported to the consolidation database. The consolidation database does not have ties to specific entries in a subsidiary's database, only to balance movements. From my experience, for consolidation purposes larger organizations concern themselves with balance roll ups. They don't need detail backup for most accounts. Any accounts they wish additional backup for they would request as part of the consolidation package from the subsidiary. However, having said that since we currently offer the ability to

generate entries based on all the G/L transaction for the period I would be against removing this option until a later time if at all.

- Rounding issues must be taken into consideration. Rounding amounts should be automatically designated to the currency exchange gain/loss account as defined on the GL interface table.

2.5 *Beyond 6.0*

- Modify export facility to have a section for new accounts created during the period. For each new account added during the period record the Account ID, Description, Type and Parent Group ID. This would require a date/time stamp when an account is created.
- For a later release I would like to look at the ability to generate a consolidated journal posting from the period balance movements in the Account_Balance table. This would reduce the size of the import file for those customers who do not need details.

In future releases we may need to address additional functionality to the report writer for consolidated reporting.

3 - Euro Dollar Regulation

3.0 General

Due to foreign regulation it will now be necessary to report values in the European theater of operation in Euro currency units as well as an entities functional currency.

The Euro Currency changeover is to be completed over three phases. Upon the completion of phase three (January 2002) for all participating members there will be a single 'functional' currency. The three phases are as follows:

3.1 Phases To Euro Integration

- **Launch of EMU** Begins early 1998 and identifies the list of member countries who will participate in the European common community. At this time the ESCB – European System of Central Banks and the ECB – European Central Bank will be formed.
- **Start of EMU** Begins January 1, 1999 with a 3 year phase in period:
 - Fixing of conversion rates.
 - Euro becomes a currency in it's own right.
 - ECB conduct single monetary and exchange-rate policy in Euro.
 - Inter-bank, monetary, capital, and exchange markets in Euro.
 - Rules for Conversion to Euro as basis for conversion to National currency.
- **Single currency fully introduced**
 - Begins January 1, 2002 with a six month phase in period:
 - Euro notes and coins introduced.
 - Banks have completed the change (retail business payment system).
 - Only Euro is used
 - Notes & Coins denominated in national currency are withdrawn.
 - Public and private operators complete the change over.

Note: Since the changeover can span a multi-year process, Visual Financials needs to be enhanced to be a truly flexible multi-currency application. Lilly's lack of maturity in the area of multi-currency functionality gives us a competitive advantage to "Get it right" the first time. We are in a position to develop a multi-currency application with the flexibility to meet the currency and future needs of the users no matter what the change in currency may be.

We are faced with a pretty good challenge for the January 1999 compliance of conversion to national currencies as discussed below. The thing to keep in mind is this; The Euro currency will REPLACE the national currencies of member countries. This means at some future date we need to be in a position to, 'FLIP THE SWITCH' and make the Euro the 'system' currency.

As mentioned in the general statement at the beginning of the document VISUAL should for the Euro sake:

1. Irrevocably set the exchange rates for participating currencies.
2. Record transaction in dual currency the Euro and National currency units for companies operating in the participating counties.
3. Store and accumulate balance information in any "tracking" currency.
4. Track material currency movement through inventory and ultimately through the costing process. This result in a generally accepted method of recording historical currency values to Finished Goods and thus Cost of Goods Sold.

By doing the three things listed above I believe we will be in a position to support an easy transition to our customer base while at the same time providing them the ability to perform comparative reporting (history).

Tying this into the potential consolidated reporting needs of customers who have a reporting currency outside the Euro influence, we need to track up to three currency balance records. They will need one record for the Euro currency, one record for the NATIONAL currency and one for the PARENT currency.

Of course not all of our customers will need this level of functionality and as a result of the number of records being updated and the possible impact on performance should we have a special command (similar to enabling VAT functionality). This would set up the database to track three currency balance movements as well as dual transaction currency movements.

We need to assess the impact of allowing (n) reporting currencies. My concern is if we allow users to set (n) reporting currencies and this in turns creates a database that is so it is rendered useless, the users will blame us for along such and want support to fix it. In my opinion 2 reporting currencies with one system currency should be more than enough for any company. In addition we will probably need to set currency at the entity level. This level of currency will be needed when we go to multi-plant.

3.2 *Considerations for Lilly Software*

As part of a three year, phase in period we need to enhance the system to handle Euro currency. What separates Euro from the historical issues companies have been faced with in the past is the idea that the Euro currency will TAKE OVER as the normal currency of the entity, thus it is much more than a reporting issue.

In December 1995 the Madrid council laid down the foundation and guidelines for companies to handle transactions and to be able to report in Euro units. For accounting matters their recommendations addressed three primary areas starting January 1, 1999.

1. Accounting systems to handle the inclusion of the Euro.
2. Accounting systems have the ability to convert from Euro to NATIONAL and back during the phase in period. This would allow for audit ability over accounting information.
3. The NATIONAL currency becomes a sub-unit of the Euro currency. In other words all national currency values are deemed subordinate to the Euro for exchange purposes.

Over the three year period it is imperative that Lilly can explain to the market how we intend to become Euro compliant by the end of the phase in period. This is not intended to be an opportunity for delay in becoming a Euro financial system. However it does give us some time to implement Euro into the system.

I recommend we implement the Euro functionality in two primary phases with a follow up phase three for any fine tuning. The base enhancement incorporated into release 6.0, the second major part to coincide with release 7.0, with a follow up release 8.0. The details of the enhancements to the system proceed along these lines.

Other ongoing issues related to the Euro

- DUAL pricing in Euro
- Currency movements through Costing Utilities / Post Manufacturing Journals.
- Revaluation of accounts to apply spot rate or user input rate.
- Maintain balances for historical rate purpose
- Switch over routine to replace NATIONAL currency to Euro (currency maintenance)
- Financial and detail Reports producible in Euro currency
- Other regulatory issues as they come up.
- Continuing examination of Euro to the manufacturing process.

-
- Application of commission bookings to the G/L
 - Inventory movements (transfers), record proper currency values & conversions

4 - Handling a Euro Transaction

4.1 Currency Conversion & Rounding

As stated earlier we need to be sure each transaction balances in transaction currency. In addition all currency balance records created from a transaction need to balance in each currency.

When dealing with exchange rates one thing is for sure. Rounding issues will come into play. In case we are not already doing this; One possible way to handle rounding issues I have heard mentioned would be to accumulate a remainder from each transaction line, in each currency. Add any remainder amount to the following transaction line prior to rounding. Follow this process until the last line. The last line should be adjusted to balance the transaction. This should ensure the last transaction line on any one entry never be more than a cent. This process should be performed for each currency affecting a transaction. The down side of this method is that lines of equal value could have different currency values in the same currency (off by a penny). While the amounts will be immaterial it would look odd. The down side to this method is that it could make transaction line with the same transaction values show different converted values. Therefore we should not use this method.

I think a better way to handle the rounding issue is to add an extra column or field in the "Reset Exchange Rates" area. It should be used to display actual rounding differences to display converted line items at their *rounded* converted values while at the same time display transaction totals that agree to the exchange rate applied to the invoice. VISUAL should compare the sum of the lines by each currency necessary. Compare the sum of the lines by currency with the transaction total converted to each currency. The converted line items in sum should add up to the same value as if you took the transaction total, multiplied it by each currency exchange rate. If it doesn't the difference is a rounding difference which should be accounted for to derive the true converted values. For example take a look at the following transaction:

- **NLG transaction Invoice converted to Euro currency**

Assume ECU = 1, NLG = 2.17248

<u>Trans line</u>	<u>NLG Value</u>	<u>Euro Value</u>
Line 1	198.10	91.19
Line 2	198.10	91.19
Line 3	<u>198.10</u>	<u>91.19</u>
Trans. Total	792.40	364.76
	792.40/2.17248	364.74

As you can see by rounding at the line level the transaction totals no longer agree with the conversion rate applied to the transaction in total. While the amount appears immaterial the transaction the re-conversion does not support the actual exchange rate applied to the transaction. This is not acceptable. The lines of the transaction should round properly from the exchange rate applied, as well should the summed transaction totals. I believe the best way to handle this is through the addition of a "rounding" line on necessary transactions. The rounding line should automatically default to a user defined accumulated rounding account on the income statement.

Under the Madrid Councils regulations for translating to the Euro we need to be able to treat the EURO as the system currency. From there we need to produce values in any other national currency or foreign currency. The major requirement set forth for determining the Euro value is that it is derived through a division calculation not multiplication. In addition for all other translations we need to adhere to the rules of conservatism, which equates to using the exchange rate which would result in the lower value. In other words countries with a very low currency equivalent to other countries (Lira, Rupee, etc.) need to use either the Sell rate or the Buy rate, which ever is lower (if Lira = the system currency then use 1 S => F, if not use 1 F => S).

Note: As long as VISUAL takes currency translations using the Sell (1 S => F) rate to the necessary number of decimals depending of the size of the exchange rate the sell rate will result in a conversion which would approximately equate to the Buy?? (1 F => S) rate (needed for extremely weak currencies).

4.2 Conversion Rule

On January 1, 1999 the EMU will set an irrevocable currency rate against the EUR for all participating countries. Those countries and their anticipated irrevocable rates are:

Austria	13.9119	Ireland	0.796244
Belgium	40.7844	Italy	1957.61
Denmark*	7.545257	Luxembourg	N/A
Finland 6.01125	Portugal	202.692	
France	6.3186	Spain	168.220
Germany	1.97738	Sweden*	NA
Netherlands	2.22799	UK*	0.653644

* These countries have agreed to hold referendums to join the EMU in the future. It is quite conceivable that these countries could join at a later time but in the interim decide to have a permanently fixed conversion rate between there local currency and the EUR.

Euro conversion dictates we first translate a transaction currency to the Euro then the National (Local) as well as every other currency. Another mandate is to convert to the Euro value as if the EUR was the base (system) currency.

When translating currencies like the LIRA or Rupee to a stronger system currency unit, which deal in the thousands of units to one system unit, we need to ensure the proper calculations of reciprocal rates for each currency. This is discussed in greater detail in section 7 – Exchange Rate Maintenance.

4.3 Currency Exchange Rate Headings

1System => Foreign expresses what one system unit equates to the number of foreign units.

1Foreign => System expresses what one foreign unit equates to the number of system units.

For the participating countries the EUR currency will effectively replace the National currencies even though the National currencies will continue to exist in reality. On January 1, 1999 the EMU will irrevocably set the exchange rates of all member national to the EUR. This value will be expressed in terms of One EUR unit to its national relative. This must be handled through exchange rate maintenance, and thus the currency conversion routines should follow the current calculation except it needs to handle it for multiple currencies on a single transaction.

Formula for translations to Euro using the Sell (1 System => Foreign) Rate:

- First derive the Euro value:
 - ❖ “Transaction Value / Transaction currency to System (EUR) conversion rate (carry to 4 decimal place)
- For all other conversions:
 - ❖ System (Euro) Value (three decimal places) * “Other” currency rate to EUR rate.

This calculation needs to happen for each currency record to be posted to the G/L.

For example:

Convert 2,500,000 French Francs to German Marks using triangulation

Trans Currency = 2,500,000 FFR, convert to EUR

Convert to Euro (EUR) value:

$$\begin{aligned} &= \frac{2,500,000}{6.63186} \\ &= 376,968.1507 \text{ EUR} \end{aligned}$$

Convert to DEM:

$$\begin{aligned} &= 376,968.1507 * 1.97738 \\ &= 745,409.2819 \text{ round to be } 745,409.28 \end{aligned}$$

5 – Application Global Maintenance

5.1 *Dual Currency Transactions*

Some countries will need to be Euro compliant. This means that all transactions will need to be tracked in at least 2 currencies for our current customers operating in a country covered by the ECC. For those customers operating in countries who have agreed to become members of the Euro community the Euro currency code and all Euro transaction will become the system currency and the national (currently existing) currency will cease to exist.

To facilitate the transition to Euro all transactions that post to the system need to post in both system and Euro currency.

5.2 *Tracking Currency Balances*

Ability to establish “Tracking” and Euro currency for a database. On the General TAB expand the Financials section to include:

- Invoke Reporting Currency (perhaps a Boolean option), if set have a field activate to enter the reporting Currency ID. Validate against currency ID in the system.
- Invoke Euro designation (perhaps a Boolean option), if set have a field activate to enter the Euro Currency ID. Validate against currency ID in the system.

5.3 *Application Global Settings*

Application global settings for the application of exchange rate date. Currently regulations among accounting boards differ on the application of the exchange rate to use for posting transactions to the system. In some countries it is acceptable to use the system date as VISUAL currently does. In other countries the local government can dictate an acceptable means for applying exchange rates on a particular date, while accounting bodies (GAAP and IAS) require the transaction date to apply the appropriate rate. In either case the application must be consistently applied on an ongoing basis with respect to the operating environment in which the company does business. To handle the variations in the rate application by date VISUAL needs to have a switch to set an "Exchange Translation Date" at the 'Entity' level. The choices that should be available to determine the exchange rate to use are:

- System Date
- Transaction Date
- Posting Date

This should be a one-time choice (i.e. like costing method) per entity. Once the choice is made and a transaction hits the system the field should be disabled.

5.4 *Maintain Multiple Balances*

Need to hold 'System' and if activated 'Euro' and 'Reporting' currencies with the ability to accumulate period balances by currency.

5.5 *Global Currency Write-off Accounts*

Establish fields for the identification of two Global accounts for currency write amounts. One field will identify the exchange 'Gain' account and the other will identify the exchange "Loss" account. Perhaps have an option under the 'Edit' menu to set the global accounts.

6 - Exchange Gain/Loss Account Overrides

6.0 General Discussion

By addressing the ability to handle currency transactions we need to provide the flexibility to allow customers to designate exchange gain/loss accounts. This functionality needs to be to the level of which currency the write off occurred in (i.e. exchange gain/loss tracking by currency). If we could take this to the point of having the choice to segregate gains transactions from loss transactions if need be would be ideal. If we need to this could wait for version 7.0.

If providing functionality to the level of different exchange gain / loss accounts in each respective area would add significantly to the programming effort and thus effect other functionality getting pushed back we need to discuss the level of importance, for this particular release, all areas and set priority over each.

There are three primary areas where currency exchange gains / losses hit the system.

1. Write-offs from cash application
2. Write-offs from Check Generation and Print
3. Write-offs from revaluation

In order to achieve this goal I see us needing to modify the system in two areas.

6.1 Global Setting (see also application global)

Provide a global designation to set the accounts used for Currency Exchange Gains/losses. Perhaps we could set this under VISUAL Financials - Application Global maintenance. If we could do something like have an option under the 'Edit' menu called "Exchange Gain/Loss Override" would be great.

If these fields are left blank, G/L interface account for Exchange Gain/Loss prevails.

6.2 Write-off's By Currency ID

On each Currency ID under currency maintenance provide a setting for the exchange gain/loss account to use for that currency. If we provide the functionality of having separate accounts for gains and losses then two fields should be provided, one for each.

If these fields are left blank check VISUAL Financials – Application Global for accounts to use.

6.3 Revaluation

Revaluation routines will need to be able to earmark currency exchange gain/loss account(s) to post write off amounts too. Discussed further in the section on Currency Revaluation.

7 - Exchange Rate Maintenance

7.0 General Discussion

For the participating countries the EUR currency will effectively replace the National currencies even though each National currencies will continue to exist in reality. On January 1, 1999 the EMU will irrevocably set the exchange rates of all member national to the EUR. This value will be expressed in terms of One EUR unit to its national relative. This must be handled through exchange rate maintenance, and thus the currency conversion routines should follow the current calculation except it needs to handle it for multiple currencies on a single transaction.

7.1 ISO code and Euro Symbol

The ISO 4217 Maintenance Agency has adopted the currency code **EUR** for the Euro. Furthermore, the European commission has created a symbol for the Euro that looks something like:



Microsoft has allocated a place for the Euro symbol in its DOS tables, etc. The Euro has been made part of the core fonts (Times, Arial, etc) of Windows 95 and NT. UNICODE has proposed OxZOAC as the two-byte code for the Euro. Microsoft will be allocating a keyboard position for the Euro symbol and other keyboards will be able to show the symbol activated by AltGR E (taken from the BASDA white paper discussing the changeover to the Euro).

7.2 Exchange Rate Column Heading

- Rename the Exchange rate columns. Exchange Sell Rate should read Sell Rate 1 S => F and the Exchange Buy Rate should read 1 F => S. This format would be consistent with the manner in which exchanges publish exchange rates.
- Create an addition field for each currency to record ISO codes or alternatively set validation over the ISO code as the currency ID. Having an additional field would be ideal for current customers who have created currency codes, which are not in the ISO standard or may wish to use something different than the ISO standard.

7.3 Euro Conversion Issue.

For companies that operate in the Euro country all currency transactions which are not denominated in Euro must first be converted to the Euro value (by dividing to derive the Euro amount) and then multiply to get the national currency(ies) value.

On January 1, 1999 the EMU will irrevocably set the exchange rates for all EMU countries. What this means is that the exchange rate will be permanently set with respect to each country that is a member of the EMU. In other words the rates between these currencies will be set with a one-time exchange rate. Therefore VISUAL needs to be able to set the exchange rate for the National (potentially System) currency on a one- time basis.

If an organization elects to designate the System as an EMU country system, the program should mandate the creation of the EUR currency and the exchange rate should be set to 1.0. In addition the system should force the exchange rate on the “replaced system currency” (assuming the system currency corresponds to one of the participating EMU countries). If not the user should be required to enter the exchange rates in the other EMU country currencies.

Summarize:

If it is decided the system is to change to an EMU system then,

1. Euro holds as a unit of 1, and thus effectively becomes the system currency for these databases.

2. Legacy National (functional) currency will require the irrevocable exchange rate to be set for each of the currencies identified below:

Ireland	Germany
Portugal	Belgium
Finland	Austria
Spain	France
Italy	Greece
Netherlands	Sweden**
Denmark**	UK**

3. Exchange rates (except for ** above) should not except rates dated past 1/1/1999.
4. Once the 1/1/1999 rate set, rate maintenance should not be allowed.

**** Countries intend to join at a later time. However, their exchange rates could very well be irrevocable set prior to the country joining the EMU.**

Once the rates have been set for systems that need to change over to the Euro, currency maintenance should be removed for those currencies. The rates between the Euro and these national countries should never change. In addition, the system must not allow the exchange rates between member currencies as well as the EUR to be changed during transaction input.

Exchange rates for those member currencies that are part of the EMU (single currency) community once set at the irrevocable exchange rate should not be allowed modification past the date 1/1/99. The rate is critical and the administrator should be able to set the currency in such a way as to not allow the exchange rate to be modified (like we currently handle the system currency. Allowing users the ability to mistakenly change an exchange rate in one of the participating currencies could have disastrous affects.

In other words the user will need the ability affect the exchange rate of the system currency if the user sets the option to be EMU. The system should provide a way of assigning the currency as an "Irrevocably Set" exchange rate currency. Of course we must make a distinction between tracking EMU as a currency and being becoming an EMU system. While some customers may need to track Euro currency, they may not need to become and EMU system.

For those user that need to become an EMU system we need to allow them to change the National (system) currency rate to the irrevocable exchange rate set by the EMU. This rate will no longer be the main currency unit, the EUR will. Therefore the EUR should be expresses as a unit of 1 with all other currencies becoming measurements against the EUR rate.

Note: Not all countries are expected to join the EMU single currency zone immediately. Therefore these customers will need to be able to set the system as EURO at some point in the future. Once this happens the EUR will effectively become the system currency unit at which all other currencies are measured against including to old National (system) currency. In fact if the system is set to be EURO then the EUR currency should become the system currency and the irrevocable exchange rate in each of the member currencies should be required if they exist or are subsequently created. Once the irrevocable exchange rates are set for the member country currencies users should not be allowed to make allow any further modifications to the member country currency rates.

7.4 Force Reciprocal

The system must force the reciprocal exchange rate in all cases. The buy and sell rate should be eliminated in the system. Unless the organization open buys and sell currency (banking institution) all exchange rates are expressed in the sell rate. As mentioned above the sell rate can be expressed in one of two ways. One national unit to foreign (1S => F as I call it) or one foreign unit to National (1F => S). Depending on which expression the user enters the system should automatically express the reciprocal.

When translating currencies like the LIRA or Rupee to a stronger system currency unit, which deal in the thousands of units to one system unit, we need to ensure the reciprocal exchange rate is properly calculated. For example; assume you are a company located in Turkey. The Turkish Lira has an exchange rate of .00000228056 UK Pounds to 1 Turkish Lira, or alternatively 1 Turkish Lira is equal to 438,489 UK Pounds.

When calculating the reciprocal rate there is a simple set of rules that must be observed:

- If the reciprocal rate equates to a value greater than or equal to 1,000 units of the system currency then the reciprocal rate is held in whole unit values (no decimals).
- If the reciprocal rate equates to a value less than 1,000 units but greater than or equal to 100 units the rate should be rounded to the nearest 2 decimal places.
- If the reciprocal rate equates to a value less than 100 units but greater than or equal to 10 units the rate should be rounded to the nearest 3 decimal places.
- If the reciprocal rate equates to a value less than 10 units the rate should be rounded to the proper value according to the calculation (i.e. 3.81301E-06 would round to .000003813) but not less than 4 decimal places.

7.5 *Require legacy National rate update prior to transacting business for the day.*

Since the Euro will be considered the “System” currency for all intensive purposes it should be mandatory to add the irrevocable exchange rates for participating countries in the system prior to transactions being processed past the point where the EMU designation is set in the database.

There should be a check on the system, not allow transaction processing until the member nations currency rate have been input into the system

7.6 *Which Exchange Rate Should I Use*

As was mentioned in the beginning of this section some counties have an extremely weak currency. For example Italy has an exchange rate of 3000+ Lira to one Dollar. Its even more than that against the UK Pound. One issue VISUAL must do is equate the inverse rates far enough so using the 1 S => F currency rate in those countries with weak currencies will effectively render the same value as if they had used the 1 F => S rate.

For example:

On the exchange for Tuesday June 23, 1998 the exchange held the Lira as

8 - Receivable Transactions: Orders, Invoices & Payments

8.0 *A/R Brief*

The idea with respect to taking customer orders invoicing and taking payments is to be able to handle this in any currency. Orders, Invoices and payments should be allowed to happen in any currency with any customer. It would be ideal for an order to be taken in one currency, the invoice created in another and the payment yet still in another currency.

With respect to the order the order currency would be changed prior to the creation of the invoice. Subsequent payments on open invoices should be allowed in any currency. The system needs to simply convert the payment currency values into the customers account currency (derived from the system (Euro) value) and perform the necessary write off of exchange gain/loss based on the movement in the exchange rate.

This really is just a question of converting first to the “base” (system) currency value (Euro if EMU country) then derive the “national”, “account” “Entity”, and “tracking” currency value(s). Compare the exchange rates posted on the original invoice (for system and account currency) to the ones posted on the cash receipt. Any difference between the two will generate a transaction gain/loss.

These types of transaction gains or losses are written off to the exchange rate gain/loss account(s) held in the income statement. For each currency

8.1 *Tracking Currencies, recording Gains & Losses*

In VISUAL when we talk about “Tracking” currencies we are talking about storing currency values for reporting purposes. These reporting values will need to be adjusted to report the proper values for reporting purposes. Exchange rate gains and losses for each reporting currency should be handled at the time of comparing the invoice to the payment.

Depending upon the difficulty of generating write off values at the time of cash application we could (for the short term) simply record the movement of invoice values for “tracking” currencies (outside of System, Euro and National) and use the revaluation routines at month end to adjust the reporting currencies. The revaluation routines need to be run at the end of the month regardless so the balances reported are done so on a month end basis. It is quite conceivable that customers will want to differentiate between gains and losses derived at the invoice level as opposed to those generated because of revaluation. In those instances the user would want to generate write-offs for each currency at the time to cash application. For now, if it saves time we can simply record the currency values for the “tracking” currencies and use the month end revaluation routines to adjust the appropriate “tracking” currency values.

8.2 *Language Considerations*

With the ability to record customer orders and invoices in different currencies, we must assume all orders and invoices as well as acknowledgements and statements should be produced in the default currency of the Customer. Of course the option to produce these reports in system currency should always be a realistic consideration. For the most part I believe customers will wish to view correspondence from the manufacturer in the customers native currency.

VISUAL needs the ability to produce the following reports in the Customers default A/R currency:

Customer Order
Acknowledgement
Customer Invoice & Credit Memo
Statements & Dunning Letters

8.3 *Transaction Currency*

We need to create additional fields to track historical currency values in every currency required as identified in application global maintenance.

Need to modify the system to store a Euro transaction rate if required. If the Euro is invoked (setting in application global) then the Euro rate is the rate basis for all other conversions. Thus we need to store it on the each invoice transaction. We have to be able to show we are compliant with the conversion process set forth by the Madrid Council.

Under 'Order Exchange Rates' I need to see each currency value displayed with the ability to select each one. This should be done on the 'Order Exchange Rate' screen.

8.4 *Revaluation*

The revaluation routines discussed below require a comparison from the original posted transaction value. I believe the current format in the tables Receivable and Receivable_Line table could provide a clear comparison to determine the necessity of a currency adjustment so long as we can equate to the original Euro. As discussed earlier all currency translations must originate their values from the Euro, not vice versa, if the entity is located in a Euro environment.

Note: Accounts receivable needs to be accumulated and stored on the general ledger in both system, reporting and Euro currency. This means we have a need to be able to derive the original G/L posting in the proper currency values.

We could submit a revaluation routing to adjust a balance without affecting the transaction file, since revaluation should affect only customer balances and not the underlying transaction. At month end when all revaluation routines are complete. One should be able to run an aging, designate a currency ID and an exchange rate/date (month end), and the system should produce a report that ties out to the G/L A/R balance in any currency.

8.5 *Aging Reports*

We need to be able to produce reports (aging) with the ability to apply a spot rate to the report, and convert the total customer balances to what is stored on the General ledger in any currency. Each month we need to perform revaluation against the account to adjust the value held on the G/L for accounts denominated in other than system currency.

8.6 *Advanced Inquiry*

We need an on-line facility where one can see customer balance information presentation with drill down capability to every transaction (invoice, credit memo, cash applied, adjustment and revaluation) affecting a customer's balance. I envision the facility to be something like the functionality associated with Utopia's inquiry windows. This is explained in more detail in section 11 – On-line Inquiry for Subsidiary Information.

9 - Customer Orders

9.0 *General Viewpoint*

From a currency point of view, unless the currency value is physically set on the order we don't need to address currency rates for more than we do now. If the rates are not set the only thing we need to concern ourselves with here is the need to be able to convert the transaction currency to the System / (Euro) currency.

The translation date as set in application global will control what currency values/rates are stored in the system. This is covered more in invoice entry.

All orders processed should default to the Customers Currency as it currently does.

Given the scenario outlined so far we need to do the following:

9.1 *Transaction Currency Override*

Be able to override the Customers currency on a customer order transaction to any currency listed on the currency file, thus record transaction currency. Ideally we should try to find a spot on the main order form where a user can select the currency. Would there be room to place it under the Original Promise Date Field. The currency field should be labeled 'Order Currency' with an adjacent field to supply the transaction currency.

9.2 *Hold Euro Rate*

Store the Euro currency rate applied to a transaction.

9.3 *Order Exchange Rate Modification*

Under 'Order Exchange Rates' exchange rates should be based on the transaction currency to the system currency. If they attempt to set the rates we need to have the following happen.

9.3.1 *Order Exchange Rates*

Under 'Edit'/'Order Exchange Rates' when I select an 'as of date' the rates in effect on that day should populate the exchange rate fields. **Is there a particular reason it doesn't do this now?**

9.3.2 *Exchange Rates Not Physically Set*

If the exchange rates are not physically set on the order, then the current way we are handling the rate application is fine.

9.3.3 *Enhance Display*

Need to add another set of fields so the display shows both the system and converted Euro values. Can you keep each group of currency fields together? Would be good from Euro compliance perspective.

9.3.4 *Currency ID Column*

Add column to each Order Exchange Rates display set denoting the currency ID. Would like to see the currency ID display to the right of the invoice total column for that currency set.

9.4 *Print Customer Order*

Customer orders should be able to be produced in Order, Customer, System or Euro currency.

9.5 *Customer History Reports*

Need to identify the transaction currency. Report should display converted values (option) in Customer or system, reporting currency or Euro.

9.6 *Revenue Account Lookup*

During Order Entry I double clicked the '<Revenue Account>' label and got a screen showing all the accounts. The user friendliness of the system would be enhanced if the user got back only posting <Revenue Accounts>.

10 - Receivable Invoicing / Memos

10.0 General Discussion

Proper invoicing is critical to the long-term success of VISUAL. When dealing with invoicing we must make sure that the subsidiary ledger, (AR & AP accounts) always tie to their respective general ledger control accounts. Any time a subsidiary account is updated the corresponding control account must be updated for each respective currency balance needing to be recorded. Likewise, if there is an attempt to update a control account, there must be a required entry in the corresponding subsidiary account.

10.1 Invoice Forms

As I mentioned in Application Global maintenance the “date of translation” setting in application global will control when to apply exchange rate(s). This is the case unless the rates were physically set at an order level. It appears we have the date issue covered from the invoice forms functionality. For those orders where the currency was set we should capture all other currency rates/values necessary at that point in time.

10.2 Customer invoice Entry

Invoices generated from manufacturing need to come over with the appropriate date applied during the invoice form generation process. Which works fine.

Posting of invoices for currency translation need to be in accordance with the date for translation as set in Application Global.

10.2.1 Setting Transaction Currency

Ability to set a transaction currency, for invoices without orders. Ideally have the transaction currency selectable (combo box) from the Customer Order screen, where the currency displays currently (just below the ‘printed’ field). Have the currency display below the combo box.

Since we are enhancing VISUAL Financials to allow for transaction currency it makes a lot of sense to place a currency ID field on the order form. I’m not concerned with the currency description appearing but the Currency ID field should. If we are going to allow customers to modify the transaction currency they should be able to select it from the main form.

The Currency ID field should default to a customer’s currency code.

Currency ID field passed with a customer’s order should be inactive, yet displayed on the main form.

10.2.2 Setting Exchange Rates

Under ‘Order Exchange Rates’ exchange rates should be based on the transaction currency to the system currency. If they attempt to set the rates we need to have the following happen:

- If the exchange rates are not physically set on the order, then the current way we are handling the rate application is fine.
- Enhance display to add another set of fields so the display shows both the system and converted Euro values. Can you keep each group of currency fields together? Would be good from Euro compliance perspective.
- Add column to each “currency display set” denoting the currency ID of the set. Would like to see the currency ID field display to the right of its respective invoice total column.

- Under 'reset exchange rates' when I change the 'As of Date' could the rates populate the new rate and invoice total without having to specifically apply the current rates. Ease of use option.

10.2.3 *Reset Exchange Rates on Posted Transactions*

With the advent of revaluation we must remove the ability to manipulate exchange rates on "posted" transactions. Up to the time a transaction is posted to the general ledger we should not need to care about any modifications to it. However, once the transaction is posted to the general ledger no further modifications should be allowed without a corresponding audit record being recorded and called up on demand to see the nature of any change to a posted transaction.

Combining this with the on-line inquiry facility discussed above this window should be limited to viewing currency information related to the specific transaction being viewed. The on-line inquiry window should be able to display

10.3 *Detail Report Modifications*

10.3.1 *Display Transaction Currency*

Detail aging reports have the ability to display transaction currency (ISO code) on the line of the value. The report heading should label the column 'Transaction Currency'. Perhaps between the invoice date and the first aging bucket print the transaction currency. This will allow the user to easily determine the transaction currency. Receivable or Receivable_Line, etc. should hold the currency ID somewhere.

10.3.2 *Detail Aging Report in Transaction Currency*

On the Print Age Receivable selection form, in the display area need to have a setting for transaction currency.

10.3.3 *Customer History Report*

Modify the customer history report to convert amounts to Customer and Euro (if applicable) currencies. As well have two columns added. A column for the transaction value and another column for the transaction currency. One thought might be to create additional data items to choose from in quest for transaction value, Euro amount and Reporting value in addition to system currency value.

10.3.4 *Customer Statements*

By allowing transaction currency we would need to modify the Customer Statement report to allow the report to be modified to display the transaction currency and converted customer's currency if so desired. Perhaps this could be a field available in quest while modifying a .qrp report.

10.3.5 *Print G/L Transactions*

This report needs to be produced in system, reporting and Euro currency. Since consolidated reports need to be done on a reporting basis we need to pull the reporting value. This value should be determined from the exchange rates held on the table.

10.3.6 *Aging That Ties to G/L Summary*

Need to be able to see an aging, which ties to the reporting value. If the reporting values are stored at historical, revaluation and reporting aging should tie nicely together.

10.4 *Multiple Invoice Generation*

As a side issue can we add the ability to select multiple invoices for generation through invoice forms. Simply allow the user to highlight the ones they want to print (similar) in functionality to 'Print one invoice'. I have had a number of different people ask me (mainly from support) about this function possibility.

10.5 *Posting Invoices to the G/L*

When the user selects to 'Post to General Ledger' we need to make sure we record all necessary transaction currency balances as described in the section on Handling Euro or Parent Reporting.

11 – On-line Inquiry for Subsidiary Information

11.0 General Discussion

To ensure the functional richness of the system it is imperative to incorporate an on-line browse for subsidiary account information. The browse (see Utopia inquiry screens) functionality should allow for summary to transaction drill down capability. The initial view should display a listing of all customers with their corresponding currency balances and the currency of the balance. Further more the users should be able to limit the display to a particular currency (system, account, entity, tracking or transaction currency) in a similar fashion to the “payment generation and print” window. Each corresponding balance should be displayed on the window which ties to the supporting balance held for each respective currency on the GL control account. The user should be able to switch to the currency balance on the initial display. The user should be able to drill down into a specific customer balance and see the supporting detail making up the balance in an aging format. From the aging display there should be the ability to drill down into any of the aging buckets and see the transactions that make up the corresponding balance. While looking at transaction details one should initially see the transaction date, time, and currency code (converted to account currency) with the ability to switch between currencies (account, system, entity & tracking & transaction) with the ability to allow users to customize their own displays.

Users should have an option to look up payment details so they can easily see the payments applied to invoices. The on-line inquiry window should also be able to view existing orders, various credit statuses, each transactions type (invoice, credit memo, unapplied cash memo) as well as the status (open, paid, partially paid) with a balance due column tying out to a total balance due in each respective currency. As mentioned above Utopia has created an online inquiry window that incorporates much of this. Their facility is nice but does not contain all the views necessary for multi-currency. We need to beef it up to correspond to the above discussion. As soon as I get their inquiry screen up and running I will address the additional functionality needed to incorporated the multi-currency concerns.

11.1 Transactions affecting an aging report

With the on-line aging view it can be a little tricky given the types of transactions posted to an account. The on-line browse should always incorporate invoice, memo, and payment (either applied or unapplied). The tricky part s where you incorporate revaluation transactions. These transactions never show up on an aging report, however, they do affect aging balances. When you adjust a customers balance because there are transaction currencies outside of the customers currency the balance displayed on the aging for each currency should tie out to the balance supported on the general ledger. If a user writes a report to gather up each currency balance in total the value must tie out to the general ledgers balance held for each respective currency (if applicable). There may be a couple different ways of handling this:

- One way of might be to hold revaluation adjustments against each ‘open’ transaction for each currency balance required.
- Another way would be to post revaluation entries against each customers account adjusting each respective currency balance.
- There may be other ways to handle this, I am open to suggestions.

In either case the online inquiry should support the balances held at the GL level.

11.2 Bank Accounts

The manner in which bank balances are handled by VISUAL effectively makes them an extension of subsidiary reporting. While bank transactions & balances are held in different currencies their GL balances are held in system currency only. This is the case with AR and AP balances. I believe if we provide that ability to report (view) account currency in the accounting window with the other online bank account facilities (cash book) we would not need any additional capability.

11.3 Internal Audit Control

From an auditors point of view a financial software system should be able to produce (on-line / report) a G/L type transaction summary, showing all transactions affecting an account. Which ultimately ties to an account balance and total summary balance in the case of subsidiary ledgers (A/R, A/P, Bank Accounts, etc).

If I run an A/R, G/L type report by accounting period I should see the Beginning balance, all transactions (invoice, memo, payment, and revaluation) and an ending balance. The sum total of ending balances in each currency should tie out to the balance held in the A/R control account on the G/L. Basically any transaction affecting the movement of an accounts balance.

Accounting systems of today with sophisticated functionality offer the ability to view not only G/L account transactions (which tie to G/L balances) but subsidiary account balances as well. Not only do they allow users to view transactions but also allow them to view them in a aging format, set diary entries, perform calculations, etc.. We need to provide a similar level of functionality.

The idea here is that the customers need a simple mechanism to allow them to view all transactions within a given date range. This would include transactions like invoices, memos, payments and miscellaneous journal entries to any account. We have this type of functionality at the G/L level, we now need to carry it to the subsidiary level.

Having the ability to produce an on-line querying ability is good practice from an audit point of view. Designing this area to make a robust functional application makes good business sense from a sales point of view. We should make it right or at a minimum set the stage for the system to have a robust inquiry ability over a couple of releases.

In addition to the ability to browse transaction details we need to enhance the look up abilities of the system to be able to easily determine the original source transactions which were applied to an open invoice(s), memos, etc. Ideally this functionality should all be contained within the same area, without the need to jump to different menu options as described above.

11.4 Selection Parameters

- What we need is a search facility where we can either leave the Customer field blank or select it from a list, similar in the way we can select customers in invoice entry. The way this works in Invoice Entry where you can click on the Customer ID field is perfect for selecting a particular customer.
 - Of course selecting a customer should not be mandatory. If the customer field is left blank the search results should display a single summary line item, one for each customer in the database. It would be nice if there was an option to display only accounts with balances based on an 'As of Date' or 'As of Period'.
- Additionally we need some fields added which apply to the drill down capabilities as follows:
 - Entity Range
 - As Of Date (Default first day of currency period)
 - As of Period (Default to current period)
 - Balance forward option (for a running balance total column)

11.5 Initial Results Display

The result display should be in a format similar to the following:

<u>Customer ID</u>	<u>Customer Name</u>	<u>Currency ID</u>	<u>Balance Customer Currency</u>	<u>Balance System Currency</u>
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This display would result in a single line, one for each customer. From the summary line we need the ability to drill down into the transactions which support the balance.

Somewhere on this screen we need to display the 'as of date' or the 'as of period'.

11.6 Drill Down to the Details

The drill down display should show every transaction affecting the account.

- Invoices / Memos
- Payments
- Journal Transactions
- Revaluation Transactions

By providing a Balance Forward option within the selection set, if activated, the first transaction line would be a sum total of all transactions immediately prior to the “As of Date” or “As of Period”. Thus the ending rolling balance total should equate to the Account (Customer / Vendor) total as displayed on the summary display.

- What I hope to be able to see is each transactions (not batch posting) which affected an account. If the transaction type field can identify to me weather a transaction was an invoice, memo, payment, revaluation, etc. would be good without having to drill down into the transaction. The Batch ID field below would be for posting trace ability to a G/L entry.
- Transactions should be sorted in posting date order, showing

<u>Trans. Type</u>	<u>Trans. ID</u>	<u>Batch ID</u>	<u>Trans. Currency</u>	<u>Trans Amount</u>	<u>Trans. Reference**</u>	<u>Running Balance</u>
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- ** Could this field be used to pull in the appropriate reference from the transaction. For example if the transaction happens to be an invoice, the Invoice ID should appear. IF it's a check the check number. If a cash receipt the customers payment ID. If this can be done in a single column, great, if not could we have a column displaying each transaction type ID field?
- If the user exits out of the Details screen they should be brought back to the Customer Balance summary view (initial display screen).

11.7 Payment / Invoice History

If we can create a robust advanced inquiry look up feature for release 6.0 that would be ideal. Other than the general audit functionality any system should have the thing that concerns me is that most accounting systems perform this level of functionality and our sales people have a much more challenging time trying to convince someone to purchase the software with these gaping holes. I'm speaking to the types of customers (Pyrotek, etc.) we are trying to attract.

Within the Customer/Vendor inquiry screen we need to ability to call up summarized payment history as well. The user should be able to drill down on a payment transaction, and easily view the invoices/memos applied to a cash transaction (could also be a memo applied to an invoice).

Also should work in reverse order. Should be able to examine a paid invoice and easily tell what payment ID was applied to it.

12 - Customer Cash Application

12.0 *General Discussion*

The way the system currently handles the write off of differences in system values based on the rate applied at the time of the invoice and the rate applied at the time of payment appears to work fine except for the fact we need to address multiple currency values. Also, it is required that all transaction (payments included) must be converted to Euro before any other currency values.

We should display the write off amounts in each currency on the screen, perhaps as a pop up display at the time of pressing the save button.

In addition we need to be able to set tolerance limits over the write of amount. However I think this can be pushed back to a later release.

In the meantime we need to ensure that we:

12.1 *Set Transaction Currency*

Be able to set the currency of the payment regardless of the customers currency. Where the currency description currently displays could we shrink the description down and insert a Currency ID field to the left of it.

12.2 *Exchange Rate Date Application*

Should be based on either the check date or the posting date as determined by the translation date setting in application global.

12.3 *Set Exchange Rates*

As soon as one sets a currency value they should have the ability to set the exchange rate. Currently, this doesn't seem to behave as friendly as the other exchange rate setting options in the system.

Modify the 'Check Exchange Rates' option to focus on the transaction currency of the vendor. Reset to the currency and appropriate exchange rate conversion. If the user simply changes the currency without affecting the rate, the date on the invoice applies for the translation date (application global). If the user supplies a date, exchange rates are applied based on the date. If the system exchange rate is physically supplied to a cash receipt the system should display the write off values for each currency based on the relationship of the rate entered to the rate in affect for each currency on the application date as set in application global. The user should have the ability to override the rates (security). I should think this would behave as a pop up form, unless it is easier to add it to the 12.2.4 item.

12.4 *A Column to View Currency Write-off Amount*

Add a column to view the currency write-off (next to the discount applied) in the system currency only (for now). We should be able to show it in multiple currencies but this will need to wait for a later release.

12.5 *Miscellaneous Cash Receipts*

Add a field to allow cash to be posted directly to a G/L account from within cash application as opposed to being forced to apply it to a customer account.

Perhaps this could y allowing the Customer ID field to be left blank. IF left blank when the save button is pressed invoke the 'Amounts Differ' screen with the third option "Apply to G/L account" set as mandatory where the user needs to input a G/L account. The transaction would affect cash and the G/L account chosen.

12.6 *Saving / Posting to the General Ledger*

When the user selects to save the cash applied. If they have applied to any invoices based on the exchange rates and date posted with each invoice entry the system should apply and exchange rate gain / loss for each currency required (Customer, System, Reporting and Euro) and display all write-off amounts for each currency required.

The user should be required to accept the screen display.

12.7 *Reset Exchange Rates on Posted Transactions*

- Revaluation negates the need to modify exchange rates on posted transaction.
- The window should filter to the transaction currently being viewed
- If revaluation summaries are stored for each transaction (accumulated summaries) the display should present those summary totals with a column supporting the adjusted 'reporting' balance:
 - System Currency
 - Tracking Currency
- Original Exchange rate & values should always be displayed with a transaction.
- If the accumulative adjustment is not stored with each transaction then the only purpose this form would serve is to display the original posted transaction values and exchange rates, for:
 - System Currency
 - Entity Currency &
 - Tracking Currency(ies)

Ideally, the incorporation of on-line inquiry facilities like what Utopia has put together is what we need to have. Where each customer account displays the customer balance in the Customers as well as System and Entity currency. These values need to equate to the values held in the general ledger.

13 - Payable Transactions: Orders, Invoices & Payments

13.0 General Discussion

The idea with respect to submitting purchase orders, invoicing and making payments is to be able to handle this in any currency. Orders, Invoices and payments should be allowed to happen in any currency with any vendor. It would be ideal for an order to be generated in one currency, the invoice created in another and the payment yet still in another currency.

With respect to the order the order currency would be changed prior to the creation of the invoice. Subsequent payments on open invoices should be allowed in any currency. The system needs to simply convert the payment currency values into the vendors account currency (derived from the system (Euro) value) and perform the necessary write off of exchange gain/loss based on the movement in the exchange rate.

This really is just a question of converting first to the “base” (system) currency value (Euro if EMU country) then derive the “national”, “account” and “tracking” currency value(s). Compare the exchange rates posted on the original invoice (for system and account currency) to the ones posted with payment entry. Any difference between the two will generate a transaction gain/loss.

These types of transaction gains or losses are written off to the exchange rate gain/loss account(s) held in the income statement. For each currency

13.1 Tracking Currencies, recording Gains & Losses

In VISUAL when we talk about “Tracking” currencies we are talking about storing currency values for reporting purposes. These reporting values will need to be adjusted to report the proper values for reporting purposes. Exchange rate gains and losses for each reporting currency should be handled at the time of comparing the invoice to the payment.

Depending upon the difficulty of generating write off values at the time of cash application we could (for the short term) simply record the movement of invoice values for “tracking” currencies (outside of System, Euro and National) and use the revaluation routines at month end to adjust the reporting (“tracking”) currency(ies). The revaluation routines need to be run at the end of the month regardless so the balances reported are done so on a month end basis. It is quite conceivable that customers will want to differentiate between gains and losses derived at the invoice level as opposed to those generated because of revaluation. In those instances the user would want to generate write-offs for each currency at the time of applying the payment. For now, if it saves time we can simply record the “tracking” currency values at the rates applied to each transaction. Then use the month end revaluation routines to adjust the appropriate “tracking” currency values.

13.2 Language Considerations

On the payable side it's important that Checks to vendors be expressed in the vendors currency. For example if we are a US vendor and transact business with a Mexican vendor and the transaction is in PECO's the vendor expects to receive the check in PECO with all the proper Spanish terminology.

13.3 Transaction Currencies

We need to create addition fields to track historical currency values in every currency required as identified in application global maintenance.

Need to modify the system to store a Euro transaction rate if required. If the Euro is invoked (setting in application global) then the Euro rate is the rate basis for all other conversions. Thus we need to store it on the each invoice transaction. We have to be able to show we are compliant with the conversion process set forth by the Madrid Council.

Under ‘Order Exchange Rates’ I need to see each currency value displayed with the ability to select each one. This should be done on the ‘Order Exchange Rate’ screen.

13.4 *Revaluation*

Part of the revaluation routines discussed below requires a comparison from the original posted transaction value. I believe the current format in the tables Payable and Payable_Line table could provide a clear comparison to determine the necessity of a currency adjustment so long as we can equate to the original transaction currency (currencies if Euro). As discussed earlier all currency translations must originate their values from the Euro, not vice versa, if the entity is located in a Euro environment.

Note: Accounts payable possibly needs to be accumulated and stored on the general ledger in system, reporting and Euro currency. This means we have a need to be able to derive the original G/L posting in the proper currency values.

We could submit a revaluation routing to adjust a balance without affecting the transaction file, since revaluation should affect only vendor balances and not the underlying transaction. At month end when all revaluation routines are complete. One should be able to run an aging, designate a currency ID and an exchange rate/date (month end), and the system should produce a report that ties out to the G/L A/P balance in any currency.

13.5 *Aging Report*

We need to be able to produce reports (aging) with the ability to apply a spot rate to the report, and convert the total vendor balances to what is stored on the General ledger in any currency. Each month we need to perform revaluation against the account to adjust the value held on the G/L for accounts denominated in other than system currency.

13.6 *Advanced inquiry*

We need a facility where one can see every transaction (invoice, credit memo, cash applied, adjustment and revaluation) affecting a vendor's balance. I envision the facility to be something like the functionality associated with the accounting window except we would need to see different information. This is explained in more detail in section 11 – Advanced Inquiry. All translation entries affecting vendor balances would be viewable in source form (as opposed to batch form) with the ability to view the transaction details. I believe this would provide a clear audit trail on a 'by vendor' basis. What I am looking for is a way to affect the balance of a vendor account, be able to view the detail (not batch) history for each vendor posting (on-line as well as a report) and equate the history to the period end balance (translated aging).

14 - Purchase Order

14.0 *Set Transaction Currency*

Ability to set a transaction currency. Ideally have the transaction currency selectable (combo box) from the Purchase Order screen, where the currency displays currently (just below the 'printed' field). Have the currency display below the combo box. I think it may make sense to bring the currency field to the front of the form display since we are allowing vendors to transact in any currency independent of the vendor currency. The currency should default to the vendor's currency code.

14.1 *Hold Euro Value*

Need to hold the Euro currency rate in addition to the system rate applied to the transaction.

14.3 *Order Exchange Rates*

Under 'Order Exchange Rates' exchange rates should be based on the transaction currency to the system currency. If they attempt to set the rates we need to have the following happen:

14.3.1 *Exchange Rates not Physically Set*

If the exchange rates are not physically set on the order, then the current way we are handling the rate application is fine.

14.3.2 *Enhance Display*

To add another set of fields so the display shows both the system and converted Euro values. Can you keep each group of currency fields together? Would be good from Euro compliance perspective.

14.3.3 *Currency ID Display Field*

Add column to each display set denoting the currency ID. Would like to see the currency ID appear to its respective invoice total column.

14.3.4 *Retrieve Rates by Date*

On the 'Order Exchange Rates' screen if the user changes the 'As of Date' the rates should be pulled in automatically without having to select the 'Get Current Rates' button.

14.4 *Purchase Order List Report*

Purchase orders list (VMPURRP5) need to produce in transaction, vendor or system currency. Currently prints in system currency only. Make transaction, vendor and system currency available to QUEST for reporting purposes.

15 - Payable Invoicing / Memos

15.0 *General Discussion*

Invoices generated from purchase order receipts need to have the appropriate exchange rates applied. As was the case with customer orders if the exchange rates are manually set on the order those rates should carry to the invoice. If they were not the exchange rates should be applied based on the translation date setting in application global.

15.1 *Set Transaction Currency – Invoices w/o Customer Orders*

Ideally have the transaction currency selectable (combo box) from the Purchase Invoice screen, where the currency is displayed now (just below the 'printed' field). Have the currency display as a selectable box on the form. I think it may make sense since we if we modify currency to the transaction level. The currency should default to the vendor's currency code.

15.2 *Hold Euro*

Euro currency rate in addition to the system rate applied and held against each transaction when applicable.

15.3 *Setting Exchange Rates*

Under 'Order Exchange Rates' exchange rates should be based on the transaction currency to the system currency. If they attempt to set the rates we need to have the following happen:

15.3.1 *Rates Not Physically Set*

If the exchange rates are not physically set on the order, then the current way were are handling the rate application is fine.

15.3.2 *Enhance Display*

Ability to view transaction values in the converted system, entity, Euro, tracking currency. For Euro compliance perspective it is necessary to keep each group of currency fields together?

15.4 *Print A/P Voucher*

Ability to print off an A/P voucher (plain paper).

15.5 *Link A/P Invoices to Packing list*

Ability to link purchase invoices or purchase orders to customer packing lists. Ability to track total landed cost for an order. This could be a memo field with no validation or a field which does have validation to the shipper table. If we validate we should probably address referential integrity on the shipper table. If a user tries to delete a packing list which is attached to a vendor order or invoice the request should fail. If no validation we should allow the users to update the memo field after it has been posted to Vendor file.

Tracking reports would need to be created through Quest. Pulls based on system currency.

15.6 *Posting Invoices to the G/L*

When the user selects to 'Post to General Ledger' we need to make sure we record all necessary transaction currency balances as described in the section on '**Handling Euro**' or **Parent Reporting**.

16 - Payment Entry

16.0 General Discussion

Payment entry assumes the ability to produce payments (Checks, BACS, File, etc) in the currency of the vendor or the transaction currency. The ideal situation is to be able to produce the payments in different currencies according the PAYEE currency. In other words for the time being if we are paying a check to a German vendor but the payment is to be in YEN, the payment should be converted to GERMAN (the default currency of the vendor). However, if the payment is being made to an indirect payee (vendor sold receivables to Dutch business) then the payment should be translated to Dutch language.

16.1 Scenarios for Cutting Check

1. Check run by bank account currency for same transaction currency as bank account.
2. All other checks entered manually at this time.

16.2 Select Bank Account

After I select the Bank Account ID, when I tab out of the field could the currency field automatically set to the currency of the bank account.

16.3 Produce Payment Run

Ability to produce payment runs by bank account currency.

16.3.1 Pass Bank Account Currency

On the Payment generation and print screen when a Bank ID is selected the currency field should automatically display the Bank ID's currency. This would eliminate the currency message that displays when you TAB out of the Bank ID field.

16.3.2 Payment Schedule by Bank ID

Ability the Select Payment Schedule by Bank ID and 'Up to Payment Date'. In addition be able to apply an exchange rate based with the ability to override the rate.

16.3.4 Filter Payment Schedule By Bank Account and Currency

If I set a bank account and currency on the Generate and Print A/P Payments these fields should be passed to the Set Schedule screen. Also if the Set Schedule screen is receiving a user input (i.e. currency) the screen it would be good if; the option for "all vendors sorted by invoice date" and the currency field were set with those defaults.

16.3.5 Add Display Columns

Payment schedule window should display (with ability to hide like other columns) for Transaction Currency as well as Converted System (Euro) value(s).

16.3.6 Enlarge Screen

Ability to enlarge the 'Set Up Pay Schedule' screen to full screen view. Allows maintenance of items without the need to go to the scroll bar.

16.4 *Cash Requirement Report*

Ability to produce cash requirement report by Bank ID. Select by Entity, Bank ID (currency default) and apply an exchange rate (either by date or exchange rate override). The report should display the invoice (transaction) amount, discount and payment amount.

16.5 *Add Column to Report*

Would like to see a fourth column added to the report, prior to the invoice balance column to show the system currency. Label column system value. If report produced in system value amounts should be the same. If the report is produced in other than system currency the user can see the currency affect. If a company is holding bank accounts in foreign denominations they will want to see the impact in system dollars even though invoices are paid in foreign currency.

- To handle Checks produced in other than transaction currency, for the interim the vendors will need to process the check under "Payment Maintenance".

16.6 *Posting to the G/L*

When the user selects to save the cash applied. If they have applied to any invoices based on the exchange rates and date posted with each invoice entry the system should apply and exchange rate gain / loss for each currency required (Customer, System, Reporting and Euro) and display all write-off amounts for each currency required.

The user should be required to accept the write-off screen display.

17 - Vendor Payment Application

17.0 General Discussion

The main reason for a Vendor cash application area is to address the issue of being able post unapplied checks to a vendors account. Then at some later time apply the check to an invoice. It quite often happens where a purchase order will require a check to accompany it as a deposit which will later be applied to the invoice balance.

I believe the current functionality under Payment Maintenance works for creating the check, we simply need to be able to post it as unapplied. The item would then need to show up on an aging as such.

17.1 Payment Maintenance

Change the bank currency to no longer be tied to the Vendors currency but tied to the currency of the check. The check currency should default to the Bank accounts currency.

If the check is being applied to a vendor invoice the check currency should be translated to the system currency and vendors currency amounts. Any difference between the system and vendor currency values should be posted as an exchange gain / loss to the appropriate accounts.

Ability to post a check as unapplied cash. After the check is filled by if the user leaves the detail lines blank and presses the 'save' button they will get the same options as in Cash Application. Similar functionality should apply except that only two options should prevail, post as unapplied cash or post to a G/L account'. I think from this area we could also get set for one-time vendors in a later release.

17.2 Functionality List

17.2.1 Set Transaction Currency

Set the transaction currency of the payment regardless of the Vendors currency. Where the currency description currently displays could we shrink the description down and insert a Currency ID field to the left of it.

17.2.2 Exchange rate date application

The exchange rate date of application should be based on either the payment (transaction) date or the posting date as determined by the translation date setting in application global.

17.2.3 Set Exchange Rates

As soon as the currency value is set there needs to be the ability to set the exchange rate. Need to make sure the 'Reset Exchange Rate' option is activated. This doesn't seem to behave as friendly as the other exchange rate setting options in the system.

Modify the 'Check Exchange Rates' option to focus on the transaction currency of the vendor. Reset to the currency and appropriate exchange rate conversion. If the user simply changes the currency without affecting the rate, the date on the invoice applies for the translation date (application global). If the user supplies a date, exchange rates are applied based on the date. If the rates are physically supplied the user should be required to enter a rate for every currency VISUAL needs to track.

17.2.4 A Column to View Currency Write-offs

Add a column to view the currency write-off (next to the discount applied) in system currency only (for now). We should be able to show it in multiple currencies but this will need to wait for a later release.

17.3 *Apply Unapplied Cash to Vendor Accounts*

Similar to the way Customer Cash Application functions we should enhance the payment maintenance option to allow for the application of previously unapplied cash. Quite often a check (on deposit) is required to accompany an order from a vendor. In these situations a company needs to be able to post an unapplied check to a vendors account (discussed above). At some future date the check will need to be applied to an invoice after the shipment has been received. Can we build this level of functionality into the payment maintenance screen. If the user fills out a check and leaves the detail lines blank and presses the 'save' button they will get the options to either apply the check as unapplied cash or post directly to a G/L account.

17.4 *Advanced Inquiry Facility*

When drilling down, if drill down is on an applied payment, should be able to view the invoices to which the payment was applied to. See section 11 – Advanced Inquiry for further discussion.

17.5 *Posting to the G/L*

When the user selects to save the cash applied. If they have applied to any invoices based on the exchange rates and date posted with each invoice entry the system should apply and exchange rate gain / loss for each currency required (Vendor, System, Reporting and Euro).

18 - Other Issues

18.0 *Chart of Accounts*

VISUAL needs to provide the revaluation process the ability to identify which GL accounts are subject to revaluation. Section 21.6.2 identifies what accounts on the general ledger are subject to revaluation.

18.1 *Reports*

I am still addressing reporting aspects with relation to currency. Adding currency fields to the database and thus accessible to quest would allow for reporting capability in the initial multi-currency release. This could be a solution for reporting in the initial steps since users have the capability of using the report format overrides. The second step may be to go back and incorporated specific .qrp reports to address various parameter selections needed.

18.2 *General Ledger*

Users will need to have the system produce at a minimum the 4 major reports off the system. In addition if the currency balance records could be accessible through users could have the opportunity to create their own reports.

- 1) Trail Balance – Ability to Produce in System, Euro (where applicable), Entity, and Tracking currency if required.
- 2) Basic Financial Statements – Ability to Produce in System, Euro (where applicable), Entity, and Tracking currency if required.
- 3) Basic Income Statement – Ability to Produce in System, Euro (where applicable), Entity, and Tracking currency if required.
- 4) General Ledger Report – Ability to Produce in System, Euro (where applicable), Entity, and Tracking currency if required.

18.3 *Mandated Chart of Accounts Label - Accounting Window*

General Ledger Account need to have an alternative reference account ID and description on the file. Perhaps there could be a button next to the Summary account field to call up the alternative account ID and Description field.

In countries like France, Italy (Goose's Jan. 14 e-mail) and Columbia SA it is a requirement to be able to produce reports in mandated chart of accounts. For the time being if we could use quest to pull that information out of the database this would be an alternative. At some point we will have to address the entire impact on reporting to assess what needs to be done from a development point of view.

I would like to provide an initial release with some kind of alternate account ID and description. In a future release we will no doubt have to take this to a summary/detail account type level. Especially as it relates to a Parent Companies mandated chart of accounts which is different in structure (in the number of accounts and/or descriptions) from a governments mandated chart of accounts.

In addition some countries require a mandated account description length of 120 characters. Visual needs to allow for a maximum length on the **account description** of 120 characters.

18.4 *Journal Entries*

I know we are going to have users who need to transact journal entries (especially inter-company entries) in other than system currency.

1. Allow postings of journal entries in other than system currency.

2. Add a currency ID field to the form, perhaps below the description field.
3. Add 'Check Exchange Rates' under the Edit window. Same form as called up in Payment maintenance.
4. For every Journal entry applied to the system, translate transaction currency to system (Euro first if required) and then to reporting currency. Write balance records
5. for all required currencies (Application Global).

18.5 Currency Field Size

The introduction on multi-currency can offer some challenges with respect to the size of the value field. Some countries have extremely high exchange rates compared to some countries. For example; the Turkish Lira on July 7, 1998 had an exchange rate of 268,100 Lira to 1 US Dollar. A transaction for 1 million US dollars translates into a value of 296 Billion Lira. As you can see a company that does 10 million in US dollar sales could run into a potential problem depending on the number of decimals stored.

Would it be possible to establish a currency field size of 20 or 25 positions.

Chris Lasswell to inquire with Centura about the possibility of expanding the size of this field to incorporate larger international customers.

Account ID Buttons

At various places within VISUAL the user can click a push button to invoke a GL account search. The window automatically defaults to all types of posting level accounts. Would like to see the "account" search incorporate something similar to VF browse.

Initially when a user goes into AR invoice entry or AP invoice entry the system automatically creates a browse .ini file which can be modified by the user. Would like to see something similar where the users can decide what defaults should appear checked in an account search window.

18.7 Cash Management

Currently under the properties the 'currency' setting will filter transactions based on the currency. This poses a difficulty when trying to establish a single cash plan with the ability to include foreign transaction. If you have customers that transact business in foreign currency one should have the ability to include these in a cash plan, converted to the currency of the plan. Cash maintenance should be enhanced in the following way.

- Cash management should have the ability to be presented in either System, Euro or Entity or transaction currency in addition to specific account currency.
- Ability to determine if foreign transactions should be converted to the 'properties' currency. Conversions should be based on currency rates applied to transactions.
 - For Customer orders currency rate from order date
 - Invoices Based on invoice date
- Cash management should take into consideration currency exchange rate movements. If there are transaction that have been aged and subsequently have revaluation applied, the cash management window should apply the amounts after the translation.
- Like with Customer statements the ability to perform "as of" cash management analysis should be present. Companies that use cash management are always interested in comparing past projections to what actually happened.

In addition the cash management feature should have the ability to record account activity for any account listed in the accounts section. Simply posted the net change in the account if identified individually. Companies will often have money in investments, lines of credit, etc, which are part of the cash inflows. Users need the ability to tie such accounts to the cash management process. If there is not enough time for this it can hold until release 6.1.

The “All other” default accounts should behave as they do corresponding to deposits, etc. should act as they currently do, which is nice.

19 - Bank Account Maintenance / Cash Book

19.1 *Currency Field*

Bank Account maintenance currency field should not be editable once a payment has been made or a receipt has been applied.

19.2 *Bank Transfers/Charges*

Often times, organizations with international concerns need the ability to receive different currencies from customers. In the same light they need to have the ability to pay vendors in different currencies. These capabilities have been addressed earlier in this document.

Most organizations with global concerns will hold bank accounts of different currency denominations. It gives them the ability to receive money in a customer's normal currency as well as giving them the ability to pay vendors in their native currency. Organizations don't always hold quantities of every particular currency they may transact business in. In these cases they will arrange for the purchase of a denomination of a particular currency. When this type of transaction occurs, banking or currency institutions will often charge a fee for this service. The fee can be charged in the currency of the local bank, however it could also be charged in the currency being purchased or sold.

19.2.1 *Bank Charges*

Banks that offer the services as outlined above charge a fee for this service. As most of us are painfully aware banks charge for practically every type of transaction they have. Here is a list of commonly known bank charges:

Reductions in Cash

- Monthly Service Fee
- Interest
- Commission (Currency)
- Purchase Fees
- Other

Increases In Cash

- Interest
- Dividends
- Other

As you can see there are a number of different types of fees banks charge for certain types of transactions. In fact these charges may or may not be in the currency of the bank account but could be charges in the currency of the transaction.

VISUAL needs to provide the ability to record bank charges in transaction currency. These are journal type transactions that need to be recorded at any point in time. Because it may be impossible to preplan the currency of the bank charge these transactions need to be currency sensitive.

Ideally, VISUAL should have the capability to set up common types of bank charges to be used by (all) banks. While different banks charge different amounts for the same service, most banks are consistent in the types of transactions they charge a fee for. Therefore it makes sense to provide the ability for users to set up their own predefined charge entries. The predefined charge should have the ability to be identified by an Bank Charge ID code. Assigned to each code should be the following information:

- GL Account
- Entity, and
- Reference
- Description

- Normal Cash In / Cash Out

Each of these fields can realistically be pre-determined. The variable items, the fields that can't necessarily be determined ahead of time are as follows:

- Transaction Date
- Posting Period
- Transaction Currency (Line Level)
- Debit / Credit Amount

Of the Variable fields, VISUAL should provide for the ability to establish settings that will invoke an automatic response. For example, we can assume bank charges will flow through to an organization on a bank statement or through a memo notice from the banking institution. If they flow through on a bank statement there probably relate to last months banking activity. A Company may want to predefine that bank charges post to the prior posting period while the transaction date remains the current system date. Alternatively some users may wish to post all charges to current period.

An example a predefined settings for Transaction Date might be "System" which would automatically populate the bank charge JE forms transaction date field with the current date. Other date settings for this field could be Prior EOM which would stand for the last day of the prior period. Below is a list of possible settings for each variable field.

Transaction Date

Current System Date
Prior End Of Month Date
User Defined (Blank)

Posting Period

Current Period
Prior Period

Transaction Currency (Line Level)**

System Currency
Currency of Bank ID
User Defined

Debit / Credit Amount^{oo}

Predefined Value (for standard charges)
User Defined

Key Features

- **** VISUAL should allow the ability to input multiple bank charges on a single JE form. Each line item can be input manually or have the ability to have a Bank ID code applied. This would streamline the input process as well as making the system functionally rich in this area. For each line item (bank charge) it is quite possible that the charge could be in a different currency. Therefore each line of the Bank Charge Journal Entry process should be currency independent. Each line is converted to bank account currency and any other currency that may be needed for the general ledger.
- oo** Above we talked about the ability to establish the whether the charge is, a reduction in cash (Credit) or an Increase in Cash (Debit). Keep in mind on a bank statement these charges are listed the exact opposite way. Reductions in cash are categorized as debits where increases in cash are shows as credits. Therefore, I think we are better served to categorize charges as either Cash In or Cash Out. For ease of use if a predefined bank charge code is marked as a normal Cash In the cursor should jump to the Debit column of the JE. If the ID code entered is a normal Cash Out charge the cursor should jump to the credit column.

19.2.2 *Currency Purchase*

In business corporations that deal with international transactions need to have the ability to transfer currencies between bank accounts as well as have the ability to purchase different currencies. When an organization purchases currency they typically will use a wire transfer from one account to another, where the resulting transfer will reduce the account being transferred from and increase the account of the transfer two. In reality this transaction mimics the purchase of a certain currency. When an organization transfers (purchases) currency from one account to another they need the ability to add bank charges to the transaction.

The exchange rate for such a transaction would normally be user defined. Then there is usually a commission charge as well as other charges that may be applied by the banking institution.

VISUAL needs to allow for a “Currency Purchase” transaction. A currency purchase could be applied to accounts within the same banking institution or alternatively could be drawn from one bank and sent to another bank.

Bank Transfers

A currency purchase by way of a bank transfer is probably the most common and easiest to handle would be a transfer request were an organization would request a transfer from one account to another. The items contained in the transactions would be:

- Transaction Date
- Posting Period
- Bank Account Transferred From: (Currency)
- Bank Account Transferred To: (Currency)
- G/L Accounts affected
- Transaction Currency
- Application of Transaction Fees (Commission, Others)

Transaction fees may be in the currency purchased or the currency purchased. Therefore VISUAL needs to be able to determine the line item currency with respect to bank charges. Bank charges and transfers should become part of the reconciliation process.

The GL accounts affected should be automatically supplied by the bank account master information so the user does not need to input the accounts manually.

Wire Transfers

In a similar fashion it is quite possible for a customer to request a wire transfer from one bank to another. This would typically be a more formal request were a currency from one bank would be transferred to an account in a different bank.

As defined above the same items contained in the transactions would apply:

- Transaction Date
- Posting Period
- Bank Account Transferred From: (Currency)
- Bank Account Transferred To: (Currency)
- G/L Accounts affected
- Transaction Currency
- Application of Transaction Fees (Commission, Others)

Transaction fees may be in the currency purchased or the currency purchased. Therefore VISUAL needs to be able to determine the line item currency with respect to bank charges. Bank charges and transfers should become part of the reconciliation process.

The GL accounts affected should be automatically supplied by the bank account master information so the user does not need to input the accounts manually.

19.4 *Advanced Inquiry*

Need a facility to see each transaction (invoice, credit memo, cash applied, adjustment and revaluation) affecting a bank account. All transaction entries affecting bank balances should be recorded with the ability to view all detail transactions (not in batch format). I believe this would provide a clear audit trail on a 'by bank' basis. See section 11 – Advanced Inquiry for further discussion. Incorporation of the Utopia inquiry and budget utilities would show quite well in a sales opportunity.

20 - Costing Utilities

20.0 General Discussion

Tracking costs of materials by currency is required under FASB 52 and IAS 21. Since the material cost is a quantifiable cost it should be processed at its historical value. Customers can run costing utilities to as often as needed (perhaps daily) for purposes of applying Labor and Burden, or ideally if we can get Labor & Burden to post the currency affects at the same time as updating system values, this would be the best of both worlds.

All Labor and Burden (indirect) costs can use the rate in existence at the time of applying to WIP or costing to Finished Goods or Cost of Goods Sold according to the translation rules established in application global.

20.1 Cost Movements

For Material costs VISUAL needs to accumulate the appropriate currency values from Inventory or Service charges and estimated bookings based on. It is appropriate that each quantifiable cost be tracked at its historical currency value while each non-quantifiable cost is updated and costed for currency at the time of being applied to a work order based on the translation dates for applying exchange rates as set in application global.

20.1.1 Purchase Journal

Costs accumulated and movements recorded by currency (System, Euro, Entity, and Tracking). Transactions should carry the System as well as the Euro currency rate.

20.1.2 Running Costing Utilities

At the time of running costing utilities can we prepare the posting entries to update WIP for each respective currency needed.

Remember the Euro will replace the national currency as the system currency and we need to back into the national rate based on the Euro rate.

20.1.3 Finished Goods Update

Finished goods updates for material accumulated cost by currency. For burden and labor costs the system value along with the exchange rate in affect on the posting date is used to derive the non-system currency values.

20.1.4 Shipments Journal

The booking of finished goods should be based on the total accumulated costs, by currency, booked to finished goods. Material, labor and factory burden should be properly translated at the time historical perspective required for postings by GAAP. All costs should be translated based on the transaction date.

20.1.5 Indirect labor

All costs should be translated based on the transaction date. All necessary currency values should be properly accumulated as required by GAAP.

20.1.6 Inventory Transactions

All costs should be translated based on the transaction date. All necessary currency values should be properly accumulated as required by GAAP. Individual inventory balances will need to be held for each FIFO layer.

21 - Currency Revaluation routines

21.0 General Discussion

As I am sure we are all painfully, the accounting world is highly dependant of regulations to determine the proper accounting treatment of transactions in the business community. The extent of regulations is no more evident when it comes to revaluation. The FASB (Financial Accounting Standards Board) and the IAS (International Accounting Standard) provide the guidance we need to properly handle revaluation with the system and thus be in “compliance” with generally accepted accounting principles.

As you read through this specification I believe it should become apparent for the need to incorporate Entity and Account currency in the database. Entity currency will be needed for consolidated translations. Account currency will be needed to hold currency balance from translation adjustments as well as accounts that simply need to be denominated to hold balances for loans, futures contracts, securities, etc. All of these types of accounts need to be held in account currency.

21.1 Terms:

Translation When a currency transaction is entered into the system Lilly displays the transaction currency values on the face of the s currency. The display is merely the converted (translated) transaction currency amounts.

Revaluation The process of assessing and resetting currency balances to reflect a companies true purchasing power of money you hold, debts to pay, or amounts owed to you. Amounts denominated in currencies, outside a nations normal currency will fluctuate daily.

Subsidiary Accounts The account that holds the specific Customer or Vendor related detail. These accounts are tied to a G/L control account. Every entry to the subsidiary account should cause a corresponding entry in the control account. This way the sum of the open items in the AP or AR accounts should equal the value reported on the general ledger. Any transaction that is specific to a Customer or Vendor account (Invoice, Memo, Unapplied Cash, Deposits, etc.) affect the individual subsidiary account as well as the G/L (Control) account.

Control Account The account in the general ledger that makes up the sum of all the account balance(s) of the sub accounts (subsidiary ledger). The control account holds the balances for each currency in which there is a sub account currency. The currency balances that should be maintained are account, entity, system, and tracking.

***** Within the body of this functional specification, I have enclosed notes between asterisk symbols for easy identification. It is my hope these notes assist you in making the best decisions for adding the needed functionality.

21.2 Currency Revaluation ‘Subsidiary Accounts’

Currency revaluation’s, in the case of accounts receivable and accounts payable would affect only those accounts that have open balance. Revaluation would never affect transactions that have been settled in full. Therefore, when setting account balances to their proper value based on transactions denominated outside the accounts normal currency one typically need only to look at open items. However, having said that, because of movement in rates and the nature of revaluation some accounts could have a no open items in an account yet still hold an account (as well as multiple tracking currencies) balance. The system should be able to examine AR and AP related accounts with no unapplied items or account balance. If any of these accounts are identified, balances for each currency held should be written off down to zero. This is known as a “zero value revaluation”.

For example:

Transactions denominated in Customer Currency

1. On October 1 1997 majestic manufacturing a US based company sold on account mustard seeds to the French Mustard Company located in Paris, France for 100 francs.

The exchange rate on that day was 1.35 francs to the dollar.

Entry:

	<u>US</u>	<u>Francs</u>
A/R (French)	74.07 DR	100 DR
Sales	74.07 CR	100 CR

2. On October 31, 1997 the exchange rate for increased to 1.37 francs to the dollar.

Entry:

Exchange Gain/Loss	1.08 DR	(No entry)
A/R (French)	1.08 CR	"

3. On November 5, 1998 Majestic manufacturing received payment of 100 francs. The exchange rate was 1.33 on that day.

Entry:

Cash	75.19 DR	100 DR
A/R (French)	74.07 CR	100 CR
Gain/Loss	1.12 CR	

4. As can be seen the customer has entirely relieved their obligation by paying the French franc amount of 100 dollars. However, a US balance still exists in the Customers account. This balance merely reflects currency movement over a period of time. In this case it will be necessary to write off the remaining US dollar balance of (2.20).

Entry:

A/R (French)	1.08 DR	0 (No Entry)
Exchange Gain/Loss	1.08 CR	0 "

This same scenario holds true for Vendor accounts as well as customer and vendor deposits. Movements in exchange rates daily affect accounts of this nature even though they are adjusted on a monthly basis for financial statement purposes.

Transactions denominated in a Currency other than the Account (Vendor or Customer)

Transactions that sit outside the "normal subsidiaries account currency" will cause the need to revalue the account (Vendor or Customer) based on the movement of the exchange rate for those transactions. Transactions denominated outside the normal account currency change their value from month to month in account currency and thus need to be revalued to properly reflect that change. Of coarse if the account currency changes all other "tracking" currency values need to get revalued. Since the transaction currency is the lowest level value held in the system it will need to be performed prior to any accounts or tracking currencies getting revalued.

Let's take a look at this scenario:

1. On October 1 1997 majestic manufacturing a US based company sold, on account, mustard seeds to the French Mustard Company located in Paris, France for 100 German Marks. The customer account is denominated in Francs.

The exchange rate on that day was 1.35 Francs and 1.76 DM to the dollar. Revert to system currency to derive the account currency.

Entry:

	US	FFR	DM
A/R (French)	56.82 DR	75.00 DR	100.00 DR
Sales	56.82 CR	75.00 CR	100.00 CR

2. On October 31, 1997 the exchange rate for increased to 1.37 Francs and 1.72 DM to the dollar. Revert to system currency to derive the account currency.

Entry:

Exchange Gain/Loss	1.32 DR	4.65 DR	(No entry)
A/R (French)	1.32 CR	4.65 CR	(No Entry)

3. On November 5, 1998 Majestic manufacturing received payment of 100 DM. The exchange rate was 1.33 Francs and 1.69 DM respectively on that day. Revert to system currency to derive the account currency.

Entry:

Cash	59.17 DR	78.70 DR	100 DR
A/R (French)	56.82 CR	75.00 CR	100 CR
Gain/Loss	2.35 CR	3.80 CR	

4. As can be seen the customer has entirely relieved their obligation by paying the German DM amount of 100 dollars. However, a US balance still exists as well as a Customer's account balance. This balance merely reflects currency movement over a period of time. In this case it will be necessary to write off the remaining US dollar and French Franc balances.

Entry:

A/R	1.32 DR	4.65 DR	(No Entry)
Exchange Gain/Loss	2.20 CR	4.65 CR	(No Entry)

Entry needed to write off remaining currency balances.

Using "T" accounts we can visually see and determine the necessary revaluation. After step 3 the account, in this case does not have any open (unapplied) transactions and should be at zero for all currencies. When we sum the balances we see this is not the case.

AR - Subsidiary			Exchange Gain/Loss		
1) USD	56.82				
1) FFR	75.00				
1) DM	100.00				
		1.32 USD (2)	2) USD	1.32	
		4.65 FFR (2)	2) FFR	4.65	
		56.82 USD (3)			2.35 USD (3)
		75.00 FFR (3)			3.80 FFR (3)
Balance Remaining		1.32 USD			
		4.65 FFR			
4) USD	1.32				1.32 USD (4)
4) FFR	4.65				4.65 FFR (4)
Ending Balance	USD 0				2.35 USD
	FFR 0				3.80 FFR
	DM 0				0 DM

Because of the credit balance remaining in the receivable subsidiary account while there are no open transaction against which to revalue the exchange difference needs to be written-off. Entry 4 provides the write-off and displays the remaining balance in the exchange gain or loss account. Note that the exchange account needs to hold multiple currency balances.

Also, at the end the exchange gain/loss account holds the true affect of the difference in the exchange rate from the date of the invoice to the date of the payment. You can see that the movements in exchange rates from month to month are for reporting purposes an ultimately wash through the exchange gain/loss account. Unfortunately this treatment is required by Generally Accepted Accounting Principles and must be handled as displayed above.

Chris, during the original multi-currency discussion you asked me if you could change the transaction currency rate and adjust it at that time. I said the transaction should never be modified from it's original posting. In addition, I said that the revaluation affects the balance of an account and not the original transaction value. This is all true with respect to regulation. Having said that, I think we are on solid ground if you wished to store (post) revaluation amounts in each currency against the original transaction as long as you do not affect the original transaction value. These amounts would need to be stored in addition to the original value and its related exchange rates.

Keep in mind:

A combination of the account balance along with unapplied transactions should determine if revaluation is necessary. We need to ensure the following points:

1. If there are unapplied transactions in the account being revalued but the sum of the transactions in account currency sum to zero all other currency balances should be written to zero.
2. If there are transaction in transaction currency that offset to zero and (1) above then all other currency balances should be written to zero. This can be tricky because if we adjust unapplied values to zero then subsequently apply them, we could very well generate a write-off to an account that already has a zero balance. This would cause a balance to an account that should not have a balance. We can handle this situation two ways. 1) If you accumulate the "accumulated revaluation amounts" for each currency against each transaction, when the items are applied against each other you would simply write off the accumulated currency values. 2) If revaluation adjustments are applied on account basis as opposed to the transaction basis a revaluation rule would need to perform step (1) above.
3. If there are transactions in transactions currency then they first adjust account currency, account currency then adjusts system currency and from system currency to all other tracking currencies.

As I have said before revaluation postings never show up on an aging report, invoice, statement, etc. They are merely adjustments to reflect the proper "currency" balance associations within a multi-currency database.

As displayed below Euro countries must treat the Euro currency as if were the base (system) currency. In other words, the Euro holds dominance over the national currency as required by the Euro commission. Therefore, revaluation of account balance should use the same conversion routine on the system (Euro) balance as discussed in the multi-currency functional specification. It is extremely important to revalue by setting the Euro as the system.

In the case of setting account balances to the system or Euro in some cases, the account balance is the driving force. If an account has a currency balance, any reporting currency values (system, reporting, etc) should properly reflect the market value based on the exchange rate at the month or year-end.

To examine the functional currency revaluation needs in version 6.0, lets first take a quick look at the multi-currency capabilities we are focussed on providing.

• Customer Invoice (any currency balances held in Account, System & Tracking).	• Vendor Invoice (any currency, balance held in Account, System and Tracking).
• Receive any currency to apply to an invoice. Write off currency differences from original invoice/memo transactions.	• Pay vendors in transaction , Account or other currency.
• Bank account transfers, in different currencies.	• Warehouse balances in different currency. Transfers converted to destination currency.
• Automatic calculations on exchange gain/loss during revaluation and on transaction settlement.	• Consolidation of databases in a “Reporting” currency. No longer tied exclusively to system currency
• Revaluation of account balance based on transaction currency other than account.	• Revaluation of “reporting” & “system” currency from account currency balance. Not to affect
• A/R Reports produced in currency: • Aging Reports • Customer Statements & History • Customer Orders • Acknowledgements • Cash receipts journal • Customer Bookings • Customer Backlog • Customer Sales Journal • Sales Commission • G/L Transactions	• A/R Reports produced in currency: • Payment register • Cash Requirements • Purchase journal • Aging • Vendor History • Uninvoiced receipts • Uninvoiced receipts (Detail) • G/L transactions
• Accounting Window reports produced in currency: • Trail Balance • General Ledger • Balance Sheet • Income Statements • General Journal	• Other Reports produced in currency: • User Defined reports, currency fields available. • Cash Plan • Cash Book • Bank Statement reconciliation • Gross Profit Report ????

21.3 Revaluation Methods

FASB 52 and IAS 21 require two different scenarios for revaluation. Some revaluations cause a posting that affects the income statement of an enterprise. These types of revaluations occur when current monetary assets and liabilities are adjusted to the reporting currency of the local units functional currency. Other revaluation routines affect the shareholders equity section of an enterprise's balance sheet. These types are revaluations occur when an organization is translating a foreign operations financial statements into an organizations "Reporting" currency.

To summarize, the translation process embodied in FAS-52 includes the following steps:

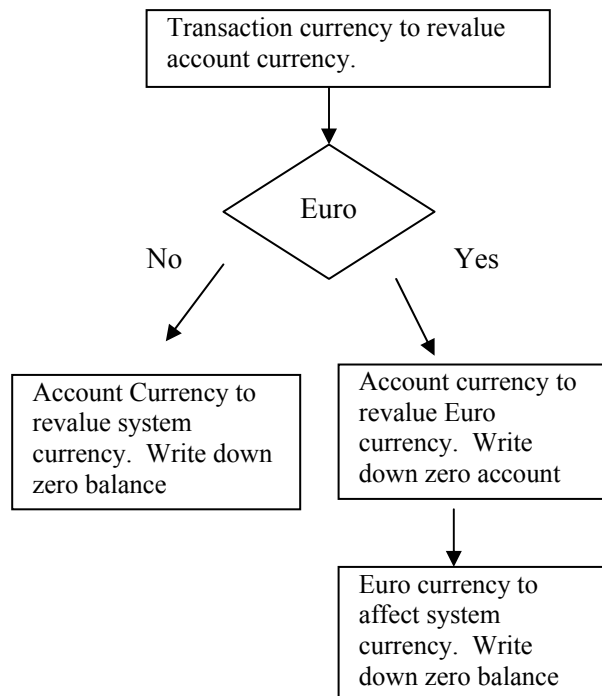
1. Financial statements must be in conformity with U.S. GAAP prior to translation.
2. The functional currency of the foreign entity is determined.
3. The financial statements are expressed in the functional currency of the foreign entity. Remeasurement of the financial statements into the functional currency may be necessary. Gains or losses from remeasurement are included in remeasured current net income. **This requires each entity (company) to be tracked in its own currency. Each subsidiaries financial statements are then translated to the reporting companies (system) currency (see step 5 below).**
4. If the foreign entity operates in a country with a highly inflationary economy, its financial statements are remeasured into the functional currency of the reporting entity.
5. The functional currency financial statements of the foreign entity are translated into the functional currency of the reporting entity using the current rate of exchange method. Gains or losses from translation are not included in current net income but instead are recorded in the shareholders equity section of the balance sheet. **For consolidation, each foreign entities (database) must have their financial statements translated will need to be adjusted to the Adjustments to affect the entity currency**

21.4 Revaluation Sequences

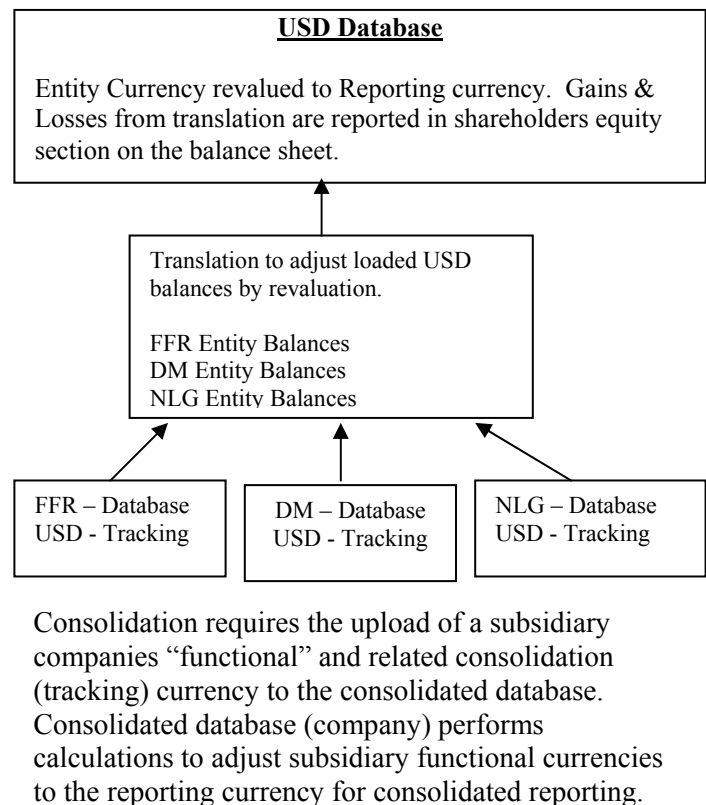
In version 6.0, transaction currency adds a different level of complexity. Invoice transactions denominated in a currency outside a, normal account balances currency automatically cause revaluation at the end of a period if the transaction is still open. The first thing that must happen is to adjust the account balance to reflect any fluctuations in the spot rate between the transaction currency and the account currency. The measurement is the change in the spot rate applied to the transaction to the change in the spot rate on the measurement day. The account balance must be adjusted for these transactions before adjustments to any adjustments to Euro, system, or reporting currency.

See next page for revaluation sequence

Revalue Functional Currency



Revalue Foreign Financial Statements



21.5 Consolidation vs. Functional Reporting (Revaluation Routines)

The above flow chart attempts to depict what is needed in order for corporations to properly adjust account balances to an entities (Companies) functional currency. All translations of amounts to a Company’s functional currency are reported in the income statement of the local company. Subsequent to translating financial statements to the functional currency of the subsidiary the next step is to revalue to the currency required for Corporate consolidation.

Observation: Visual allows for different entities in the database. From an international perspective these entities may in fact have different functional currencies. For example, a manufacturer may have a plant in Germany but hold sales offices in Holland and Italy. Each office records transactions in their local currency. Each entity in this case should have its functional currency as their local currency. If the entity is held in the functional currency of the system currency (as ell as Euro in this case) should be held for conversion. All accounts should be translated into the functional currency of the entity.

If a company has multiple manufacturing sites round the world and each site determines their own course of business and holds their database in their own functional currency Visual needs to allow the proper consolidation of these entities into the corporate reporting currency. These revaluation need to take the numbers reported in the subsidiary financial statements currency and re-measure the values to the reporting currency using the rules mandated by GAAP. Any gains or losses due to re-measurement must be reported in the shareholders equity section of the balance sheet.

Observation: The above scenario depicts the requirements needed to properly consolidate financial information at the consolidated level. It seems necessary to allow the upload of different currency balances into the consolidated database. It would make sense for VISUAL to assume each database (system currency) holds the functional currency of the subsidiary. By making that assumption we can establish a guideline that consolidation entries are done at the system currency level. Uploads into the consolidated database would need to allow for different system currencies by entity in addition to the accumulated consolidated

currency balance values. Once uploaded to the consolidated database revaluation routines (algorithms) can be invoked to set the reporting currency balances to their proper values.

21.5.1 *Timing*

- The flow chart above depicts the sequence of events needed in order to set the system values to their proper state in order for management reports to comply with FASB 52. Visual needs to provide the means to set account, system, Euro, and tracking currency values to what is mandated by GAAP as well as IAS. Typically, revaluation is done at the end of each month, however Visual should provide the flexibility to allow the user to run them whenever they choose.
- An entry should be recorded in the database to perform the actual adjustment. The date of the journal entry as well as the period to be affected by the revaluation should be set by the user. The user should be allowed to set these in advance and store them or submit them at the time of invoking the algorithm.
- The system should allow each revaluation to be run as a mock entry. If the user selects to run it as a mock run, a report should be produced would show the accounts affected by the revaluation routine as well as the overall gain and loss, by currency, the revaluation would generate.
- The system should allow users to create and store settings for all the necessary revaluation they need to perform. They should not be required to create each rule every time they wish to run it.
- If the user creates several revaluation rules they will do so with the intent of running multiple rules in succession. If VISUAL provides the ability to affect a single currency with each rule it will be necessary to piggy back rules. The system should provide the ability to assign a multitude of sub-revaluation rules to a parent rule. Each revaluation rule within the Parent revaluation routine should be allowed to have a sequence assigned to it because the order in which revaluation rules need to be executed is critical to the success of revaluation.

21.6 *Remeasuring Financial Statements to Functional Currency*

The following is a brief review of the translation provisions of FAS-52 for the remeasurement process from the recording currency to the functional currency, prior to translation from the functional currency to the reporting currency.

Two categories of exchange rates are used in remeasuring financial statements. Historical exchange rates are those that existed at the time of the transaction, and the current exchange rate is the rate that is current at the date of remeasurement.

Monetary assets and liabilities are those that should be fixed in amount each period, such as cash, accounts receivable, and most liabilities. Monetary assets and liabilities are translated at the current rate of exchange. All other assets, liabilities, and stockholders' equity are remeasured by reference to money price exchanges based on the type of market and time (historical exchange rate). Therefore, VISUAL needs to provide a way for users to designate which accounts in the trial balance are subject to revaluation and at which rate.

21.6.1 *Monetary assets and most liabilities are measured using the following exchange rates:*

1. Past purchase exchange—the historical or acquisition cost, because it is based on the actual past purchase price.
2. Current purchase exchange—the replacement cost, because it is measured by the current purchase price of a similar resource.
3. Current sale exchange—the market price, because it is based on the current selling price of the resource.
4. Future exchange—the present value of future net money receipts, discounted cash flow, or the discounted net realizable value, because it is based on a future resource.

21.6.2 *Remaining assets, liabilities, and stockholders' equity*

All other assets, liabilities and shareholder equity accounts are remeasured based on the four money price exchanges, as follows:

1. Accounts based on past purchase exchanges (historical or acquisition cost) are remeasured at historical exchange rates.
2. Accounts based on current purchase, current sale, and future exchanges are remeasured at the current exchange rate.
3. Revenue and expense transactions are remeasured at the average exchange rate for the period, except those expenses related to assets and liabilities, which are remeasured at historical exchange rates. For example, depreciation and amortization are remeasured at historical exchange rates, the rate that existed at the time the underlying related asset was acquired.

The following is a list of assets, liabilities, and stockholders' equity items and their corresponding remeasurement rates under FAS-52:

	Remeasurement Rates	
	<u>Current</u>	<u>Historical</u>
Cash (in almost all forms)	X	
Marketable securities—at cost		X
Marketable securities—at market	X	
Accounts and notes receivable	X	
Allowance for receivables		X
Inventories (FG) - at cost		X
Inventories (FG) - at market, net realizable value, selling price	X	
Inventories—under fixed contract price	X	
Prepaid expenses		X
Refundable deposits	X	
Advances to subsidiaries	X	
Fixed assets		X
Accumulated depreciation		X
Cash surrender value—life insurance	X	
Intangible assets (all)		X
Accounts and notes payable	X	

	Remeasurement Rates	
	<u>Current</u>	<u>Historical</u>
Accrued expenses	X	
Accrued losses on firm commitments	X	
Taxes payable	X	
All long-term liabilities	X	
Unamortized premium or discounts on long-term liabilities	X	
Obligations under warranties	X	
Deferred income		X
Capital stock		X
Retained earnings		X
Minority interests		X

Revenue and expenses not related to any balance sheet items are remeasured at the average currency exchange rate for the period. The average may be based on a daily, weekly, monthly, or quarterly basis or on the weighted-average rate for the period, which will probably result in a more meaningful conversion. Revenue and expense items that are related to a balance sheet account, such as deferred income, depreciation, and beginning and ending inventories, are remeasured at the same exchange rate as the related balance sheet item.

Observation: VISUAL needs to provide the ability for users to input the exchange rate to use on the revaluation (as opposed to simply pulling the current spot rate on any given day). Because it is our intention to perform consolidated entries in system as well as reporting (Tracking) currency, we are effectively storing historical exchange information at the transaction level for all income statement accounts. In my opinion, this appeases the need to provide a routine to establish a weighted average exchange rate to revalue income and expense accounts (except depreciation). If a user finds it necessary or desires to perform a “weighted average” translation adjustment, we need to allow them to do so. By offering them the ability to manually enter an exchange rate they could determine the average rate to use, outside the system, and manually supply it to the revaluation algorithm.

21.6.3 *Measuring Finished Goods Inventory*

In remeasuring finished goods inventory according to the lower-of-cost-or-market rule, the remeasured historical cost is compared to the remeasured market, and whichever is lower in functional currency is used. This may require a write-down in the functional currency from cost to market, which was not required in the foreign currency financial statements. On the other hand, if market was used on the foreign statements and in remeasuring to the functional currency market exceeds historical cost, the write-down to market on the foreign statements will have to be reversed before remeasuring, which would then be done at the historical rate. Once inventory has been written down to market in remeasured functional currency statements, the resulting carrying amount is used in future translations until the inventory is sold or a further write-down is necessary. This same procedure is used for assets, other than inventory, that may have to be written down from historical cost.

What this means is that the finished goods inventory accounts will be written down if the market value of the inventory is below the cost. However, if the market value rises to a price above the original cost the value should never exceed the original cost of the finished goods inventory. Therefore, it would be

necessary in these circumstances for the original cost of the finished goods inventory layers to be permanently stored. Any translation adjustments up from the market value (derived by a write down) would stop as soon as the accumulated value for that layer reached zero (i.e. original cost). Of course the write down of inventory could occur in multiple stages.

Observation: The reason for the above procedure in applying the lower-of-cost-or-market rule in remeasuring foreign financial statements is that exchange gains and losses are a consequence of remeasurement and not of applying the lower-of-cost-or-market rule. This means that remeasured market is equal to replacement cost (market) in the foreign currency remeasured at the current exchange rate, except that:

1. Remeasured market cannot exceed net realizable value in foreign currency translated at the current exchange rate.
2. Remeasured market cannot be less than (1) above, reduced by an approximate normal profit translated at the current exchange rate.

21.6.4 *Current Exchange Rate*

For remeasurement purposes, the current exchange rate is the one in effect as of the balance sheet date of the foreign statements. Therefore, if the parent company's financial statements are at a date different from the date(s) of its foreign operation(s), the exchange rate in effect at the date of the foreign subsidiary's balance sheet is used for remeasurement and translation purposes.

Any translation adjustment arising from the remeasurement process is included in net income for the period. In other words, any gain or loss resulting from the remeasurement process that is required by FAS-52 is included in net income in the remeasured financial statements (FAS-52, par. 47).

After the foreign entity's financial statements are remeasured in the functional currency, they are ready for translation. If the functional currency of a foreign entity is the U.S. dollar and the reporting currency of the parent is also the U.S. dollar, there will be no translation adjustment.

21.7 *Translation Of Foreign Operations—Highly Inflationary Economies*

FAS-52 defines a highly inflationary economy as one in which the cumulative inflation over a three-year consecutive period approximates 100%. In other words, the inflation rate in an economy must be rising at the rate of about 30-35% per year for three consecutive years to be classified as highly inflationary.

For the purposes of FAS-52, a foreign entity in a highly inflationary economy does not have a functional currency. The functional currency of the "reporting entity" is used as the functional currency of the foreign entity in a highly inflationary economy. Thus, the financial statements for a foreign entity in a highly inflationary economy are remeasured into the functional currency of the reporting entity. The remeasurement process required by FAS-52 is the same as that required for a foreign entity's financial statements that are not expressed in the functional currency (FAS-52, par. 11). By instituting "tracking" currency we can appease this requirements.

Observation: Apparently, exchange adjustments resulting from the remeasurement process for foreign entities in highly inflationary economies are included in the determination of remeasured net income, rather than reported as a separate component of stockholders' equity.

The International Monetary Fund (IMF) publishes monthly statistics on international inflation rates. After the financial statements of a foreign entity in a highly inflationary economy are expressed in the functional currency of the reporting entity, they are ready for translation. Since the financial statements are now expressed in the reporting currency, however, there will be no translation adjustment.

21.8 Translation Of Foreign Currency Financial Statements

Foreign currency financial statements must be in conformity with GAAP before they are translated into the functional currency of the reporting entity. FAS-52 covers the translation of financial statements from one functional currency to another for the purposes of consolidation, combination, or the equity method of accounting. Translation of financial statements for any other purpose is beyond the scope of FAS-52.

Observation: If the functional currency of a foreign operation is the same as that of its parent, there is no need for translation. A translation adjustment occurs only if the foreign operation's functional currency is a functional currency different from that of its parent.

The translation of foreign currency financial statements to the functional currency of the reporting entity does not produce realized exchange gains or losses. Instead, the gains or losses are considered unrealized and are recorded and reported as a separate component of stockholders' equity (FAS-52, par. 13). For this reason it is imperative that the revaluation algorithms have the ability to assign which exchange gain/loss account will be affected according to the currency being revalued. Companies that require the ability to consolidate foreign entity financial statements need the ability to determine whether to affect the accumulated translation adjustment account in the shareholders equity section of the balance sheet or affect the income statement.

Observation: Paragraph 12 of FAS-52 states, "All elements of financial statements shall be translated by using a current exchange rate." This statement is potentially misleading because common stock, paid-in capital, donated capital, retained earnings, and similar items are not translated at the current exchange rate. Translation of these elements of the financial statements is made as follows:

- Capital accounts are translated at their historical exchange rates when the capital stock was issued (Common Stock), or at the historical exchange rate when the capital stock was acquired (Treasury Stock).
- Retained earnings are translated at the translated amount at the end of the prior period, plus the translated amount of net income for the current period, less the translated amount of any dividends declared during the current period.
- Assets and liabilities are translated from the foreign entity's functional currency to the reporting entity's functional currency using the current exchange rate at the balance sheet date of the foreign entity (FAS-52, par. 12). If a current exchange rate is not available at the balance sheet date of the foreign entity being translated, the first exchange rate available after the balance sheet date is used (FAS-52, par. 26).
- Revenue, expenses, and gains and losses are translated from the foreign entity's functional currency to produce the approximate results that would have occurred if each transaction had been translated using the exchange rate in effect on the date that the transaction was recognized. Since the separate translation of every transaction is impractical, an appropriate weighted-average exchange rate for the period should be used (FAS-52, par. 12). This is not the case if we institute "tracking" currency. By doing so we will capture every income & expense transaction at its historical rate and thus would be in compliance with the spirit of FAS-52, par. 12.
- Gains or losses on the translation of foreign currency financial statements for the purposes of consolidation, combination, or reporting on the equity method are not included in current net income. All adjustments resulting from the translation of foreign currency financial statements are recorded and reported as a separate component of stockholders' equity. Thus, these adjustments are treated as unrealized gains and losses which are reported as a separate component of shareholders equity.

Due to the above regulation regarding consolidation of related company foreign currency financial statements is ability to upload consolidation entries in 'functional' as well as consolidated currency. By uploading both balance types as they exist on the foreign entity we appease the need to calculate a weighted average exchange rate to apply to income statement accounts and we provide the historical reference necessary to properly adjust the currency balances to their proper historical system currency.

Barring the ability to upload multiple currency balances, because of the need to report historical “consolidated VISUAL would be Users need the ability to revalue these foreign currency financial balances in “consolidated reporting” currency. For this to occur the upload process needs to record consolidation entries by functional (system) as well as consolidated reporting (tracking) currency.

The consolidated entry should be based off the consolidated chart of accounts. See consolidated chart of accounts in the next paragraph.

21.9 Realization Of Separate Component Of Stockholders’ Equity

Upon part, complete, or substantially complete sale or upon complete liquidation of an investment in a foreign entity, a pro rata portion of the accumulated translation adjustments attributable to that foreign entity, which has been recorded as a separate component of stockholders’ equity, is included in determining the gain or loss on the sale or other disposition of that foreign investment (FIN-37, par. 2). Thus, if an enterprise sells a 50% ownership interest in a foreign investment, 50% of the accumulated translation adjustments related to that foreign investment is included in determining the gain or loss on the sale of the interest.

OBSERVATION: Any required provision for the permanent impairment of a foreign investment is determined before translation and consolidation (FAS-52, par. 118). Apparently, this means that the amounts accumulated in the separate component of stockholders’ equity for a specific foreign investment are not included in determining whether the investment has become permanently impaired.

21.9.1 Revaluation Requirements

Based on the discussion above there are different types of routines required in order for an organization to properly adjust and translate foreign accounts and operations. One can also see that any resulting gain/loss in the remeasurement process does not necessarily affect income and expense. It may be written to an accumulated adjustments account held as a separate component of stockholders equity. In addition, certain types of accounts are inexplicably tied to the currency spot rate, while other accounts simply report historical values yet still others must be adjusted to reflect a weighted average rate.

As state above the local functional entity will need to be, able to adjust currency monetary assets and liabilities to their current market value based on an exchange rate at the end of a period. Therefore, users need to be able to establish monetary assets and liabilities from non-monetary assets and liabilities. Monetary assets and liabilities are always converted at a spot rate on a given day (month or fiscal period end). Non-monetary assets and liabilities are usually reported at their historical exchange rate.

21.10 Types of revaluation rules needed

- Rules to adjust account balances based on transactions held in other than account currency.
- Monetary assets & liabilities adjusted to current spot rate. Resulting exchange gain/loss posted to income statement account.
- Rule to adjust functional currency accounts to reporting currency. Resulting exchange gain/loss posted to income statement account.
- Rule to adjust functional currency financial statements to reporting currency. Resulting gain/loss posted to translation adjustment accounts as a separate component of shareholders equity. **
- Rule to adjust income & expense accounts to reflect a weighted average. Resulting gain/loss posted to income statement account.

**** This method results when translating financial statements of entities that are not an integral component of the reporting entity (i.e. the foreign entity operated autonomously from the reporting entity). This is a**

consolidation issue only. Therefore, entities will need to first be consolidated in their functional currency. Next, the functional currency needs to be translated to the reporting currency.

21.11 Revaluation Rules

There will be a need to setup rules for revaluation. Customers that use the multi-currency aspects of VISUAL will need to keep their accounts, system (Euro), entity and consolidated reporting (tracking) currencies in their proper values.

Ultimately every value in the database stems from a transaction value and the currency assigned to the transaction. Then when you introduce account currency (AR, AP, GL, Bank Accounts, etc) as well as entity and multiple tracking currencies you introduce another level of complexity. In Version 6.0 we will be introducing each scenario. This requires Lilly to provide a facility where users have the ability to maintain the account balances they need to track. For lack of a better term I call these Revaluation Rules/Algorithms.

21.12 Requirements of the Revaluation Process

- Assigned accounts (currency) to revalue. Its quite possible users may want to skip revaluing accounts denominated in a certain currency. However I think they should have the ability to choose on a individual account basis or on by a global need by currency.
- Assign the exchange rate.
- Assign the GL exchange gain/loss account to hit. These accounts should be denominated in the currency of the write-off. The transaction could be in the system currency yet the users need a way to determine what the write-off amount by currency is, as well as the balance.
- Identify the posting date, period and year to affect.
- Have the ability to delete a portion or an entire revaluation posting run.

21.13 Revaluation Rule Sub-routines

Establish revaluation rules where selections can be stored to kick off each month end without having to set the criteria for revaluation (other than exchange rate information) to execute each month.

21.14 Account Selection

In general, not all accounts in a general ledger held outside the system (or Euro) currency are subject to revaluation. Only those accounts where account balances are required to be reported at the current exchange rate or by some weighted average require remeasurement.

In most cases movements in exchange rates affect balance sheet accounts, unless a user decides to revalue income statement accounts. This is completely allowable by GAAP and thus we need to provide users this ability. Therefore, we need to give the users the flexibility to determine the G/L accounts to be revalued. Lets take a closer look at the accounts affected by revaluation:

- Accounts Receivable (subsidiary ledger, account currency)
- Accounts Payable (subsidiary ledger, account currency)
- Bank Accounts (Account currency)
- Marketable Securities (account currency)**
- Notes Receivable (account currency)**
- Customer Deposits (account currency)**
- Vendor Deposits (account currency)**
- Warehouse Inventories**
- Income Statement (If revaluation performed daily)

- etc

**** Again we see account currency implication.**

As you can see there are many types of accounts on the general ledger and subsidiary ledgers that can be sensitive to movements in exchange rates. Because of this Visual needs to provide users the ability to make or assign which accounts to revalue. For AR, AP and bank accounts Visual should handle these automatically. We know these accounts are subject to movements in exchange rates so we need to provide routines that will scan and adjust according to the flow chart above.

Visual Financials can make certain assumption with respect to periodic revaluation routines needed. First, we know the sequence (flow chart above) of events that needs to happen to get the functional system values to their proper reporting state. Therefore, we can assume users of Visual that transact business outside their national currency will use parts or all of the sequences defined above. What we do not know is which of the sequences they need. For example, if all transactions are posted in account currency then there is no need to perform a revaluation routine that checks for transaction currency. Likewise if a company reports only in system currency and does not need to report in any reporting or Euro currency then there is no need to run a revaluation routine which checks for reporting currency.

- For these reasons users need to flexibility to set up different kinds of rules to determine the type of revaluation being performed (Transaction => Account, Account => Euro, Account => System, System => Reporting (*n*)). The sequences of running these routines are just as important.

Ideally, if Visual Financials could determine the sequence of events for them that would be great. For example, if Visual was smart enough to know when a transaction currency fell outside of an account currency then it could track that. Further, if it could remember what the currencies were (transaction and account), then it would know would know which Transaction => Account revaluation routines need to be performed. In addition, if Visual knew if an account currency fell outside the system (Euro) currency and could remember, then it would know which Account => System or Account => Euro routines need to be performed. All these would require settings on the account level. If we allow settings on the chart of accounts to determine which accounts are revalued and how (spot rate, average rate, no revaluation) then it may be possible for the system to simply handle all the revaluation needs without ever setting up a revaluation routine.

- Euro and reporting currency revaluation decisions need to be made on a global scale, therefore Visual should know what to do in these circumstances. I think it is important for Visual to be able to assist the end user by alerting them to the fact that certain routines need to be run and the sequence of running them. For example, if Visual knows that there are open (unpaid) invoices (remember not all transactions outside an accounts normal currency balance has rate fluctuation sensitivity) outside an accounts normal currency balance it should alert the user. If they try to run an Account => System routine the system should alert them that there are transaction on the file which may affect certain account currency balances and thus could lead to inaccurate revaluation of account balances.

21.15 Change Default Currency for Customer & Vendor Accounts

With the advent of the Euro some users will need to have the ability to change Customer & Vendor default currency setting on a potentially massive basis. The EMU is going to be putting pressure on banks to transact in EUR currency. The banks could indeed put pressure on their clients to transact in EUR. It is quite possible that at any point in time a large group of customers and/or vendors could request invoices and payments to be handled in EUR.

Visual should allow users to change the default currency on a single account or a large block accounts by some designated manner. You would not want to change all accounts globally because there could be customers or vendors that do not need to have their currency changed. Users should have the ability to change the default currency of accounts that have a default currency of one of the EMU countries or a currency that has been permanently fixed with respect to the EUR. This change should only be allowed by SYSADM and no other security profile:

Food for thought on facilities to change default account currency. Again, this should only be allowed by SSADM security.

- Manually if EMU county.
- Globally for accounts in EMU country
- Provide a utility that incorporated advanced browse where a list of customers or vendors and their currencies are displayed and are allowed to be manipulated. Something along this idea might be the most effective way to handle. Requires manual adjustment, but makes the process simple.

21.16 *G/L Control Accounts*

Revaluation routines always apply to account balances. Whether an account tracks a single currency balance or multiple currency balances they apply to accounts. During the creation of an account in account maintenance users should be able to identify to VISUAL if the account is subject to revaluation. Those accounts that report historical information would not be set to allow revaluation while those that are subject to the current spot rate or some weighted average rate would be subject to revaluation. This would assist Visual Financials in isolating the accounts it needs to potentially adjust when performing a revaluation routine.

- VISUAL needs to be able to define and account in the GL as a control account. The identification of a control account has specific ramifications.
 1. Entries affecting a control account, unless performed through revaluation, are not allowed unless they are affected through the Customer or Vendor subsidiary account. Normal journal entries should never be allowed to a control account.
 2. Revaluations affecting the control accounts are bases on balances sitting in specific subsidiary accounts. A subsidiaries account balance can be made up of several items. Invoices, credit memos, unapplied cash memos and deposits. Any open items in a transaction currency denominated in a currency outside the customer or vendors normal account currency will affect the currency balance of those accounts. Transaction currency outside the normal account currency (for subsidiary accounts) will affect the account currency balance. From the correct account currency balance any system, entity and tracking currency balances need to be adjusted. **We must ensure that the sum of open items by subsidiary account currency for each period equate to the currency balances held against the GL Control account(s) (AR, AP, Deposits, Bank accounts, etc) in each currency.**

Observation: Aging reports should always tie out to the General Ledger for any given currency balance required to be held. They also need the ability to track history for the following transactions, invoices, credit memos, unapplied cash memos and deposits. If users have the ability to print an AP or AR aging or a customer statement report at any point in time and generate the proper subsidiary account balance that existed as of that moment (taking invoices, deposits, credit memos and unapplied cash memos), VISUAL can avoid the need to post revaluation entries to the specific subsidiary accounts. The postings to the GL would need to be made in the proper order, for each currency balance needing to be held against each specific control account.

- Bank account balances are another balances that are affected by movements in exchange rates from day to day. The sum of bank accounts denominated in a non-system currency need to be revalued. There is no need to examine transaction currency in these accounts only account currency. Account currencies will undoubtedly need to be revalued periodically. The GL control account for the bank accounts need to reflect all necessary currency balances for proper lookup and the ability of tying the sum of individual banks of their particular currency.

21.17 *Accounts Holding Consolidation Balance Information*

Summary accounts should roll up system, entity, and “tracking” currency balances. Posting level accounts should be able to alternately display account, system, or “tracking” currency balance information.

21.18 *Consolidation Entries*

Gains or losses on the translation of foreign currency financial statements for the purposes of consolidation, combination, or reporting marketable securities on the equity method are not included in current net income. All adjustments resulting

from the translation of foreign currency financial statements are treated as unrealized gains and losses reported as a separate component of stockholders' equity.

- This mandates the need to assign different exchange gain/loss accounts to a revaluation rule based on the type of revaluation to be performed. In a true business sense all consolidated revaluations will be done at the corporate headquarters. This means VISUAL will need to provide the Parent company with the consolidated entry in both the functional currency as well as the translated consolidation currency. The Parent company will need to perform the consolidation revaluation routines to further adjust the subsidiary companies general ledger balances to properly consolidate foreign currency financial statements of the subsidiary companies.

21.19 Multi-Currency and the Affects on Commission Calculations

Generating commissions needs to handle transaction currency. When an invoice is created in currency outside the system and account currency, the appropriate exchange values need to be assigned. In addition, the commission to the vendor (Sales Rep) should be posted in the same transaction currency, with the proper conversion from the transaction currency to the vendor (or employees) currency.

As far as my testing has confirmed (still more to be done) the commission module appears to be working fine. To date I haven't uncovered any anomalies.

Currently the vendor (or employee) bears the exposure of movements in exchange rate, from the time of invoicing to the time of payment. I believe this is a safe assumption to make for now. If any changes need to be made to who bears the exposure we will hopefully be able to build this in when we address configurable commissions some time in the future.

21.20 Current System Anomaly

The system does not calculate the proper commissions where the customer currency and the sales rep (Vendor ID) currency are different than the system currency it appears improper values are being calculated. The following happened:

System Currency = USD
Vendor Currency = CAD
Sales Rep. Currency = NLG

Assume the following rates in affect for each transaction.

NLG 124.22 NLG to 1 USD
CAD 1.49 CAD to 1 USD

Took a customer order for 15,000 CAD and subsequently shipped it. Commission rate = 10%.

Generated Commission prior to creating the Invoice through invoice forms. Created with the "Pay" option.

Sales Rep invoice generated for 277,465.25 off of a system currency of 2,333.66. I don't know how it came up with that value.

When the invoice was finally generated it was created with a equivalent system currency value of 10,066.50 and a commission accrual of 1,006.65 which appear to be correct. The value of 1006.65 USD should have equated to an NLG value of 125,046.06. Which is the same value the AP invoice should have been created for as well the converted system currency value should have equated to 1006.65.

We need to ensure the system properly records commission values for transactions, customers, sales reps, system, entity, and tracking currency.

21.21 Payments to Vendors

While transactions to certain vendors should be posted in transaction currency, very rarely would a company want to pay a vendor (commission agent) in a currency other than what the commissioned agent expects to receive. VISUAL should handle the following functionality for version 6.0.

Invoices posted in transaction currency should be converted to vendor (commission agent) currency for the purpose of generating payments in the proper currency.

This requires the system to convert a transaction denominated in other than vendor currency, apply an exchange rate based on the payment date. Any resulting "currency" write-off in system, account and reporting should occur. Exchange gains and losses should be captured in the appropriate account, system, entity, and tracking currency where necessary.

Sales reps. (vendors) cause a need for revaluation. They should be treated like any other liability account. All commission costs generated are on a one-time basis. While market rates for a liability denominated in a different currency will fluctuate, this fluctuation should be reflected as an adjustment to the GL control account for each period. This should not affect the liability to be paid to the sales person (vendor).

For example: Assume there is a US manufacturer that sells goods in Canada. They have sales people in Canada to where they pay in CAD dollars. Further assume the customer applies a rate at the time of shipment, not at the time of the order unless prior arrangements have been made. Assume 10% commission rate.

<u>Currency</u>	<u>2/1/98</u>	<u>2/28/98</u>	<u>3/31/98</u>
USD	1.00	1.00	1.00
CAD	1.45 to 1 US	1.51 to 1 US	1.40 to 1 US

- On 2/1/98 Customer orders goods which total 1,000 CAD

No entry required, no entry made.

- On 2/28/98 they ship the goods to the customer and invoice them for the goods. No prior arrangements had been made.

	<u>CAD</u>	<u>USD</u>
Accounts Receivable	1,000.00 DR	662.25 DR
Commission Expense	100.00 DR	66.23 DR
Commission Accrual	100.00 CR	66.23 CR
Sales	1,000.00 CR	662.25 CR

- When the system creates the Vendor Invoice (Generate Commissions) the accrual is relieved and the AP vendor liability account is credited. The commission should be properly converted to the vendors currency from the system currency value.

Commission Accrual	100.00 DR	66.23 DR
Accounts Payable (Vendor)	100.00 CR	66.23 CR

For simplicity sake movements in exchange rate are not taken into account in this example. The exchange rate applied to the sales invoice are the ones posted with the vendor invoice created through the generate commissions option.

- On March 3/31/1998 adjust system to reflect proper system value.

AR Account adjustment		
Accounts Receivable	no entry	52.04 DR

Exchange Gain	no entry	52.04 CR
AP Account (sales rep) adjustment		
Exchange Loss	no entry	5.20 DR
Accounts Payable	no entry	5.20 CR

While there was an unrealized gain on the fluctuation of the Canadian rate on the receivable side, there was a loss on exchange for the liability.

Note: In the case of where commissions are shared with sales reps in different countries, the transactions to the other sales rep. should be booked in the original transaction currency. Payments to these vendors should be based on the rate in affect at the time of payment, however the sales reps. need to be paid in their expected currency, not the transaction currency. To protect against currency fluctuations some users will want to apply the rate in affect at the time of original booking the AR.

This is a perfect example of what rate fluctuation do on the receivable side as well as the payable side of the house. A better way to view this is to think of accounts as normal debit balances and normal credit balances. Account receivable accounts are normal debit while account payable accounts are normal credit balances. Of course it's important to keep in mind that only accounts with true market exposure should be revalued. This would not be the case with income and expense accounts. These accounts need to keep there historical perspective, unless a customer will revalue on a daily basis, which is highly unlikely. In any case if they choose to do so they can set up a revaluation rule to do so.

21.22 Warehouse Currency Balances

Visual needs to handle warehouse currency transactions. Currently the system assumes warehouses are stored in system currency. In Europe and Asia often times manufacturing facilities will have warehouses tied to a single entity located in different countries. These warehouses can often transfer goods between on another without there being any kind of inter-company transaction. When these goods are transferred the cost associated with the goods needs to be reflected in both warehouses books in the warehouses currency. Most of these transactions are handled through an inter-company account, a Due to/From Subsidiary. These accounts should be in the currency of the subsidiary and have transaction values flow through them. Again, we have another area where it may make sense to include account currency.

Warehouse transfers can be in one of two forms. The first type is where a single company has multiple warehouses in different countries yet they belong to the main manufacturing unit and are not separately operated. The second type of scenario is where the warehouses are operated as separate profit centers.

Warehouses run and operated as separate profit centers will no really transfer inventory to one location, they will sell inventory to the other warehouse. By the very nature of these transactions they are called inter-company transactions. GAAP requires any profit derived on “inter-company” sales, be eliminated in the consolidated financial statements. **It is not our intention to offer the automatic handling of inter-company transactions in version 6.0. It makes much more sense to incorporate this level of flexibility when addressing multi-plant, which is where Dick would like us to venture into next.**

The type of inventory transfers we do need to automatically handle are those that simply transfer inventory from one location to another. Users should have the ability to transfer inventory from one warehouse to another regardless of the currency of the warehouse.

VISUAL needs to offer:

- Warehouses denominated in different currencies.
- Ability to transfer from one warehouse to another regardless of the currency of the warehouse.
- All costs should be kept at their historical values.

What we need to do is to hold all warehoused in warehouse, system, entity and tracking currency. Any transfers from one warehouse to another should convert only the warehouse currency values. All other values should be carried at their historical values. **The cost of the inventory layer should not change in value due to a transfer from one inventory location to another. The base currency value(s) should be maintained at all times.** Theoretically, the same inventory lay could be transferred between warehouses held in different currencies and the cost of the layer after the first transfer should be the same after the 100th transfer.

For example:

Assume a German manufacturer has two warehouses one is located in Germany and one in France. The German warehouse requests a transfer of 100 parts from the French warehouse. Assume the French warehouse has a cost associated of 15,000 Francs. Additionally, assume the FIFO layer held a cost at a DM rate of .7250. Assume further the exchange rate on that day of the transfer was .7500 francs to one DM.

Transactions:

French Warehouse

	DM	Franc
Inventory shipped to Warehouse	10,875	15,000 DR
Inventory shipped from Warehouse	10,875	15,000 CR

Because the inventory layer should be carried in system currency the FIFO layers original cost should be held. Therefore the original inventory layer should be costed at its original historical value.

Transfers from a warehouse where historical costs are maintained in a separate database (system currency) should be capitalized in the local database at the cost associated with the inventory layer.

22 - Ongoing Examination of Areas to Address

I am still in the process of examining each area with respect to VISUAL's need to be a multi-currency compliant product while at the same time wrestling with phasing in this large undertaking within manageable levels.

22.1 Areas Still Under Research

Language support for acknowledgements, invoices, statements, Cash Receipts & Cash Payments

Progress billings

Cash management

G/L currency balance views **Subject to Change**

Statutory reporting issues

Others to be added to the list.

Allocation routines

Lilly Software Associates, Inc.
Training Guide
Visual Financials 7.0
March 03

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Introduction

This document was prepared to serve as a high-level discussion guide for implementing VISUAL Financials Global Edition. This document is not intended as a replacement for training. The extensive flexibility inherent in the system makes it impossible to outline the option available in determining how an individual environment should be implemented. In fact, this document presupposes that the individuals using the document have undergone the necessary training to understand the concepts and options discussed.

The development of a Chart of Accounts (COA), customers, suppliers and other pertinent data required for every organization cannot be performed by a "one solution fits all" approach. It is expected that each organization will utilize different fashions and will create a totally unique database to suit their specific business requirements.

It is assumed that all installation and security issues have been resolved prior to any "hands-on" education and training takes place. Please refer to other documentation and the product implementation team with any questions on these matters.

Although all efforts have been put forth to make this document as accurate and complete as possible, Lilly Software Associates, Inc. can take no responsibility regarding inaccuracies and inconsistencies due to the continual ongoing development underway in the application. We will continue in our efforts to keep our documentation up to date; however, all topics discussed must be evaluated against the most recent version of the software available.

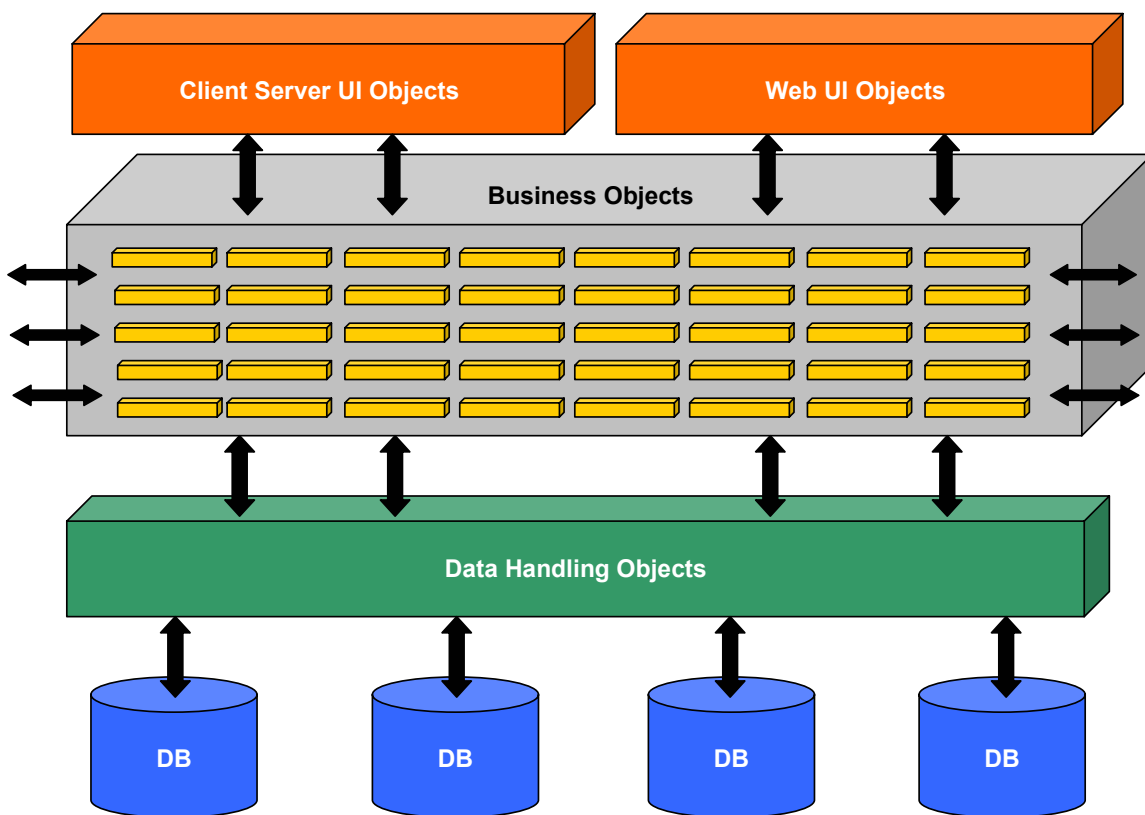
We welcome all questions and comments regarding this documentation and hope that you find this information helpful.

.NET Environment

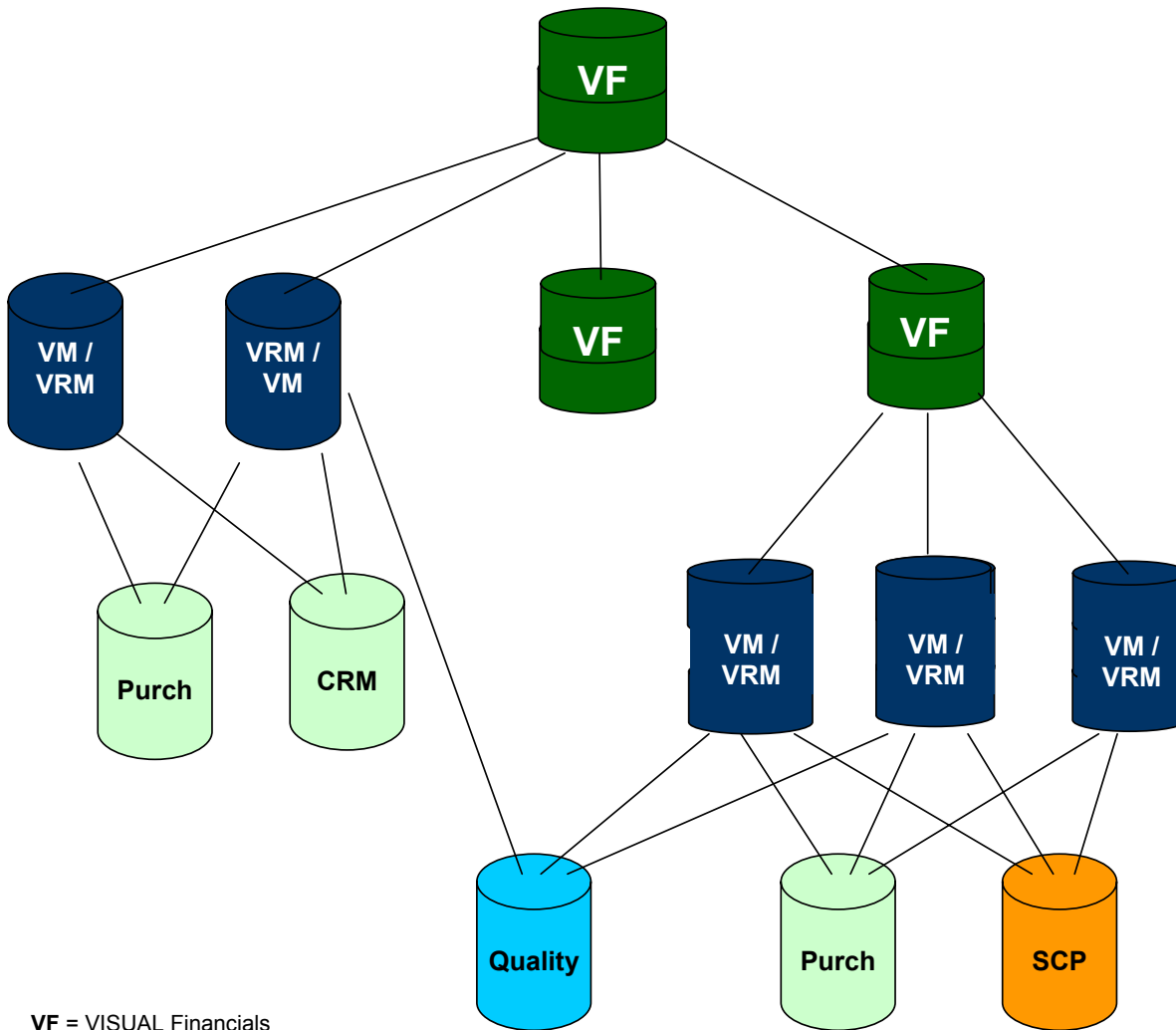
.Net is Microsoft's development environment for building web and wireless enabled applications. It offers the promise of allowing people access to information anytime, no matter where they are located. The only requirement is to be able to access the Internet.

Why Lilly and .Net?

- Centura who? New technology direction to address the markets concerns about Lilly's technology base.
- Offers a more rapid application development environment than Centura
- Multi-tiered, object-oriented application architecture
 - User Interface Objects
 - Business Objects
 - Data Handling (Database) Objects
- Web enabled and Wireless technology



Lilly Software Future Philosophy



VF = VISUAL Financials

VRM = VISUAL Repetitive Manufacturing

VM = VISUAL Manufacturing

Quality = Quality

Purch = Central Purchasing

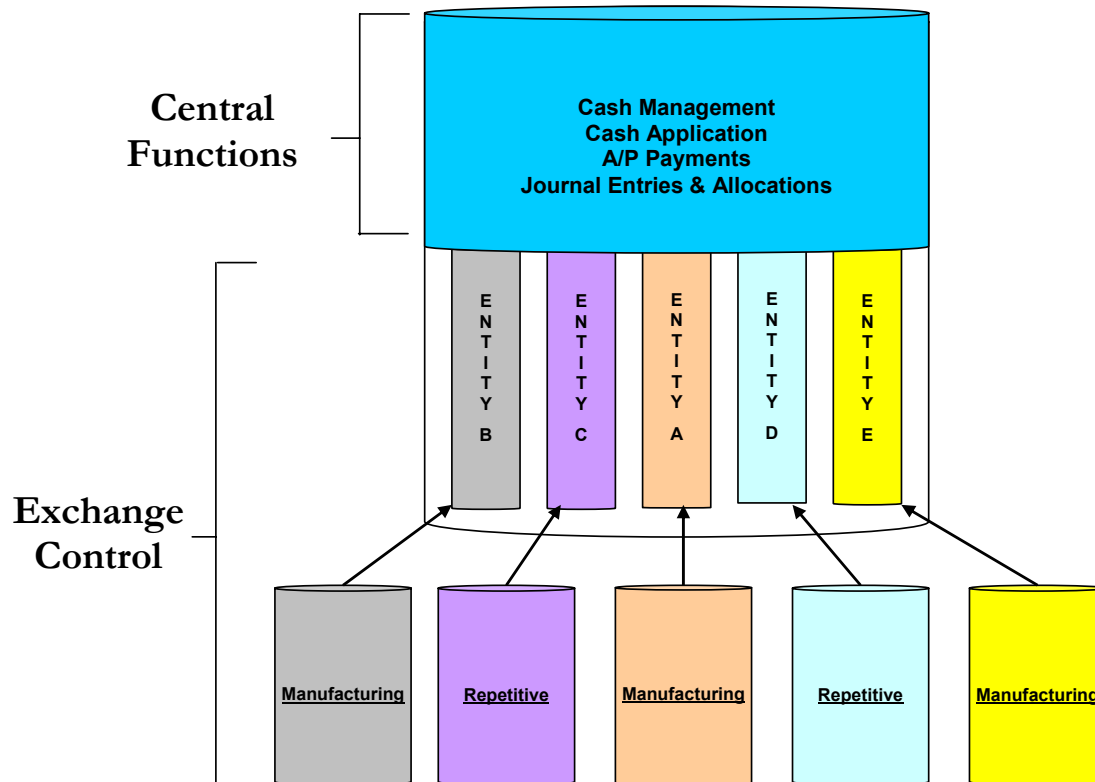
SCP = Supply Chain Planning

CRM = Customer Relationship Management

VISUAL Financials Environment Structure



VISUAL Financials DB Structure



System Presentation

Main Form Components

Upon logging into VISUAL Enterprise and selecting VISUAL Financials, the user is presented with a main (home) form along with the Activity Center (four smaller windows down the left hand side of the form). The home form area serves as the primary area where the user will be working most of the time.

Within the Activity Center, the top window (VISUAL Financials) lists the individual modules within the system that are available for selection. Once an item is selected, the main window is populated with the functions, forms, and tasks for that module. In addition, the second small window (Open Documents) is updated.

The Open Documents window holds all current open forms that the user has accessed. This window provides the user with a very simple way of jumping back and forth between forms and to verify and obtain information quickly.

When opening certain forms, the Tasks window is populated with a variety of related tasks that may be of use while working on the current form. Again, this listing is to assist users in finding the specific task required quickly and easily. Of course, the Favorites window allows users to store their most useful system options in a convenient area for quick retrieval.

The Activity Center can be turned on or off by selecting the Activity Center visible switch within the Window menu on the toolbar.

Menu and Toolbar

Above the window is a standard Menu and Toolbar presentation. The options displayed and highlighted change based on where the user is within the system. This area is commonly used to save or clear a record, add or delete a line within a grid list, and browse through records.

Key aspects of the Menu and Toolbar include:

- When adding new records, the Duplicate or Clear options are used to prepare the form. The system will not allow typing over the key field to create a new record.
- If a Maintenance Menu appears, it generally contains the same options supplied in the Tasks window discussed above. This is provided as a shortcut method to assist users in navigating around the system efficiently.
- An Entity Menu will appear on some forms and system options. Within a Multi-Entity environment it is important that the user is working within the correct entity. The Entity Menu allows the user to change to a different active entity for this form (if security access is allowed) and change the default entity of the user if desired. The Active entity is only valid while the form is open and reverts back to the user's default entity when the form is closed.
- A user can change the column widths of grid displays and ask the system to save the settings. Under Tools, the Save Settings On Exit option must be checked for the widths to be retained.
- The Collaborate option under the File menu links into the user's e-mail system.

Information Bar

Below the main presentation window is the Information Bar. The first and largest area is where messages and hints appear when the system is having trouble performing a task. Further along this bar the system displays the current entity name attached to the user and the user's original User ID and Domain names.

Form Buttons

As users navigate through the system, they will notice two types of buttons attached to many fields.

Down Arrows

The simple "down arrow" indicates a drop-down list of established values that may be selected instead of entering the value. Wherever a "down arrow" indicator is present, that field has the "type ahead" feature and attempts to fill in the remainder of the field based on your initial keystrokes.

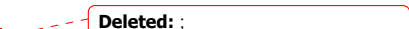
Ellipse (...)

The second type of button is referred to as an ellipse (...). This button invokes a browse window to present the list of available options. The user may scroll through the results to find the desired value, however if the list is very long, filtering options may be used. The system presents one thousand records per page on the query.

The results of the Query can be customized for each user in each form to include or hide information beyond the basic key fields. By right clicking the browse panel, the customize option is available. Users must remember to Save the Layout in order to keep the changes.

By clicking on the down arrow in the upper left corner of the browse panel, a Quick Filter line is opened above the browse results. The user selects the column to filter on and can insert the value to match (% can be used as a wildcard). Filter criteria can be placed on multiple columns if necessary. The results of a Quick Filter are for that page of the original Query results (1000 records).

In most instances, whenever data is presented in grid format, column headings may be clicked to change the sorting and in many cases the filtering characteristics of the information presented. The sort arrow can be clicked multiple times to toggle between ascending and descending sort patterns.



Deleted: ;

Required Fields

During data entry, the system indicates when a field is required with gray arrows in the upper left and lower right hand corners of the field. VISUAL Financials is designed to input all default information whenever possible to ease the burden of remembering standard data.

Security

Overview

The VISUAL Financials system has many facets that create a full security umbrella able to control an individual's access. In general, Roles are established to define the access and monetary levels for processing. User ID's are then added easily and attached to a particular role. Only the master login established at installation is allowed to create new users or roles.

Instances

The installation process requires the definition of the Instances. Under most circumstances multiple Instances are needed. The Master/Control Instances are usually built as LSA. A second Instance is built for the live database and a third instance may be built for a test database.

Users

Under the Tools menu there is an option to Manage Databases select the option to open the Manage Databases option. Select the Users tab, and click the Add New User to add a new user. The User ID (CAPS), User Name, and Password can be established, and in addition, the User ID is also attached to a Role Name from the list on the Roles tab.

These same steps must be repeated for every application instance required for the user. For our purposes, the user must also be added to the VISUAL Financials instance (usually named VFIN). Change the drop-down value on the Instance field to the Instance you want and create the new user in the same fashion as described above.

Roles

Roles are initially established in a very similar way to Users. Under the Tools menu, select the Manage Databases option, and click on the icon to add a role.

This must be done in both the master instance (LSA) and the proper application instances (such as VFIN). In the master instance (LSA), the Domain for the Role must also be established. Highlight the new Role and select the Setup user domains icon. Choose the icon to add a new domain, type in a name and description, and click the icon to add a new instance within the domain. Select the instances required for this role (VFIN would be required for our purposes, LSA should be included if access is required to multiple applications). Multiple domains may be established for a role, this allows an individual to access different databases from the same User ID.

Set Permissions

Now with the new roles established, they should be refined further within the application. Using the master user setup at installation, login into the desired application, and select the Set Permissions option from the Tools menu. Each role is presented in the lower window and each application form is presented in the upper window. Select the form and review each role's access, Read/Write, Read Only, or None. Make any changes necessary to provide the desired accessibility.

Use the System Commands tab to determine which roles will have access to Set Permissions and access other system administration aspects.

Entity Roles

Each role must be further defined for each entity. Although this will be discussed in more detail when the entity records are established, it is important to note that each role is given a security level (0 – 999). A security level is also established on some specific records within the database (Natural Accounts, Calendar Periods, Budgets, Document Types, etc.). Users are given access to records with a higher security level code. Therefore, if a role is set at a level of 50, users on that role cannot access records given a security level of 30.

In addition to the security level assigned to the role on the entity record, different tolerances and override switches are available. Below each role, amount limitations must be set for each currency

NOTE: The Currency must be typed into the field and tabbed out of in order to establish a currency for a role.

Account Views

Primarily used for inquiry purposes, account views can be defined to limit access to certain segment values attached to natural accounts. These views are then saved to the proper role. This will be discussed further in the inquiry section.

Security Levels

Various items within the system permit the setting of a security level. Security levels are assigned to each user role. Security is determined on an ascending priority basis with the lowest setting representing the highest security level (i.e. 0 = Administrator Level security and 999 = Lowest possible security setting).

Database Set-up

The system is designed to support multiple financial entities.

Shared Administrative Parameters

Shared administrative parameters allows users to establish the following defaults:

- Company parameters
- Ledger (account separator)
- Receivable aging period sizes
- Payable aging sizes
- Credit management defaults
- Default auto-numbering for the following areas
 - Budgets
 - Consolidation
 - Recurring general journals
 - Bank accounts
 - Bank Deposits
 - Customer ID's
 - Recurring receivables
 - Suppliers
 - Recurring payables
 - Entity ID's

Period Calendars

One of the first tasks required within VISUAL Financials is to build the accounting calendar. Calendars are common to a database. When assigned to an entity they establish the entities fiscal year and default reporting time frames. However, they can also be used in a reporting or inquiry session to summarize data anywhere from a single day to multiple years. Some calendar examples include:

- Annual
- Fiscal
- 4-4-5
- Weekly
- Daily

An annual calendar is presented below.

Calendar ID Description		ANNUAL Annual Calendar					
Year	Period	Begin Date	End Date	Quarter	Period In Qtr	Label	Security
20yy	1	1/1/20yy	1/31/20yy	1	1	Jan-yy	50
20yy	2	2/1/20yy	2/28/20yy	1	2	Feb-yy	50
20yy	3	3/1/20yy	3/31/20yy	1	3	Mar-yy	50
20yy	4	4/1/20yy	4/30/20yy	2	1	Apr-yy	50
20yy	5	5/1/20yy	5/31/20yy	2	2	May-yy	50
20yy	6	6/1/20yy	6/30/20yy	2	3	Jun-yy	50
20yy	7	7/1/20yy	7/31/20yy	3	1	Jul-yy	50
20yy	8	8/1/20yy	8/31/20yy	3	2	Aug-yy	50
20yy	9	9/1/20yy	9/30/20yy	3	3	Sep-yy	50
20yy	10	10/1/20yy	10/31/20yy	4	1	Oct-yy	50
20yy	11	11/1/20yy	11/30/20yy	4	2	Nov-yy	50
20yy	12	12/1/20yy	12/31/20yy	4	3	Dec-yy	50

Currency Codes

VISUAL Financials provides an extensive multi-currency environment with the ability to track multiple currencies by entity, provide translation at the transaction level, create revaluation adjustments, and support Euro triangulation.

Currencies are common files for use by all entities established in the database.

Exchange Rates

The system supports a currency cross rate environment. The system automatically establishes any reciprocal exchange rates from the point of view of the exchange rate entered by the user.

The system allows reciprocal rates to be modified within a .005 tolerance without affecting the cross rate from which the reciprocal exchange rate was created.

Below is a look at the currency exchange rate table.

To	AUD	CAD	EUR	GBP	SWF	USD
From						
AUD	1.00000	0.8114	.5902	0.33400161	.85849345	0.53112
CAD	1.2325	1.00000	.7274	.41162273	1.05800513	.6546
EUR	1.6943	1.3748	1.00000	.5658983	2.84484362	1.76005142
GBP	2.99399753	2.42940908	1.7671	1.00000	2.5703273	1.59021329
SWF	1.16483125	.945175	.6875	.38905551	1.00000	0.61868125
USD	1.8828	1.5277	1.1112	.62884949	1.61634121	1.00000

The table above is read From/To. Conversions of currency values are performed from one currency to another. In the above table converting a USD transaction to CAD would involve looking up the USD currency in the "From" row and multiplying it by the CAD currency rate contained in the "To" column. For example, \$1.0000 USD would equate to \$1.5277 CAD

Euro Conversion

The system converts all values via multiplication unless the currencies are identified as Euro participants. Where currencies are identified as Euro participants the system uses the triangulation method of conversion.

Entity Records

Entities are established in the database by creating an entity record with a unique entity ID.

Note: When integrating a VISUAL Financials entity to a VISUAL Manufacturing entity, the entities in the two databases are integrated through the VISUAL Exchange process. To link a financial entity to a manufacturing entity requires the entity ID's both databases to be identical.

General Tab

Identifies general entity default setting and processing options:

- Calendar – as discussed above
- Root Category – Default reporting structure
- System = Entities functional currency
- Industry ID – Industry ID in which the entity operates.
- Multiple currencies Allowed – Required to enable multi-currency processing
- Partial payment discounts – Permits discounts applied on partial payments or receipts
- Prorate tax in agings – System defaults tax amounts to the first installment.

Currencies Tab

The currency tab is used to determine which database established currencies are permitted for processing for a given entity.

Due To/From Accounts Tab (Cross entity processing)

Establishes the accounts to be used to balance cross entity transactions between the source entity and a target entity applied to transaction lines.

The "Due to/from accounts" are required in both the source and target entity to enable cross entity processing between two entities.

Default Accounts Tab

Default accounts are defined for each entity and are utilized to create posting distributions when override accounts are not pre-supplied (i.e. from the customer, supplier, sales rep, etc.).

Finance Charge Tab

Allows each entity to establish default finance charge settings.

Addresses Tab

Establishes the addresses pertinent to the entity, and allows addresses to be defined as the main address, a remit to address and identify an address as a default remit-to address.

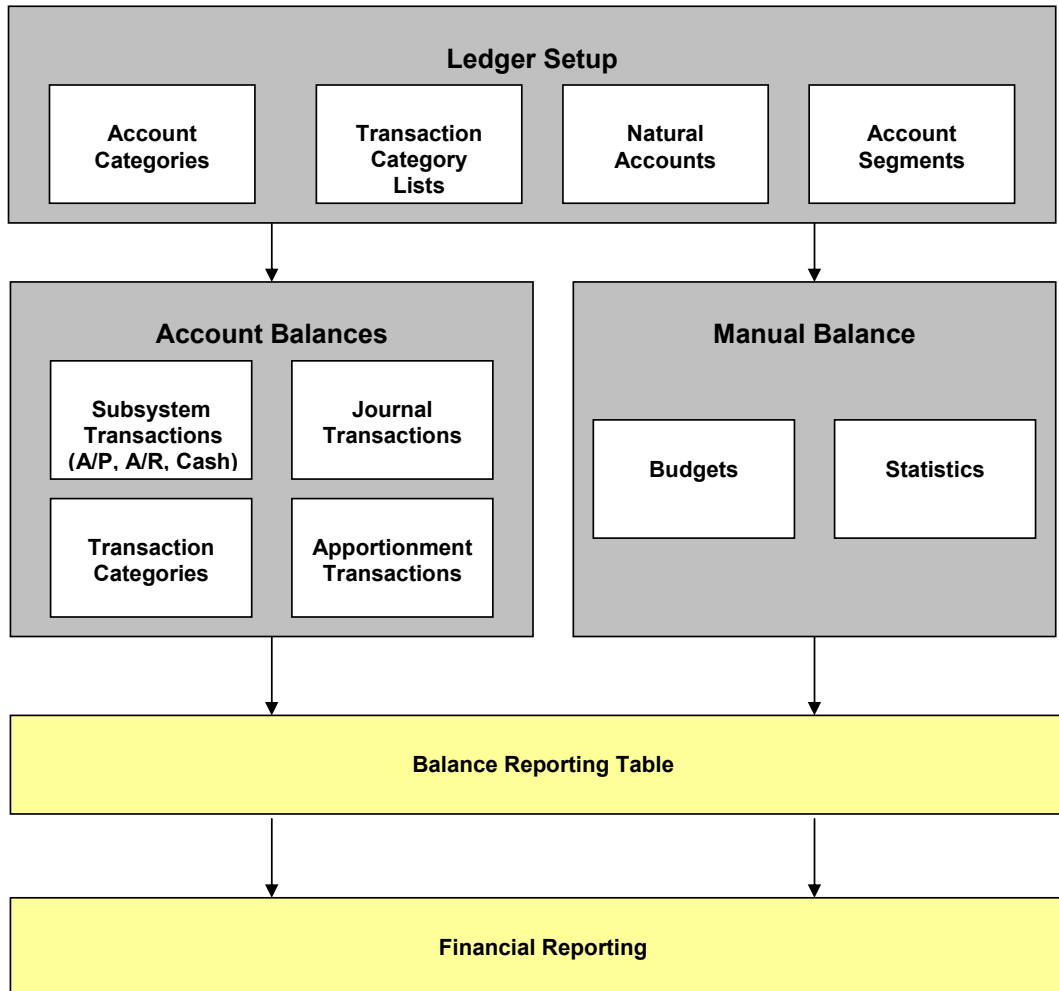
Entity Role Tab

Roles are assigned to entities. Each entity establishes the roles security level and a variety of transaction tolerance and overrides.

Chart of Accounts (COA)

The system requires all postings in the system to be assigned to posting level accounts. Posting level accounts at a minimum are defined by a "Natural account". The natural account can be further defined to include account "Segments" as well as "Transaction Categories".

Overview



The systems financial account/reporting structure is made up of four main components:

1. Account categories (defined in hierarchical structure)
2. Natural Accounts (linked to account categories)

3. Segments (linked to natural accounts)
4. Transaction categories (assigned to natural accounts or segments)

Account Categories

Account categories provide users the ability to establish their particular financial reporting structure. The reporting structure sits above the natural account.

- Categories are created in top-down fashion from the highest-level summary to the lowest level.
- Each natural account created in the system is assigned an account category.
- Only Account categories at the lowest level can be assigned to natural accounts. For example, the account categories CHECKING, PAYROLL and PETTY can be attached to one or more natural accounts where CASHEQUIV cannot as it is subordinated by additional categories.

Category ID	Description	Level	Class	Natural Account
Root	MMC Corporate	1		
TOTASSETS	Total Assets	1	Asset	
CURASSETS	Current Assets	1	Asset	
CASHEQUIV	Cash & Cash Equivalents	1	Asset	
CHECKING	Cash In Banks	1	Asset	1000
PAYROL	Payroll Impress Account	2	Asset	1005
PETTY	Petty Cash	3	Asset	1010
SHORTINVEST	Short Term Investments	2	Asset	
MONEYMKT	Money Market Accounts	1	Asset	1050
TERMCERT	Term Certificates	2	Asset	1055
CD	Certificates of Deposit	3	Asset	1060
NOTESREC	Notes Receivable	3	Asset	
CUSTNOTES	Customer Notes	1	Asset	1100
RPNOTES	Related Party Notes	2	Asset	1105
ACCTSREC	Accounts Receivable	4	Asset	
DOMREC	Domestic Receivables	1	Asset	1200
INTREC	International Receivables	2	Asset	1205
RELREC	Related Party Receivables	3	Asset	1210

The Account Category form requires the Root or highest record to be established and then the remaining records are built below the Root level. In addition to supplying an **Account Category ID** and a **Description**, the system also requires an **Account Class** and a **Sequence** value.

The **Account Class** value defines how values will be displayed (whether a credit balance is shown as a negative or positive value). Acceptable Class values include the following:

The following class values are available in the system:

<u>Class Value</u>	<u>Parent Class</u>	<u>Display</u>
Asset	Root, Asset	Credit is Negative
Liability	Root, Liability	Credit is Positive

Equity	Liability, Equity	Credit is Positive
Retained Earnings	Equity	Credit is Positive
Current Earnings	Retained Earnings	Credit is Positive
Revenue	Current Earnings, Revenue, Expense	Credit is Positive
Expense	Revenue, Expense	Credit is Negative
Income Expense Summary	Current Earnings	Credit is Positive

The system limits the number of levels in the account category structure to 20. Users attempting to exceed 20 levels should seek consulting assistance, as their understanding of the level structure may be inadequate.

Natural Accounts

The system supports a six-segment account structure excluding the entity level. The account structure is built from left to right, with segment one (left most segment) reserved for the Natural account. The natural account is used to define the account structure at the highest-level categorization of posting activity to be summarized as financial balances. Financial balances feed the financial inquiry and reporting functions. Natural accounts can exist independently in the chart of accounts or be further refined by additional segments. Natural accounts definitions include the following settings:

- Natural Account ID code
- Description
- Optional Segments 2-6
- Account Category ID
- Control Type
- Revaluation Type
- Security level
- Currency ID
- Tax Group ID
- Tax Required Flag
- Transaction Category List ID
- Transaction Category Required Flag
- Notes

Segments

Provide further definition in the chart of accounts beyond the “natural” account. This lower level categorization provides the ability to report or inquiry at the refined segment definition level. Segments 2-6 are optional for each natural account. The system offers a truly flexible design by allowing each natural account to independently define its lower level segment structure relationships. For example, an entity may require the natural accounts “Cash” to support a segment 2 for location and “Accounts Receivable” to support a segment 2 region. Users would set up a segment 2 for location and one for region. Cash would be subordinated by location where accounts receivable would be subordinated by region.

Note: The system builds the Cartesian product of the number of segments times the natural account. For example, assume a user defines a natural account cash of “1000”. Also, they have set up a segment two for location with three codes. By defining the natural account “1000” with the segment “location” the system will generate three posting level accounts as follows:

1000-BNKAME	Cash, Bank of America
1000-FLEET	Cash, Fleet Bank

1000-BNKBOS Cash, Bank of America, etc.

Segments are defined by building of lists of the values. Care must be taken to build logical lists that can be used on many accounts. Some examples for consideration include:

Location/Division Codes	For a majority of Natural Accounts
Bank Codes	For Cash Account detail
Department Codes	For use with expense accounts
Employee Codes	To attach to Employee Receivables and Travel Advances
Sales Person Codes	For Commission Liability Accounts

Any number of Segment Lists can be added as needed.

Segment definitions include the following settings:

- Segment ID code
- Description
- "Allow In" setting (No entry indicates available in any segment)
- Segment Value
- Short Description
- Description
- Active Flag
- Currency ID
- Tax Group ID
- Tax Required Flag
- Transaction Category List ID
- Transaction Category Required Flag
- Notes

Transaction Categories

Transactions Categories allow the organization to define the transactions for a particular account in greater detail. Accounts may be established requiring Transaction Categories to be supplied at data entry. The system summarizes information by Transaction Category as well as by Natural Account and Account Category. Transaction Categories are intended to capture information that is less permanent than segment information. Examples of Transaction Categories might include:

- Product Codes
- Loan Codes
- Sales Campaigns

Transaction categories are defined by creation of a category and an independent associated list of items, for example, a category product line might be set up to include the following items:

Trans. Category List ID	PRODLIN
Description	Product Line

Trans. Cat ID	Description	Included
FURN	Furniture	√
GEN	Generic	√
INJM	Injection Mold	√
STAMP	Stamping	√
TELE	Telephone	√
SOUND	Sound Material	√
SEAT	Seating Material	√
ILLUM	Illumination Products	√
01301224432	Lexus Sport	
08896521897	Lexus LS	
0520875342	Cadillac	

Some of the Natural Accounts must be defined as Control Accounts. Control Accounts are specialized in that they are attached to and are updated by subsidiary ledgers. Valid options for this field are None, Payables, Receivables, and Cash.

Document Types

A document type must be established for each type of transaction (Journal Type) that will be processed. Additionally, multiple document types can be defined for a single Journal Type where basic information is variable (i.e. a payment sent from the Buffalo bank account, and a payment sent from the Toronto bank account).

Document types are linked to Journal Types and establish the numbering scheme for the system to utilize.

General Tab

Establishes the processing behavior associated with the document. Setup includes:

- Document ID and Description
- Entity ID
- Journal Type
- Bank Account ID (cashbook transactions)
- Security level – allows only users with greater security to process
- Process options
 - Allow mixed entity – required for cross entity processing
 - Allow mixed currency – required for multi-currency processing
 - Allow landed – Landed cost document setting
 - Allow delete – permits deletion of unposted documents
 - Reverse next period – General journal option to establish reversing journal. Set reversal delay. Automatically reverses in the next period but can be extended beyond the next period.
 - Related party required – set to require customer/supplier to be related party
 - Post immediately – option to establish document default to post on save. Can be overridden at the transaction level.

- Adjustment – option available for general journal transactions to cause distributions to be recorded as an adjustment distribution as opposed to the system default “normal activity” type distribution.

Numbering

Establishes the numbering scheme associated with the document. All document types support a 15-character numbering capability. The following numbering schemes are available:

- None – user supplies document numbers
- General – Permits a number in conjunction with optional prefix and suffix settings. Uses general numbering options.
- Period – Combines the posting period and year with a sequential document number. Each period the sequential numbering scheme is reset.
- Tax book – Permits tax books to control the number scheme associated with a document.
- User – Permits user based numbering on documents.
- Nest number – Allows users to establish the next number assigned using a document.
- The Decimal places determine the size of the numeric portion of the document number.
- Leading zeros establish if leading zeros pre-fill the decimal places.

Apportionment (soon to read Template)

With the template switch activated, users can preassign g/l accounts to a documents. When the document is invoked the template accounts prefill the transaction form. This is designed for static month-end or any document that is static in nature.

This is also used to define apportionment documents. Apportionment documents are available for A/P to allow certain kinds of AP transactions (such as utility bills) to be apportioned immediately as opposed to through the apportionment function.

Workflow

Allows users to establish authorization routings on a transaction where certain conditions are encountered (i.e. Document exceeds a user transaction processing tolerance amount). It invokes the user of the internal e-mail system to route documents to appropriate individual when user limits are surpassed.

Authorizations are granted by the system on a per document basis up to the limits of the document. Any attempt to change documents limits beyond their initial authorized amounts will cause the removal of the prior authorization, thus requiring the document to be reauthorized for the new amounts.

Bank/Holding Accounts

Bank Accounts (also referred to as Holding Accounts) need to be defined in the system by entity. These records supply default information when dealing with payments. In addition to traditional checking accounts, investment, debts and marketable security accounts are also defined and as holding accounts as they require similar accounting behavior.

Bank/Holding Accounts carry the following settings:

- Bank Account ID and name = Entity's identification of a bank account.
- General Settings
 - Bank Identification Information
 - Bank ID – Routing Number
 - Branch ID

- IBAN Number – International Banking Account Number
- Account number
- Account type
- Contact Email address
- Electronic Transfers
 - Pay Export ID – Export format required by bank for electronic processing
 - Transmitting User ID – user-defined setting
- Deposit Auto numbering – Supplies numbering scheme for bank deposit creation
 - Next number – Sequential numbering field maintained by the system. User override permitted
 - Prefix & Suffix (optional)
 - Number size – size of the deposit
- Bank Address Information
- Accounting Option Settings

Terms Rules

Rules governing terms are established to automatically calculate due dates, discount dates, and discount amounts. Default terms rules can be established at both supplier and customer levels but may be overridden at the transaction level if necessary. A typical Terms Rule would be established as follows:

Terms Rule ID 210N30G
Description 2% 10 Days, Net 30 Goods only

Discount Type	Number of Days	Number of Days, Day of Month, Days from EOM
Disc Month	0	
Disc Age/Day	10	
Disc Basis	Goods	Goods, Gds + Freight, Gds + Freight + Tax
Disc Percent	2.000	
Net Type	Number of Days	Number of Days, Day of Month, Days from EOM
Net Month	0	
Net Day of Month	0	
Net Days	30	

Installment Rules

VISUAL Financials also allows the definition of Installment Rules for items with multiple payments, initial amounts or percentages due, and/or final payments to be defined. An installment rule requiring a 10% initial payment followed by 5 equal payments and a 25% balloon payment at the end would be established as follows:

Installment Rule ID I105B25
Description Initial 10%-5 Installments-Balloon 25%

Initial Amount	Initial Percent	Initial Terms ID	Installments	Reg Terms ID	End Amount
0	10	NET30	5	NET30	0
End Terms ID	End Percent	Use Percents	Initial Payment Method	Reg Payment Method	End Payment Method
NET30	25	n/a	CHECK	CHECK	CHECK

Tax Books & Tax Reports

Used primarily in VAT taxation, a Tax book can be established to track transactions with suppliers and customers. Multiple tax books can be established to track invoices separately from memos if desired. In addition, a Tax Book Report can be associated with a Tax Book.

Tax Codes & Groups

VISUAL Financials supports a wide variety of tax situations including Sales & Use taxation, VAT, GST, and Withholding taxes. Each specific tax code for a necessary city, state, province, or other jurisdiction is defined with its own structure and rate. Once defined, these individual tax codes are grouped to build a complete taxing profile for a particular jurisdiction. Individual tax codes may be joined to any number of tax groups providing the most amount of flexibility with the least amount of data input.

In the following example, many transactions within the city of Buffalo, New York require a city, county, and state tax assessment. First, each individual tax code must be defined. The second step is to define the Tax Group and link the individual tax codes.

The individual tax codes might resemble the following:

Tax ID	BF01	NY02	NY01
Description	NY Buffalo City Tax	NY Erie County Tax	NY State Tax
Tax Type	Normal	Normal	Normal
Tax Basis	Goods	Inclfreight	Goods
VAT	1	1	1
Exclusive	√	√	√
Tax Authority	NYBUF	NYERIE	NYSTATE
Currency	USD	USD	USD
Tax Rank	0	0	0
Registration #			
Expense Account ID			8600-110
Recovery Account ID			
Accrual Account ID	2300-110-NYBUF	2300-110-NYERIE	2300-110-NYSTATE
Effective Date			
Recovery %	0	0	0
Up To (Amount)			
Plus (Percentage)	.25	8.0	1.0

Once the individual codes are defined, the group can be established.

Tax Group ID NY00
Name Buffalo, NY 3 Tier Tax Profile
Tax Type Normal

Tax ID	Description
BF01	NY Buffalo City Tax
NY02	NY Erie County Tax
NY01	NY State Tax

Note: Once completed, Segment Values and Natural Account data should be reviewed to determine whether Tax Groups should be defined on those records. It is important to note that the Tax Authority field references a supplier record. These suppliers must be added prior to the Tax Codes being completed.

Sales Reps

Sales reps are used in the system to support commission processing. Sales reps are established by reference to a sales rep ID and description with processing defaults based on the sales reports status as an employee or contractor and if they permit commission sharing.

Sales reps are database level information with activation at the entity level. Thus a single sales rep may be processed in multiple entities.

Sales reps support the following options:

- ID and name
- Address details
- Type (Contractor or Employee)

- Depending on type, establishment of the employee code or supplier ID
- Currency ID
- Commission rate
- Payment percentages
- G/L account overrides
- Commission sharing details if required

Product Codes

Product codes are utilized in the system to provide override capability for general ledger accounts related to the following areas:

- Purchase price variance
- Commission expense

Purchase Price Variance

To support standard cost production environments the payables business logic provides for purchase price variance where a difference is accepted between the unit price associated with a receiver and the price on a supplier invoice. The system performs the following defaulting in choosing the purchase price variance account to use in the posting distribution.

- Product code
- Supplier
- Entity default account

Commission Expense

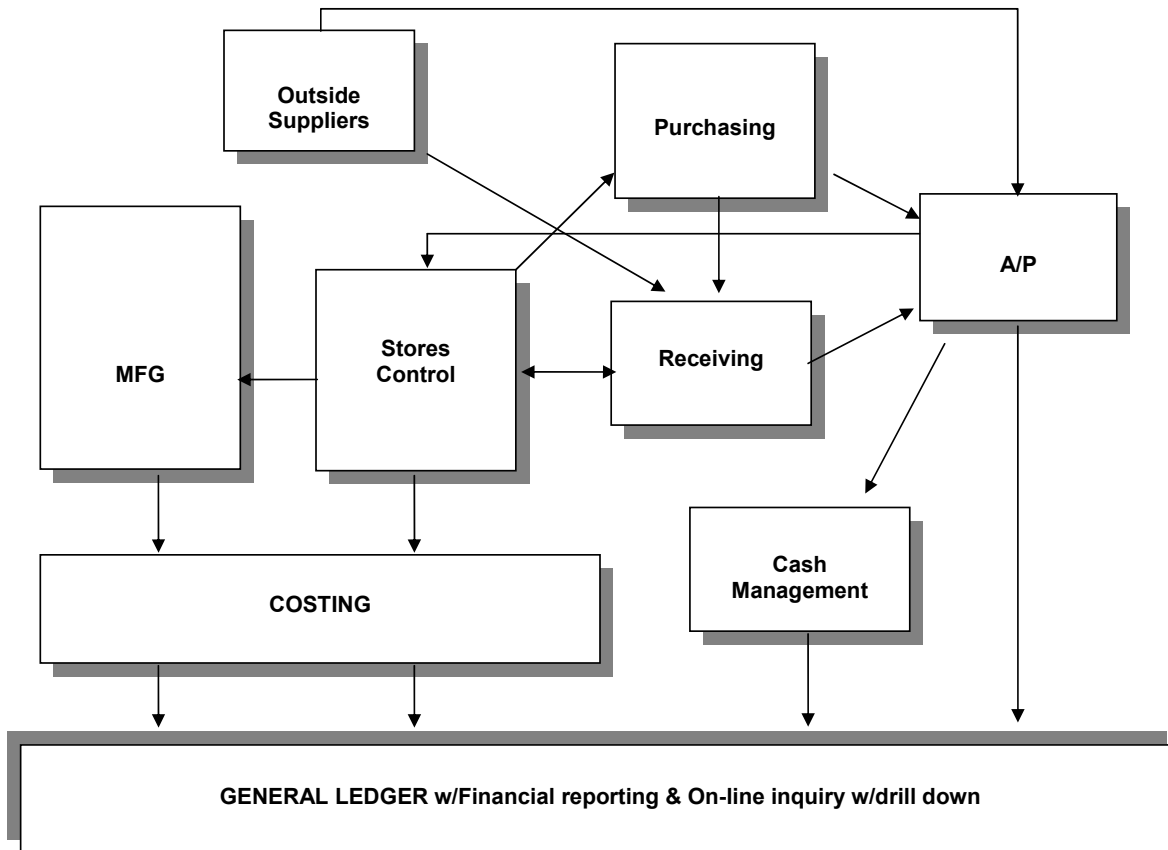
Product codes also permit users to provide an override to the commission expense associated with a sales invoice line. If a commission expense account is supplied to a product code and the product code is associated with a commissionable invoice line, the commission expense account in the product code overrides the sales reps default commission expense account. The accounts receivable system uses the following defaulting in choosing the commission expense account to in the posting distribution:

- Product code
- Sales rep
- Entity default account

Accounts Payable

Overview

Procurement and payable activities are responsible for an organization's inventory requirements across all departments (manufacturing, supplies, fixed assets, etc).



A/P Processing

- Inventory levels for planned manufacturing/sales are checked against stores control. Manufacturing determines the necessary orders to place in order to satisfy production planning.
- Purchase orders are created and passed to the selected supplier(s).
- Goods are received to inspections awaiting approval. Accepted items are transferred to stores control (warehouse), or are placed directly into production.

- A/P personnel perform three-way-match between PO, goods received and the A/P invoice. Differences falling outside established tolerance levels require authorization prior to acceptance. Variances accepted are processed as follows:
 - Actual cost environments – Updates initial inventory cost and back flushed
 - Standard cost environments – Updated reflected as PPV expense distribution

A/P Setup

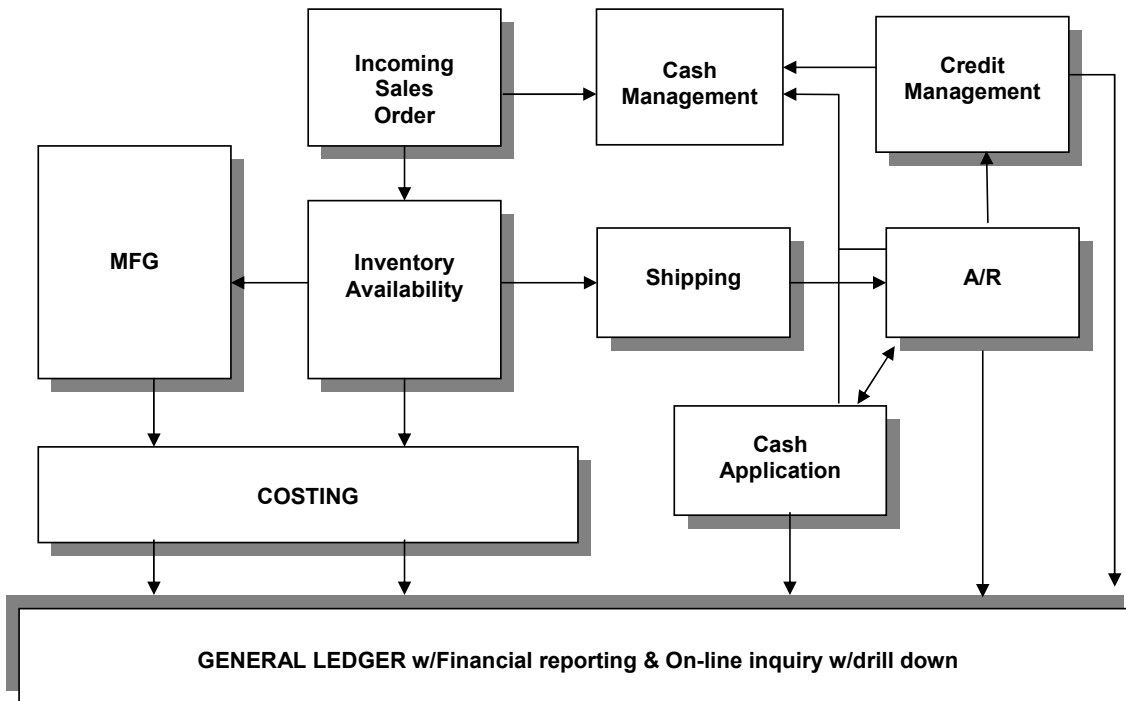
Consider the following primary items needed to process A/P related transactions.

- Related Master files
 - Terms rules or Installment rules
 - 1099 codes
 - Tax ID's and related groups
 - Payment methods and required medias
 - Supplier currency
- Establish Supplier records in the system
 - Country codes
 - Purchase from / Remit to address
 - Supplier contacts
 - Payment priority
 - Consider establishment of supplier hierarchy structures
 - Related customer ID's
 - Related party setting
 - Supplier Bank details if using electronic processing
 - Payment terms
 - Inspection control setting & Matching criteria
 - Tax/Withholding/1099 processing options
 - Credit options
 - Allocation control options
 - G/L default accounts
 - Supplier Groups
- Invoice processing requires consideration and/or set up of the following items:
 - Invoice document types and numbering schemes
 - Memo document types and numbering schemes
 - Supplier disbursement document type
 - Supplier receipt document type (refund received)
 - Payrun document type
 - Memo apply document type

Accounts Receivable

Overview

Order entry, receivable billing and cash receipts encompass the primary cash inflow segment of most organizations. Included in the receivable is the credit management process where department personnel constantly monitor aged invoices to ensure cash comes into the organization as quickly as possible.



A/R Processing

The system is designed to create invoices based on shipment and/or customer order fulfillment details provided by feeders systems such as VISUAL Manufacturing. The system also supports manual entry of receivable transactions.

A/R Setup

Consider the following primary items needed to process A/P related transactions.

- Related Master files
 - Terms rules or Installment rules
 - Tax ID's and related groups
 - Payment methods and required medias

- Customer currency
- Industry Templates and codes
- Ratios
- Sales Reps
- Establish Supplier records in the system
 - Country codes
 - Sold to / Bill to address
 - Customer contacts
 - Payment priority
 - Establishment of customer hierarchy structures
 - Related supplier ID's
 - Related party setting
 - Credit report details
 - Customer Bank details if using electronic processing
 - Invoice process options
 - Finance charge process override options
 - Tax codes
 - Credit options
 - G/L default accounts
 - Customer Groups
- Invoice processing requires consideration and/or set up of the following items:
 - Invoice document types and numbering schemes
 - Memo document types and numbering schemes
 - Customer disbursement document type
 - Customer receipt document type
 - Memo apply document type

Cashbook

Overview

Cashbook processing involves the receipt of cash and the payment of obligations. Payment and receipts can be handled manually or electronically.

The cashbook function supports the following types of transactions:

Receipt Transactions

- Customer Receipts
- Supplier Receipts
- Miscellaneous Receipts

Payment Transactions

- Supplier Payments
- Customer Payments
- Miscellaneous Payments
- Payrun Processing

Bank Transactions

- Bank Transfers
- Bank Adjustments
- Bank deposits

Memo Apply Function

Another area of the system supports the ability to apply memos to open invoices without being required to process a zero value payment/receipts.

Processing Requirements

Each of the above processing techniques requires the setup of document types designed for the intended purpose. A discussion on document type settings is discussed later in this document.

Payment Receipts

The Payment Receipts Entry form allows for the process the following manual receipts.

- Customer receipts
- Supplier receipts
- Miscellaneous receipts

Payment Disbursements

The Payment Disbursement Entry form allows for the process the following manual payments.

- Supplier payments
- Customer payments
- Miscellaneous payments

Payments should require a controlled numbering scheme to account for every payment document recorded in the system.

Payment Runs

Payment Runs are provided as an easy methodology for producing larger payment runs across a variety of suppliers. The user must supply a Payment Run ID, as the numbering scheme on the Document Type is the check-numbering scheme. In addition to the standard header information presented for user review, there is a checkbox allowing the user to specify that all discounts offered should be taken regardless of the discount date comparison with the run date.

Once the header information is established, the user may select the Populate Grid button. The grid identifies all suppliers to be considered within this payment run. The user may examine individual invoices by expanding the grid below each supplier. Users may delete invoices and suppliers from consideration, or enter zero in the Authorized Amount column to bring the total payment amount to a satisfactory level. When partial payments are being made, the user may enter any value less than the total amount due into the Authorized Amount column.

Once complete, the form is saved and the user moves to the Generate Payment Run form. The Payment Run ID must be entered or selected from the browse window. The payment details may be reviewed here, but any changes require the user to go back to the Payment Run Setup form.

If the Payment Run detail is considered satisfactory, the user selects the Start tab, verifies that the next check number is correct, and clicks on the GO button. The checks are processed and the Results tab is opened for review.

After reviewing the checks, the user must click on the Post Payments button to complete the process. Any damaged checks and the last check used (even if damaged) should be indicated and then posted. The user is then allowed to go to the Start tab, reprocess the run and review and post the results until all items have been closed properly.

Bank Transfers

Occasionally it is necessary to transfer funds between banks. Under the Cash Management tab within the Maintenance section of VISUAL Financials, Bank Account Transfer Entry may be accomplished. A special document type must be used to designate this type of transaction and this document type may be defined to provide the Transaction ID numbering scheme.

The form requires the source Bank Account and Currency to be provided in the header of the document with the target Bank Account ID and Entity ID on the transaction line.

Bank Adjustments

Bank adjustments are provided as a means of allowing users to manipulate bank balances for miscellaneous bank charge amounts such as processing fees, returned check fees, etc.

Bank Deposits

Bank deposit information can be entered manually or built automatically from the Payment Receipts entry or alternatively permits users to create a deposit ticket then process the receipt against customer accounts or apply the receipts as miscellaneous.

To create a deposit ticket the system requires a user-defined Deposit ID and bank account to be entered for reconciliation purposes. Additionally, an optional description may be entered. Once the bank has been identified, the user may select the task "Insert all undeposited payments". This task builds a bank deposit from all undeposited receipts applied against the bank selected. This operation automatically populates the grid with all entered information for this particular bank.

If the users builds the deposit ticket prior to processing the receipts the user can select the second task option "Apply payments to deposit lines" to process the payments received.

The user can insert and delete lines as needed to create the deposit. Once the form is saved with the deposited flag checked, the deposit ticket is produced and the deposit is available for bank reconciliation.

Bank Reconciliation

Upon identifying a Bank Account ID and a statement date, the Bank Reconciliation screen is automatically populated with outstanding deposits and disbursements. The user is allowed to Clear all items, highlight lines and clear those, or manually clear each line individually. The Bank Adjustments tab allows the user to charge any bank charges, fees, interest, or discrepancy information to accounts for proper distribution and a complete reconciliation to the bank statement.

General Ledger Transactions

The system supports the following general ledger transaction. Like other transactions in the system they require document types to be established with the appropriate options set for their particular processing requirements.

General Journal Entries

General journal entries are used to adjust general ledger accounts not classified as control accounts. General journal entries affect all tracking currency and account currency balances maintained for both the source, and target entities affected in the course of a journal entry transaction. Additionally, and accounts held in other than one of the entities tracking currencies.

Direct Journal Entries

Direct journals are used when a modification to a single tracking currency or account currency is required. For example, the system uses direct journal entries in the revaluation process; however, users are also permitted to manually affect a particular currency balance when needed.

Adjustment Option

Document Types may be established to define General and Direct Journal Entries as Adjustments. Adjusting entries are stored separately from normal entries so that data can be reviewed and/or reported for normal activity, adjustment activity, or all activity. This eliminates any special "period 13" processing to segregate month-end or year-end adjustments.

Special Functions

The system supports the following special functions.

Apportionments

Individual payables invoices can be apportioned as part of the Document Type definition. If an account's activity needs to be apportioned, the Apportionment Maintenance form is utilized to define the logic and journal scheme.

After supplying an **Apportionment ID**, **Document Type**, and **Description**, the user can indicate whether each item defined should generate separate journal entries or if the system should post everything at the end. This is an important item when an individual apportionment is based on a prior apportionment being completed.

The user must now insert an Item line to identify the base account for the apportionment. If the formula yields a percentage, it is the value in the base account that will be used with the formula. This base account is also used as the offset to the journal entry produced on the detail line.

The Detail line is inserted below the Item line to establish the Allocate To account and the formula to calculate the proper amount or percentage.

Some simple examples are provided:

Item Line	Account	EEE-NNN-S21 (Period Net Change \$400.00)			
Detail Line	Account	EEE-NNN-S22	Formula	75	Result Percentage
	Dr	EEE-NNN-S22	\$300		
	Cr	EEE-NNN-S21		\$300	

The Detail Line (Target) Account is debited because the value in the Item Line (Offset) Account is a debit.

Item Line	Account	EEE-NNN-S21 (Period Net Change \$800.00)			
Detail Line	Account	EEE-NNN-S22	Formula	75	Result Amount
	Dr	EEE-NNN-S22	\$75		
	Cr	EEE-NNN-S21		\$75	

The Detail Line (Target) Account is debited because the amount in the formula is positive.

Formulas can also be defined using accounts with standard (+ - * /) operations. A space must be entered before and after each operation code and when parentheses are used (MMCNA-5100-110 / MMCNA-4100-110) where MMCNA is the entity value and 110 is the Segment 2 value.

It is also possible to enter non-posting accounts and wildcards within formulas. MMCNA-6525-% / MMNCA-6525 would divide the summary value of the 6525 natural account into each segment 2 value defined for 6525. If there were three different segment 2 values, three target accounts would be journalized with one offset to the Item account specified.

All Apportionments will equal 100% of the Item Account balance. The last detail line will process the remaining amount.

Document Change Control

The system permits any posted document to be subsequently modified. Each time a posted document is saved, the system examines its current state. If the posting distributions do not equate to the document's current state, the system applied a net change distribution. The net charge posting causes the distributions to equate to the documents latest state.

Budget Entry

Budgets are defined in the system by reference to a natural account and a segment level depth to budget to. The system permits budget segment levels to differ from posting level segments. The system provides a budget entry application that supports the following functions:

- Copy budgets from prior budgets with percent change
- Copy budgets from actual balances with percent change
- Import a budget
- Export a budget

Statistic Input

The Statistic Maintenance form allows users to record the current balance of a statistical account. The balance is always held and reported, not the period change value. If headcount is being recorded and the value needs to change from 250 to 246, the user enters the new value of 246, not -4. When utilizing statistical information in Apportionments, the system always looks back to the most recent input value.

The Account View ID identifies the filter being used to limit the accounts being displayed. Please refer to the security documentation for more information.

Year-end Entries

A specialized year-end adjustment General Journal Document Type must be established for the system to close out the temporary accounts for each entity. The entry must bring the Net Income Account to zero and transfer the net effect to the Retained Earnings account. The user normally utilizes the Income Summary Account for the year-end journal.

Prior year adjustment

The only special consideration for prior year entries is that the posting date is set properly. The system will make sure the period is open to accept the journal. After prior year adjustments are made, an additional year-end entry can be made to transfer any Net Income into Retained Earnings.

Apportionment

The apportionment process creates journal entries that redistribute the balance from one posting level account to other posting level accounts. This process allows organizations to reclassify period expenses and other activities applied to departments, divisions, locations, cost centers, etc. in order to produce management evaluation reports.

VISUAL Financials supports three manners of apportionment. First, apportionments can be manual, where one or more static value is apportioned from one account to another. Second, the apportionments can be based on a percentage, where the percent assigned to an apportionment detail line is removed from the apportionment items account. Third, apportionments can be formula based, where users establish item formulas for determining the amount apportioned from the apportionment item account to the apportionment detail account.

When apportionments are processed, they adjust specified account balances. Adjustments of this kind allow users to isolate the effects of month end/period end adjustments in any period.

Create and maintain apportionment rules in the Apportionment Maintenance window. You can also print an Apportionment Generation Detail report that includes the details of generated journals, allowing users to determine if the formulas used are accurate. For more information, refer to "Reports" in this manual.

Apportionment Definitions

Apportionments are made up of 3 components.

1. Apportionment Rules – Establish the items and details for an apportionment.
2. Apportionment Items – Identifies the apportionment from account
3. Apportionment Details – Identifies the apportionment "to" account(s) and the value or formula used to derive the apportionment values.

This structure provides users the ability to perform single step and multi-step apportionments from a single apportionment rule definition.

Apportionment Rules

Apportionment rules are defined by an apportionment ID, Description and also require the assignment of a document type. The document type is used in the apportionment process to post the apportionment journal.

In most cases we expect the apportionment to be generated in the currency of the entity in which the apportionment is generated. If so a general journal can be used. However, if users need to set a currency other than the system currency then the document type must be defined as a direct journal type document.

The option for multiple journals is relevant only in the case where multiple items are established for a single apportionment rule and the user wishes to post to the general ledger the results of each item prior to processing each subsequent item.

Apportionment Items

Apportionment items establish the account and entity from which the apportionment values will be apportioned (taken from). When the apportionment rule is executed the item account is reduced by the value of each detail items computed amount.

The exclude flag can be used to skip an apportionment during the execution of the apportionment rule.

Apportionment Detail

The apportionment detail established the accounts to which the value in the apportionment item account are distributed. It also contains the establishment of the amount or formula used to determine the apportionment amounts to be computed in the apportionment process.

The account identified on the item record can be a posting level or summary level account. If the account specified is a summary level account, then a formula is required to be used. Formulas require users to set the result type field to "pct". In this scenario, the number of data points under the summary account must equate to the number of data points in the formula.

If the user specifies a posting level account in the detail lines account ID field, users are at liberty to use either an "Amount" or "Pct" type result type.

The entry in the description field is placed on the reference line of the apportionment journal lines.

Consolidation

Creation of mapping structures between parent and subordinate entities permits the transfer of net change in balance account balances for a given time period. An export is created and passed to the parent company for posting to support subsequent consolidated reporting via the system's financial report writer.

The system simplifies the consolidation set up through an automated "quick-map" tool. The quick map tool attempts to automatically map similar accounts.

Status Displays

The system provides four main status display areas.

- General Ledger Status
- Accounts Receivable Status
- Accounts Payable Status
- Cashbook Status

Account Views (Security)

Before any of the inquiry capabilities can be explored, Account Views must be defined to determine the user's access. The Account View forms opens with the option allowing access to all segment values being selected (non-restricted view). After providing an Account View ID and Description, the user is allowed to define access to particular values within each segment and customize the view for a specific role. A user can select all values within a segment, specify a range (From-To), or individually list the allowed values.

The view must be attached to the role with the Entity Roles tab. An individual role may have many different views to choose from when utilizing the inquiry forms.

General Ledger Status

The General Ledger Status option in the VISUAL Financials Activity Center, permits users to view balance sheet or income statement related information. The display is secured via the Account View security profiles established in the system. Additionally the status defaults to the period in the entities calendar ID based on the systems current date. The general ledger status presents summarized account category balances held within the system in the order defined under account category maintenance. Users have the ability to drill down through the summary balances to the posting level accounts to the transaction details. Once at the posting level users can elect to open up a detail transaction.

The system permits users to override the existing calendar with any calendar defined in the system thereby presenting various "date range" summary down to daily summaries if desired.

The system supports the following information in the general ledger status display.

- Account category summaries
- Natural account summaries
- Posting level summaries

Activity Type

The system supports two types of balance activity, normal and adjustment. Designed to segregate year-end (as opposed to incorporation of period thirteen) users can separately view the affects of adjustment activity from normal period activity.

Tab Details

The following tab details are available in the general ledger status display:

- General – Displays information about highlighted section of the balance summary area of the display.
- Comparative – Defaults to display prior year comparative information but can also be modified to incorporate one of the entity budgets.
- Summarized Activity – Requires the user to be focused on a posting level account balance with a period containing posting activity. The system summarizes the summary level details as follows:
 - By Date, then
 - By Document type
- Posting Activity – The system presents a list of the posting activity for the period in date sequence.

Default Settings

The general ledger status display allows users to optionally set the following defaults when activating the general ledger status display.

- Account View
- Statement Activity
- Balance Type

Accounts Receivable Status

The accounts receivable status display presents summaries of customer open invoice in summary with detail level drill down capability. Within the accounts receivable status display users can:

- Quickly view accounts receivable control account current and prior period balances as defined by the period selected in the view.
- Examine customer summary aging balances by receivable control account
- Drill down to the open invoices and/or memos that make up the customer balance by double clicking on the desired record line
- View summarized or posting level activity
- Browse/maintain customer level details and contacts
- Browse/maintain customer order status items
- Process cash receipts, payments, invoices or direct journals
- Modify customer credit status details

Like the general ledger status display the accounts receivable status display requires the user to enter an account view in order to activate the selection process.

Accounts Payable Status

The accounts payable status display presents summaries of supplier open invoice in summary with detail level drill down capability. Within the accounts payable status display users can:

- Quickly view accounts payable control account current and prior period balances as defined by the period selected in the view.
- Examine customer summary aging balances by payable control account
- Drill down to the open invoices and/or memos that make up the suppliers balance by double clicking on the desired record line
- View summarized or posting level activity

- Browse/maintain supplier level details and contacts
- Browse/maintain supplier order status items
- Process cash receipts, payments, invoices or direct journals
- Modify customer credit status details

Like the accounts receivable status display the accounts payable status display requires the user to enter an account view in order to activate the selection process.

Cashbook Status

The accounts receivable status display presents summaries of cash/holding accounts and also supports detail level drill down capability. Within the cashbook status display users can:

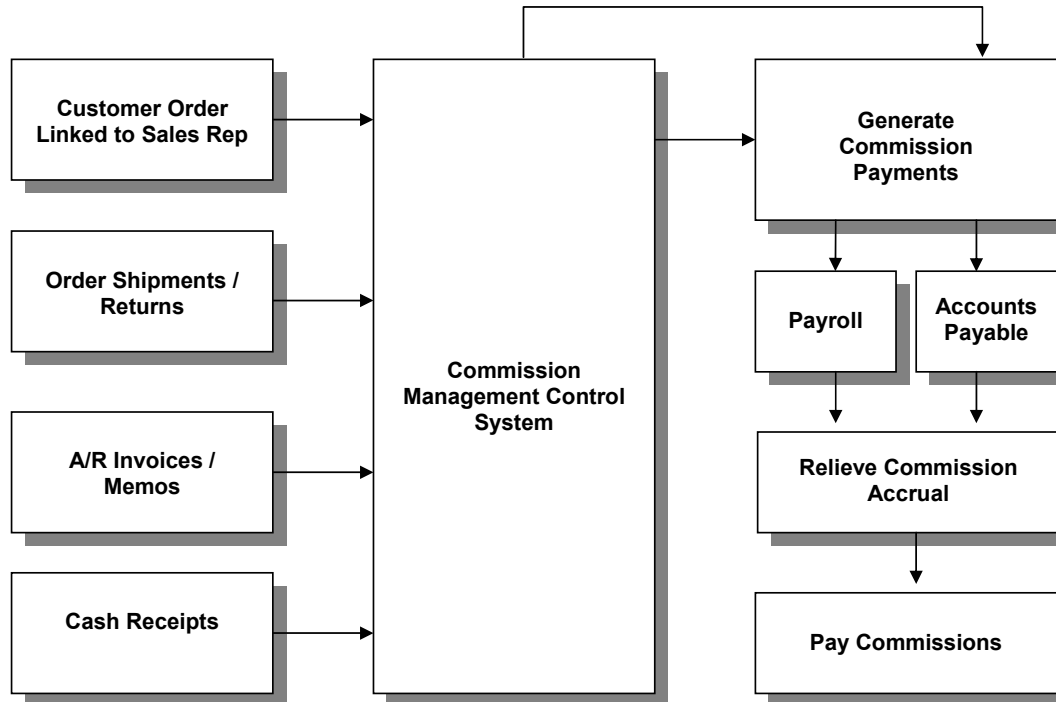
- Quickly view accounts payable control account current and prior period balances as defined by the period selected in the view.
- View summarized or posting level activity
- Drill down to the open invoices and/or memos that make up the suppliers balance by double clicking on the desired record line
- Process cash receipts, payments, bank adjustments, bank transfers or direct journals
- Examine prior bank reconciliations

Like the other status display the cashbook status display requires the user to enter an account view in order to activate the selection process.

Commission Management

Overview

The tax reporting system administers the details and tax reports necessary to provide perpetual audit trails of taxable transactions reported to a tax authority.



- The system accepts orders from customers and attaches sales rep to the orders, invoices, or memos.
- Commission payment requests are presented based on predefined sale rep payment percentage triggers as follows:
 - Percent on booking
 - Percent on Invoice
 - Percent on Cash Receipts
- Commission Accrual recorded on posting of receivable invoice or receivable memo
- Commissions earned are recognized upon receipt of customer payment.
- The system supports payment of commissions in advance of the receipt of a customer payment against the open invoice/order. These are categorized as commission advances.

- Requests for omission payment causes the creation of an accounts payable or a payroll entry. Accounts payable entries are passed to the financials accounts payable control system. Payroll entries are prepared in an electronic format to await transfer to a payroll system. Accrued commissions are automatically relieved.
- Payable and payroll payments are made through their respective normal processes.

Financial Reporting

The system contains a functional report writer that can report as well as filter information by account categories, natural accounts and segments. The report writer combines VISUAL's powerful data-gathering capabilities with Crystal Reports formatting capabilities making a truly powerful reporting and flexible presentation tool. The system allows users the ability to create and store multiple report definitions and a separate execution and scheduling capability.

Deleted:

The reporting writer contains the following features:

- A Report definition creation wizard to quickly generate reports using a predefined report
- Separate definitions for lines and report columns.
- Selective filtering of report rows or columns by the following capabilities:
 - Categories
 - Natural Accounts
 - Segments
 - Transaction Categories
 - Budget Values
 - Entity ID
- Formula creation capability on the line or column
- Flexible subtotalling capability
- Initially formatting for:
 - Line spacing
 - Page breaks
 - Suppress zero balance activity
 - Underlining or over lining
 - Amount type presentation
 - Explode features
 - Value divisor and description
- Preview option prior to permanently saving the report
- Incorporates the systems natural account and segment security features
- A report scheduling capability

The systems reporting and on-line inquiry capability will operate only as good as the users chart of account definition. It is extremely important that users understand how the system uses each of the features in the chart of accounts definition to properly design a general ledger system that will enable them to report on the information critical to their business decisions.

VISUAL Exchange

VISUAL Exchange is the application that integrates one or more applications to the VISUAL Financials Global Edition suite. It provides links (mapping structures) between databases and their table definitions so that two or more databases operate together as an integrated solution as opposed to an interfaced solution.

Integration is achieved by allowing VISUAL Exchange to operate as a “service” at the system level. VISUAL Exchange runs as a background service. The exchange service subscribes certain tables between multiple databases. Changes to the subscribed tables cause exchange records to be generated and passed to an exchange queue for processing. Exchange processes records the date and time sequence in which they were received.

Steps in the Exchange process:

1. Install LSA Enterprise .Net environment
2. Install VISUAL .Net application (i.e. Financials, Repetitive, COE, etc.)
3. Create and setup a VFIN environment
4. Create and setup a VM environment
5. Install VISUAL Exchange components
6. Install Integration .Net components (i.e. VISUAL Manufacturing)
7. Install Exchange Triggers in desired VMFG database.
8. Register the Instance type you wish to connect with (i.e. VISUAL Manufacturing)
9. Import necessary scripts
10. Exchange records manually (use Exchange request).
11. Turn on automated exchange process

The exchange setup process begins after steps one through four above are completed.

Install Visual Exchange

- a. Locate the SETUP.EXE file in the VISUAL Exchange directory of the installation CD and double click on it. This brings up the exchange setup wizard dialog.
- b. Click next to get to the license agreement display. Answer “I Agree” and click next to continue to proceed to the “Select Installation Folder” dialog display.
- c. Identify the desired folder and use the “everyone” option at the bottom of the display. It is recommended that the user leave the default folder location provided by the installation process. Click next to proceed to the Customer Information dialog display.
- d. Enter the name and organization of the user. Click next to proceed to the Confirm Installation dialog display. From this dialog display clicking next will install VISUAL Exchange.
- e. Once complete the system will display an Installation Complete dialog display. Click on close, to close the dialog display.

Install Visual Manufacturing .Net Components

- f. Locate the SETUP.EXE file in the VISUAL Manufacturing directory of the installation CD and double click on it. This brings up the VISUAL Manufacturing .Net interface setup wizard dialog display.
- g. Click next to get to the license agreement display. Answer "I Agree" and click next to continue to proceed to the "Select Installation Folder" dialog display.
- h. Identify the desired folder and use the "everyone" option at the buttons of the display. It is recommended that the user leave the default folder location provided by the installation process. Click next to proceed to the Customer Information dialog display.
- i. Enter the name and organization of the user. Click next to proceed to the Confirm Installation dialog display. From this dialog display clicking next will install VISUAL Exchange.
- j. Once complete the system will display an Installation Complete dialog display. Click on close, to close the dialog display.

Install Visual Exchange VM Triggers

- k. Locate the VMFINXCH.EXE file in the directory that contains the VISUAL Manufacturing program files. This process requires the user to log into the existing VM database with the appropriate VM user ID and password.
- l. Select the desired triggers. It is recommended that the users "Select All" triggers and click on Add Triggers". This will begin the load process of the triggers.

Register the necessary exchange instances

- m. Double click on the VISUAL Enterprise icon and log into LSA with the LSA user and password. This brings you to the LSA enterprise home page.
- n. From the home page click on the Tools drop down menu and select Manage Databases. Next click on the far left icon to create/register new database instance. This brings up the Welcome to the Database Wizard display. Select the option to Register and existing database and click next.
- o. On the following display provide the following information and click next.
 - Instance type = VISUAL Manufacturing
 - Instance Name = VMFG
 - License Number = <leave field blank>
- p. On the following display provide the following information and click next.
 - Provider = SQL Server or Oracle
 - Owner = SYSADM
 - Owner Password = SYSADM
 - Repeat Password = SYSADM
 - Administrator = sa (equals default SQL Server administrator)
 - Admin Password = <enter the SQL Server admin password>
- q. On the following display provide the following information and click next.

- Server Name = ID of the server where the VISUAL Manufacturing DB is installed
 - Database Name = VMFG database ID
- r. On the following display click Finish.

Import Scripts

Next exchange needs to be loaded with the scripts that will be used to transfer information between VISUAL Enterprise database environments.

- s. Log on to the LSA environment using the LSA user name and password. This brings you to the LSA home page.
- t. From the home page select the VISUAL Exchange option.
- u. From the activity center select the "Maintenance" option then select Export Maintenance within the Administration tab.
- v. Place your cursor in the working area of the form, right click the mouse and select the option to Import Data.
- w. Locate the scripts directory on the installation CD and open the VmfgVfinMaster.lsc file.
- x. Assuming no errors were encountered all scripts should be loaded at this time.

Perform on Demand Exchange

At this point exchange has been set up to integrate a VM database with a VFIN database. To exchange information between two databases exchange uses the entity ID in both databases as the basis for integration.

This next process is to establish the starting point for both databases. VISUAL exchanges' "on demand" process capability can assist greatly in this area.

Note: Users should take care in determining which tables represent the master list from which to start. For example, if a user is proving the starting synch point for accounts the master list should be in VFIN not VMFG. As a result the user should map the VFIN accounts to the VMFG Accounts, and so on.

The display shows the subscription topology. The left side is the publishing side (source location of the data) and the right side is the subscribing side (target location of the data).

- Each view represents the databases available to select from.
- The subscriptions loaded earlier contain the mappings of the tables between the databases.
- Transfers of data in this display are performed one-at-a-time. Select the table from the publishing view. The system will automatically attempt to map (link) it to a like table in the subscription view. Check to ensure that the auto link mechanism chooses different databases else you'll get a new transfer effect of nothing.
- Initial exchange "on-demand" request processing order:

Master Files

- i. Currency ID
- ii. Country
- iii. Commodity
- iv. Earnings
- v. FOB
- vi. Industry
- vii. Product
- viii. Ship Reason
- ix. Ship Via
- x. State_Province
- xi. Territory
- xii. UOM
- xiii. Account
- xiv. Sales Tax
- xv. Sales Tax Groups
- xvi. Supplier
- xvii. Sales Rep
- xviii. Customers

Transaction Files

- i. Customer Orders
- ii. Shipments
- iii. Customer Invoice (Temporary until invoice program complete)
- iv. Customer Memo (Temporary until invoice program complete)
- v. Purchase Order
- vi. Receipts

- At this point you are ready to turn on the Visual Exchange Service. This is handled through the control panel “services” option.

Note: The VISUAL Exchange Service is installed during the VISUAL Exchange installation process. It is installed with the startup type option set to manual. Users can leave the startup as manual, however, it is recommended for live environments to have this set to automatic since exchange will process all exchange records immediately in the order in which they were received by the task program.

- Exchange results can be viewed via the “Event viewer” option located on the MS windows Administrative Tools menu.

Manufacturing Document Assignments

VISUAL Exchange supports the assignment identification of the documents to use when posting the following VISUAL Manufacturing posting journals:

- Purchase Journal
- WIP / Finished Goods
- Shipments Journals
- Part Adjustment Journal
- Indirect Labor Journal

Customization

The system is designed to allow users to write complete applications and utilize system .Net business objects where necessary. The application allows the following areas of customization without the need of users modifying source code. The system supports the following areas of customization:

- Business Logic
- Data logic
- User Interface Forms
- Database tables (columns)

Customizing Business Logic and Data Logic

The customization capabilities of VISUAL Financials Global Edition allow users to supplement the systems business logic and data logic. It does not permit users to override the systems logic.

Customization of supplemental business logic and data logic requires users to have licensed VSA (Visual Studio for Applications).

The following options are available within the customization:

- Edit Code
- Delete Code
- Export All Customizations
- Import Customizations

Steps to customize logic

1. Select the desired tab (Business logic or data logic).
2. Locate the desired function within the tab selected
3. Select the customize menu option
4. Select "edit code" to begin customizing.

It is recommended that users periodically save their work as customizations are being performed. From within the edit code function select the file menu option and select save. When finished select save and close as a single option or as separate options on the file menu.

Customizing User Interface Forms

Customization of User interface forms does not require any additional software.

Steps to customize forms

1. Select the Forms tab
2. Locate the desired form to customize
3. Select the customize menu option
4. Select edit layout.

This form is displayed and users are allowed to customize. Users can perform the following customize functions:

- Add or remove the following
 - Labels
 - Text fields
 - Date fields
 - Check box
 - Radio button
 - Picture
 - Address Fields
 - Group box
 - Panel

Additionally users move existing fields and labels around the form and even eliminate fields they do not wish to appear on a given form as well as establish field level validation as needed.

When complete save the modifications and close the form. Log into the system and call up the modified form. It is presented with the new modifications.

Customizing Database Columns (User Columns)

Customization of User columns also does not require any additional software.

Steps to customize user columns

5. Select the User Columns tab
6. Locate and open the desired data space name to customize
7. Locate the desired table name
8. Select the "insert row" option
9. Provide the column details

Note: It is recommended that all user added columns be named to begin with "User_Mod_<field name>" or User_Defined_<field name>" where the "<field name>" represents a unique user name for the field. Adhering to this convention will ensure that users modification will not interfere with future published enhancements to the system. Failure to follow this convention subjects users to possible upgrade errors.

VISUAL/Distribution Demand Planning

Functional Specification

Stanley C. Chew
Product Manager – Distribution
1998
Lilly Software Associates

Proprietary and Confidential Information

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1.0 Introduction

This document is the Functional Specification for the VISUAL/Distribution Demand Planning system (*VISUAL/ddp*™). The VISUAL/ddp software application and this Functional Specification are properties of Lilly Software Associates containing proprietary and confidential information about the VISUAL/ddp.

VISUAL/ddp Overview

VISUAL/ddp is a sophisticated software application intended to support manufacturing and distribution companies manage customer order allocation, distribution center replenishments and new products deployment planning throughout the supply chain in response to anticipated fulfillment.

VISUAL/ddp is designed to operate with Lilly Software and Associates' VISUAL/Supply Chain™ ERP product suite, including VISUAL/Manufacturing and VISUAL/Distribution Center Management System (VISUAL/dcms).

General features supported by the VISUAL/ddp are:

- Graphical User Interface (GUI) presentation of information supporting expedient decision making,
- Inventory Control Table, containing aggregate SKU information, by each DC, supporting Customer Allocation, DC level replenishments and soft allocations against future receipts,
- Route Control Table, containing information about the source of SKUs, vendor or manufacturing, as well as inter-branch transfer information regarding other DCs aggregate SKU information supporting transfers of inventory within the DC network
- Planning Guide for existing and new items introduced into the Supply Chain
- Sales history overlays, assisting the planning guide to determine similar replenishment points.

The major functional areas of VISUAL/ddp include:

- Table maintenance and parameterization,
- Auto-create receipts and orders, with transmission using EDI
- Messaging for manual-mode receipt and order entry,
- Order allocation,
- Order typing,
- DC level assembly directives,
- Source management,
- Transportation cost factoring,
- Inter-branch transfer support,
- SKU attribute definition,
- SKU product and demographic modeling,
- Product life cycle definition,
- Aggregate unit definition,
- Distribution shipment modeling and history analysis,
- Future order creation,
- Software allocation against future receipts,
- Retain acknowledgments of receipt and acknowledgments of shipments.

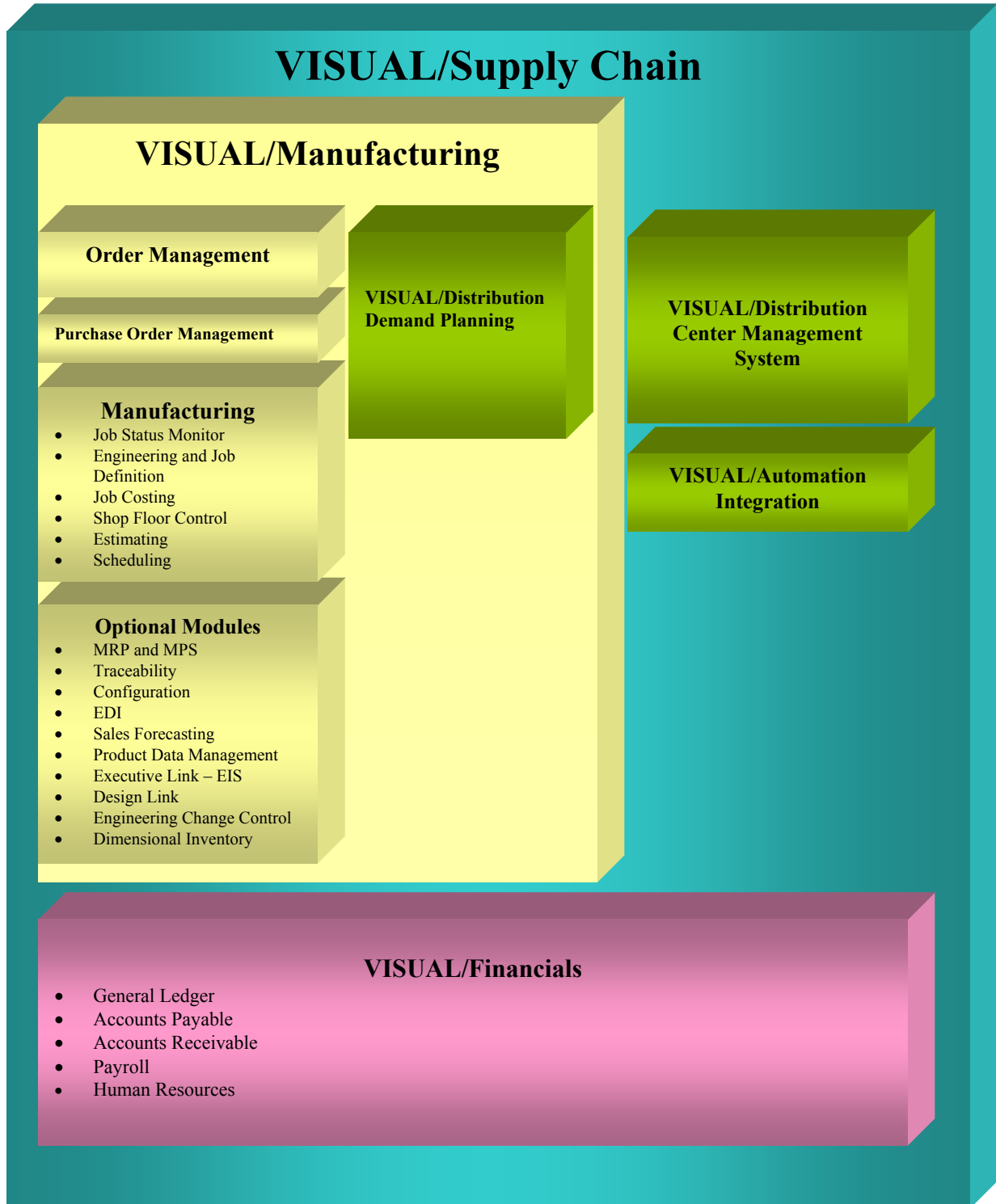
1.1 VISUAL/ddp Product Evolution

Visual/ddp development efforts are evolutionary in that the first release focusing on Distribution Demand Planning and Allocations. The functions in and of themselves are not purely DDP related, they lay the groundwork for execution functions in distribution which make Lilly Software Associates' DDP initiative distinctive in the marketplace. Once release of VISUAL Manufacturing 6.0 is completed, *pure* DDP development may start in earnest.

1.2 VISUAL/ddp™ within the Enterprise

The VISUAL/Distribution Demand Planning system enables the enterprise to plan and manage the distribution requirements of a single distribution center or across the network of distribution centers.

The following is a schematic representing VISUAL/ddp™ within the VISUAL/Supply Chain™ suite:



The figure clearly shows differing suites of applications, principally by color and or platform. However, Visual/ddp is on the same platform as Visual Manufacturing, implying the functions are enterprise related, not execution related as is the Visual/dcms and Visual/ai applications. Further, Visual/ddp typically would be used by Lilly Software Associates' clients with a strong distribution requirement. Therefore, Visual/ddp is considered a part of the Visual/Distribution suite even though the application is integrated within Visual Manufacturing.

Order Management, Material Planning and or Management personnel in the enterprise setting use Visual/ddp's capabilities. Visual/ddp would rarely be used directly by DC operations personnel.

V/ddp enables many business practices and technologies including EDI generation of purchase orders, maintenance of purchase orders using supplier generated ASNs and the tracking of incoming shipments and shipments to customers.

1.3 VISUAL/ddp Scope

The five major functional capabilities of VISUAL/ddp are:

- Order allocation,
- Order allocation against future receipts,
- Information management and communication using EDI
- Inventory replenishment control, and
- Demand Planning.

In addition to the above functional areas, interfaces (replication) with Visual/dcms and the integration of information within Visual/Manufacturing is of major consequence.

To the user, Visual/ddp will appear as functions within the Visual/Manufacturing ERP application suite. Its mission is to interact with order management personnel during order entry, and buyers and material planners for inventory replenishment forecasting/planning. For companies using EDI, Visual/ddp makes purchasing decisions, triggered without user intervention, and issues these sets of PO's to customers in an automated manner. Additionally, Distribution Demand Planning functions interact with management personnel in establishing unit sales goals, and the effect those goals have on the logistics supply chain.

Visual/ddp's item (SKU) availability data is closely maintained by the information processed using Visual/dcms. In doing so, the inventory dispositions within a company's supply chain reflect the actual SKU balances and activities of the distribution operations. This data is available in a real-time fashion through interfaces. Additional data interaction with Visual/ddp includes order management, and purchasing. These interactions are maintained through the relational database within the Visual/Manufacturing application.

2.0 Visual/ddp Systems Overview

The following subsystems provide an overview of the Visual/ddp functions.

2.1 Order Allocation

During order entry, customer service personnel are requested to confirm inventory availability, as well as future availability to orders. This process, known hereafter as soft allocation, confirms a quantity of an item to an order after the item has been investigated for its availability to the order, using customer order entry functions. Soft allocation confirms inventory at the item level for a specific distribution center (or manufacturing plant).

In contrast, the Visual/dcms receiving the order, *hard* allocates the inventory to specific locations within the DC in order to direct operations personnel to locations for picking, etc.

Central to this process is the inventory control table maintaining the on-hand available amounts by SKU, per DC. Addition values are discussed later in this specification. The inventory control table's on-hand values are maintained through interfaces with the distribution center's Visual/dcms application. In doing so, the values represented to the customer ordering the items are factual, based upon distribution center activities, not systemically derived through plans or assumed accuracies.

2.2 Order Allocation Against Future Receipts

Customers may require orders placed as reservations against future stock. Additionally customers may request an amount of inventory too large for the supplier to be willing to commit to. In either case, the order entry personnel must review future deliveries of inventory (PO's) and their unique quantities, and soft allocate the quantities to future orders.

Central to this process is the inventory control table maintaining by SKU, all PO's and/or other inbound transfers of inventory. Once the PO's reviewed, the inventory may be allocated to the order. In addition to the allocation to the order, one of two processes may occur:

Flow through/Cross-Dock

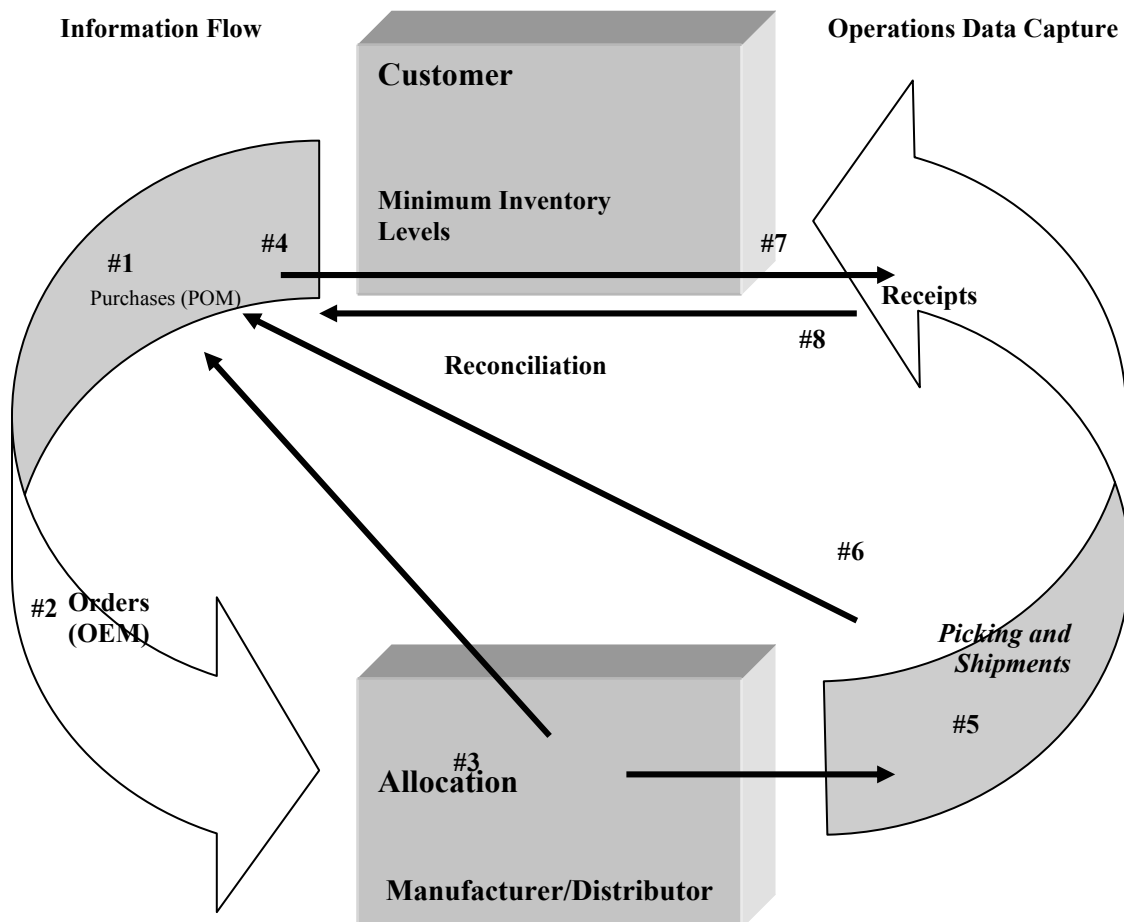
The order may be processed as a cross-dock or flow-through order to the specific PO, SKU and quantity. Given this case, the order is communicated to the Visual/dcms immediately.

Host Level Back Order/Future Order Processing

The other process involves holding the order at the order management level until the PO is received. At this point, the inventory is available, order management may be made aware of this and the order automatically released to the Visual/dcms for processing.

2.3 Information Management and Communication Using EDI

Central to most distribution strategies is the use of EDI to communicate information.



Using functionality already supported in the Visual Manufacturing Purchase Order and Order Management subsystems, information is created automatically, formatted into EDI compliant standard files, and transferred. The flow of the information is described below:

1. EDI Purchase Orders typically driven by customer's minimum inventory levels, maintained in V/ddp.
2. When customer creates PO, the PO generates an Order in the suppliers system.
3. Allocation may adjust the Order and maintain the original customer PO in the form of an ASN. ASN's at this point are PO header and line/qty information. Allocated Orders are passed to V/dcms for distribution processing, or managed using the shipping functions in Visual/Manufacturing.
4. Customers POM communicates the ASN data to the customer's warehouse for receiving.
5. Manufacturer/Distributor picks to the allocated order and builds carton level ASN using V/dcms (sub level to line/qty)
6. Trailer departs and ASN is communicated to the customers POM, in turn communicated to customer V/dcms.
7. If picks to the order where not exact to the original ASN, Customer POM maintains the ASNs
8. During customer receipts, actual inventory received is checked against the last ASN maintenance and reconciliation takes place by POM for invoice payment.

The areas of impact using Visual/ddp are in the minimum inventory levels, and the allocation of orders. Shipment information is supported using ASN information at the container level.

Information Maintenance

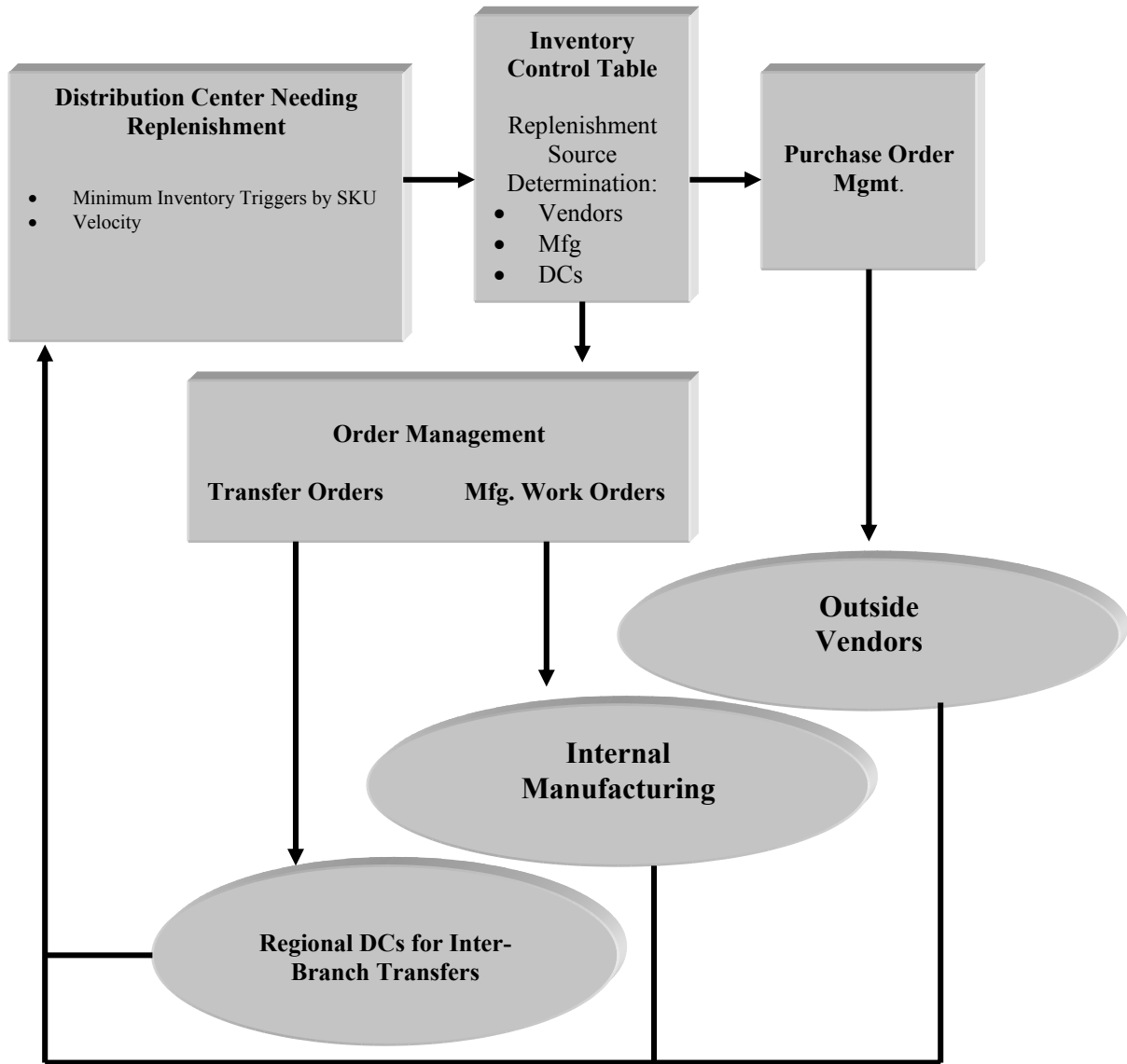
It should also be noted there is information maintenance communications between the customer and supplier systems using EDI. An example is a customer PO failing complete allocation on the supplier's system. The failure of the allocation must be communicated to the customer's system allowing for final PO acknowledgment. The customer may adjust the PO to the allocatable quantities which in turn, become expected receipts, communicated to the customer's V/dcms. During the supplier's distribution processing, the exact quantities may not have been available in the DC as previously thought doable during allocation. The supplier's shipment's ASN's must be communicated back to the customer's system in order to adjust the expected receipts in order to reconcile the customer's receipt to the actual supplier's shipment.

2.4 Inventory Replenishment Control

Inventory Replenishment Control enables the enterprise to replenish SKUs to one or more distribution centers through interacting with existing systems within VISUAL/Supply Chain. The interaction with these systems involves:

- Purchasing items from outside vendors,
- Manufacturing items,
- Inter-branch transfers from other DCs.

Therefore, the scope of application interaction is between VISUAL/ddp, the VISUAL/Manufacturing's Order Management, Work Order Management and Purchase Order Management Systems, and the VISUAL/Distribution Center Management System (VISUAL/dcms). Replenishments may be generated using messaging functions, and subsequent user entered orders, or automatically created Work Orders or Transfer Orders, or Purchase Orders issued to vendors using EDI.



The Inventory Control Table

Central to the determination and coordination of inventory replenishments is the Inventory Control Table (ICT). ICT maintains, but is not limited to, the following information:

- Minimum inventory levels for all SKUs per distribution center (DC),
- Current on-hand quantities per DC,
- Committed to order quantities per DC,
- Available for Shipment per DC,
- Intransit Quantities per DC, Inbound and Outbound.
- Other Classification SKU Quantities

Minimum Inventory Levels

The minimum inventory level establishes the re-order point for each SKU, managed within each DC. Enterprises operating multiple DCs will have multiple sets of information, and often, differing values based upon the demographic needs of the customer community being served by the DC.

Current On-hand Quantities

Maintained per SKU per DC, current on-hand inventory quantities are based upon updates from the DC. These quantities initially are established using Physical Inventory, where the aggregate SKU quantities are communicated to the VISUAL/ddp from the VISUAL/dcms. Adjustments to Stock, Notifications of Receipts and Notifications of Shipments, as generated by the VISUAL/dcms, establish the true values of current on-hand inventory.

Committed to Order Quantities

Per DC, SKU quantities committed to orders that have not yet left the DC are maintained. This figure is adjusted upward during allocation of inventory to orders, as well as adjusted downwards after shipments have departed the DC.

Available for Shipment Quantities

Per DC, the quantity of each SKU that has not been allocated to orders is maintained as available for shipment. Committed-to-Orders, and Adjustments-to-Stock decreases this value.

Intransit Quantities Per DC

Intransit quantities per DC represent SKU quantities destined for the DC (Inbound) that have yet to be received, or outbound SKU quantities that have left the DC but have not been reconciled. Inbound tracking is by Inbound Control Numbers (ICN) and outbound tracking is by Outbound Control Numbers (OCN). Not maintained in the ICT, but highly important to distribution processes are the ASN information sets associated with the ICN and OCN information. In cases of Inter-branch Transfers there is both an ICN and OCN set for the same order.

Other Classifications SKU Quantities

Classifications other than Available for Shipment are maintained in the Inventory Control Table. These classifications are user defined and typically represent On-Hold classification inventory, with further definition of the on-hold status being QA Inspection, Damaged, Returned Inventory, etc. These values are established through adjustments to stock and receipts of QA inventory.

The only time On-Hold inventory is used for shipment is in returns-to-vendor processing.

Additional Uses for the Inventory Control Table

In addition to maintaining perpetual SKU inventory levels per DC, the ICT interacts with Purchase Order Management and Order Management systems supporting:

- Source Determination
- Order Allocation and Future Reservations
- Transit Costing and Time Factors
- Preferred Quantity Replenishment Configurations

Source Determination

Source determination is the selection of the appropriate source for SKUs, either for order fulfillment or for DC replenishments.

For Manufacture/Distributors, decisions must be made as to the appropriate source of SKUs. An example being: if SKU quantities exist across DC's, should manufacturing be required to make items when SKUs may be transferred from other DCs? Other scenarios exist as well.

The creation of Purchase Orders, Work Orders or Inter-branch Transfers is driven by two factors:

- Manually placed requests

- EDI or systems created requests

The ICT maintains an Auto-Create parameter at the SKU level. In maintaining this parameter, Purchase Orders may be created systemically and transmitted to vendors through EDI, or in the case of internal manufacturing, work orders may be created and transmitted in the same fashion, for scheduling using VISUAL/Manufacturing.

For first time vendors, vendors who do not support EDI, or other non-system related factors, the parameter may be turned off. In this case, requests for replenishment notifications are sent as messages to the Purchase Order level (Vendor source) or Work Order level (Manufacturing source) or Order Level (Inter-branch Transfer source), and entered manually by users of the VISUAL/Manufacturing system.

Additionally, during manually placed requests, the user has the option to select differing vendors, as currently supported in VISUAL/Manufacturing, or for Inter-branch Transfers, differing DCs. However, if the Auto-create parameter is set on, only one vendor or one DC may be selected, determined through a value established when initializing this parameter. At any time, the source may be changed.

Order Allocation

During customer order entry, the ICT supports order entry personnel with allocation at the SKU aggregate level, also termed “soft” allocation, through the display of the ICT table’s SKU quantity values by DC. Each customer has a specific DC assigned to the ship-to, based primarily upon geographic region. As orders are placed, available to ship inventory quantities decrease, while commitments increase. This allocation process is simple and effective.

Where inbound intransit inventory for the SKU is visible from the ICT, orders without the appropriate inventory quantity available on-hand may be placed, and communicated to the VISUAL/dcms as “cross-dock” orders. In doing so, upon arrival, the inventory will be processed as cross-dock items and flowed through the DC bypassing storage. Therefore, commitments of inbound inventory to cross-dock orders must be tracked by the ICT as well.

Alternative DC SKU Allocation

When the customer’s “ship-to” location is entered, the ICT displays the SKU quantities for the DC serving the ship-to. If inventory is not available at the primary DC, and cross dock orders are not able to be placed, one of three options exist:

1. Place Inter-branch Transfer from an alternative DC with sufficient quantities, replenishing the primary DC, and creating fulfillment operations through cross-docking or
2. Place an order for shipment to the customer from the alternative DC, or
3. Place a work order in manufacturing to replenish the distribution centers.

For points 1 and 2, the decision is user driven. VISUAL/ddp supports the user’s decision through displays of transit costing and time factors. For the 3rd factor, VISUAL/Manufacturing procedures apply.

All allocation is real-time with orders being available for communication to the DCs servicing the order in real time. This process provides many advantages, including immediate reservation of inventory to priority customers whose ship-dates may be well into the future.

Transit Costing and Time Factors

Using alternative DC’s may be a costly operation, or may enhance flow through distribution. In order to assist in the determination, a transit costing percentage is given for the customer’s *primary* DC, as well as percentages for each other DC. The percentages reflect the transportation factor in the cost of distribution for the items. Inter-branch transfers may have a higher transit costing factor, but the standard cost of distribution is lower due to the shorter carrying cost times and storage requirements being eliminated.

Time factors are also represented in additional days for intransit from alternative DCs. During order entry, or when deciding Inter-branch Transfers, the user reviews this information for the impact on the cost and shipment.

VISUAL/ddp does not calculate these values – the user outside of the application determines them.

Preferred Replenishment Quantity Configuration

Preferred replenishment quantities and configurations differ from DC to DC. The purpose is to ensure the correct quantity is moved, given normal replenishments, using the correct Case-Pack-Quantity and the correct pallet configuration. In doing so, the utilization of the receiving DC is optimized and the inventory conforms to the receiving DC's current information.

2.5 Demand Planning

Demand planning has been included in this Functional Specification, however the development of this functionality is delayed till release 6.1 and will tie into VISUAL/aps planning functions.

Demand Planning functions within the VISUAL/ddp support the tools required to successfully introduce new SKUs into the enterprises supply chain or configure existing SKUs distribution requirements into the future. The tools supporting this effort include:

- SKU Product and Demographic Modeling
- Distribution Shipment Modeling and History

There are many other activities associated with demand planning, including event contributors such as advertising, econo-metrics, consumer behavior forecasting, etc., required of a world-class demand planning system. For the initial release of VISUAL/ddp, these sets of algorithms and functions have been not been considered.

SKU Product and Demographic Modeling

During the planning phase of a new product, or the re-planning phase of an existing product, specifics about the product's life cycle are captured in order to assist in the modeling of the product's distribution requirement. There is one of two approaches taken:

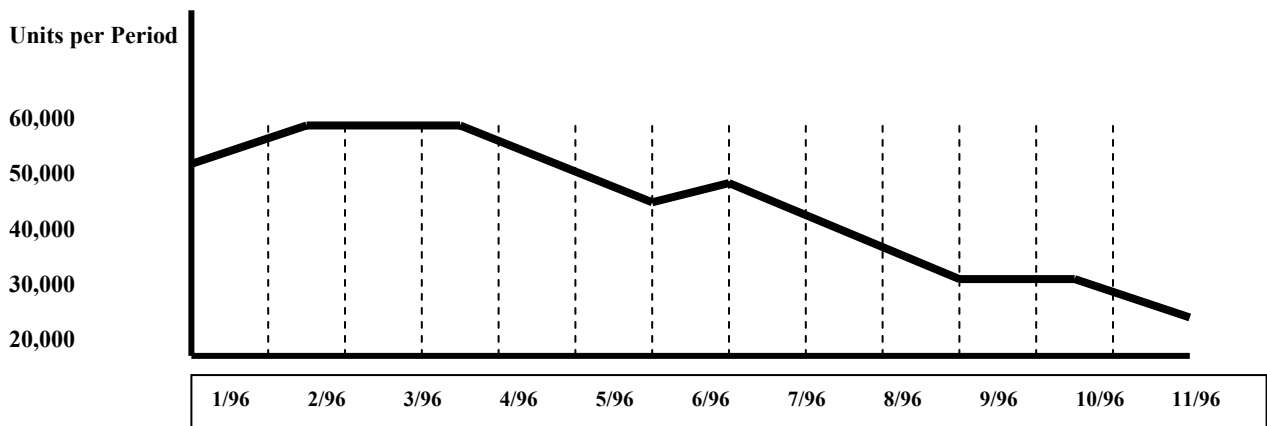
- Copy an existing SKUs model
- Create a new SKU Model

The following tools are found in SKU Product and Demographic Modeling:

- Product Life Cycle
- Aggregate Unit Definition by DC
- SKU Attributes

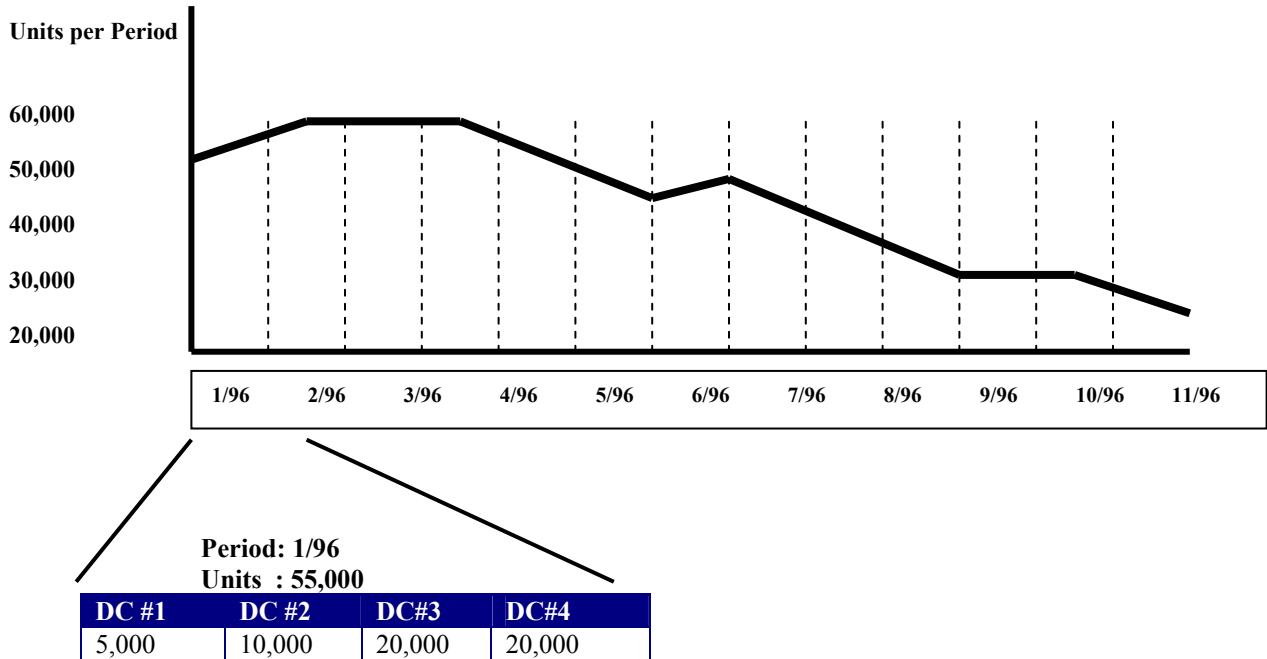
Product Life Cycle

The Product Life Cycle purpose is to model and examine the effects a product's life cycle has on the supply chain's distribution operations. It factors the aggregate number of SKUs targeted to be sold in the life cycle of a product, the annual and monthly number of Units, and the evaluation of the DC level replenishments in order to support the units sold. The following figure illustrates the product life cycle chart.



Aggregate Unit Definition

Once the product's life cycle has been established, the regional (demographics) requirements of the product's aggregate units are applied specifically for each period. Each period for the life cycle of the product requires aggregate unit definition.



SKU Attributes

In order to determine the SKU's effect on distribution, specific attributes about the SKU must be defined, including CPQ, weigh, cube, minimum inventory levels and preferred shipping configuration. In doing so, distribution center capacity and replenishment forecasting is able to determine shipping impact.

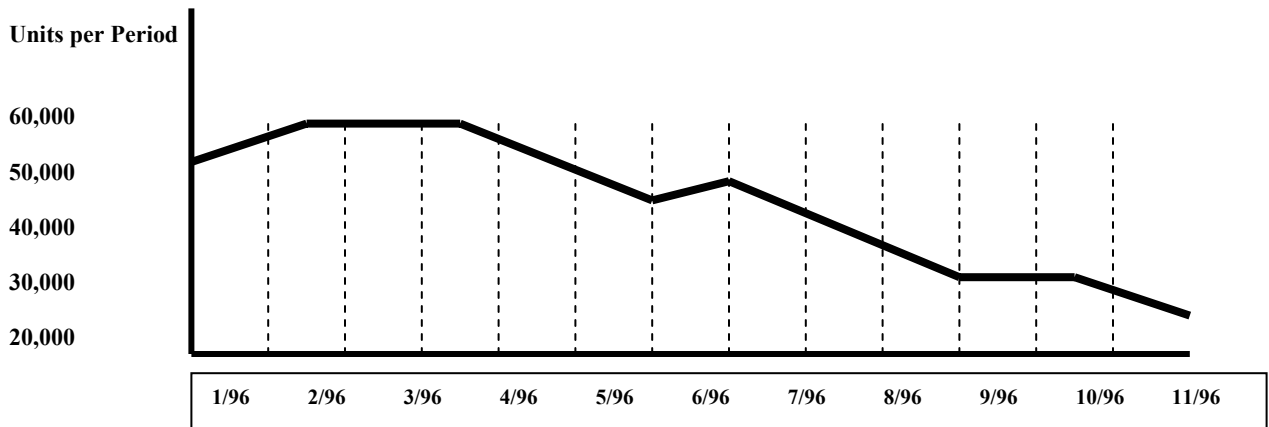
Distribution Shipment Modeling and History

Once the product life cycle is defined, aggregate units projected, SKU attributes defined and period demand defined, shipment modeling may take place.

For each SKU in a DC, the source or sources of the SKU must be defined for the DC. These sources may be outside vendors and suppliers, internal manufacturing or inter-branch transfers from central DCs to depots (2-step distribution).

The minimum inventory levels set per DC drive distribution shipments. Factored with the anticipated demand, as set per DC, initial shipment orders may be created. In addition to these orders, using the SKU attributes, and factoring the order quantity, transportation requirements may be forecasted. All information is presented in model form, allowing for re-configurations supporting optimization. Additionally, shipment history, based upon selected SKU's for which the new SKU distribution pattern is intended to replicate may be viewed. In doing, the history provides further insight into the model.

The following figure presents the Distribution Shipment Model.



Period: 1/96
Units : 55,000

DC #1	DC #2	DC#3	DC#4
5,000	10,000	20,000	20,000

Period : 2/96
Units : 55,000

DC #1	DC #2	DC#3	DC#4
5,000	10,000	20,000	20,000

Period : 3/96
Units : 55,000

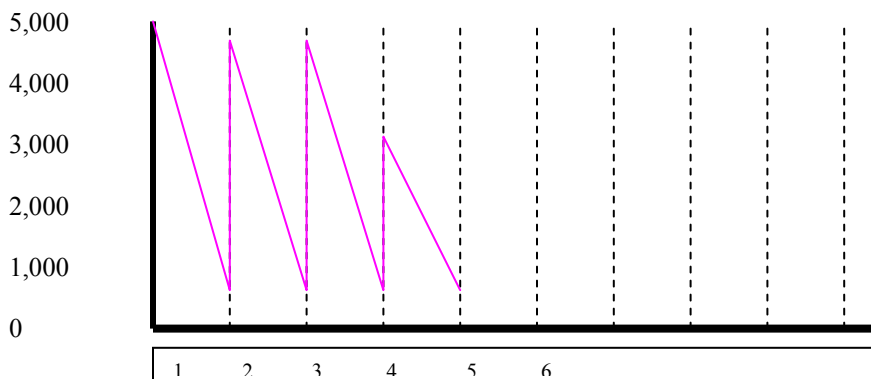
DC #1	DC #2	DC#3	DC#4
5,000	10,000	20,000	20,000

Period : 4/96
Units : 48,000

DC #1	DC #2	DC#3	DC#4
3,000	7,000	18,000	20,000

DC #1 has an expected velocity of 5,000 units per period for SKU 123 for the first 3 periods and the velocity is expected to decline in period 4 to 3,000. Safety stock levels are 10% of the overall period or 500 units. This level represents the minimum inventory level for DC #1. Theoretically, this level should never be reached. In this example the distribution center velocity (turns) is planned for 12 time yearly.

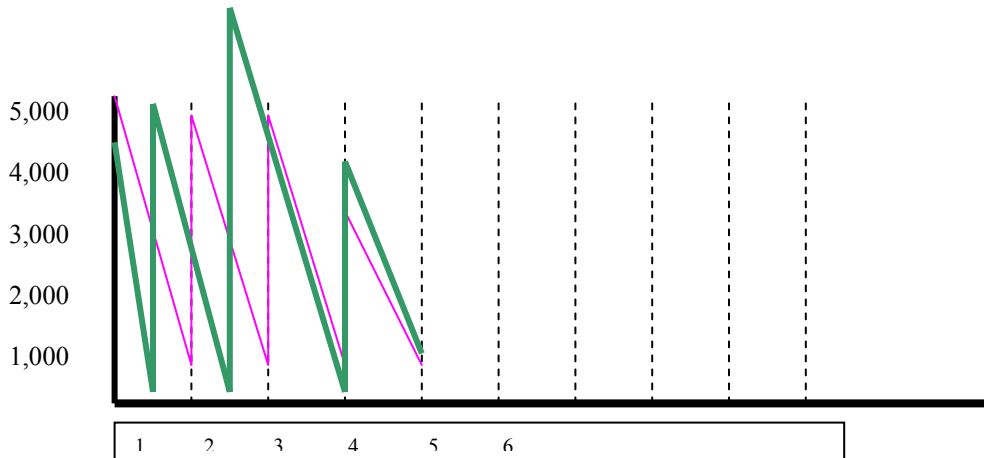
The inventory velocity and Shipments to DC#1 should look as follows:



The source of inventory for the DC #1 is central manufacturing plant #1 in Chicago. Therefore, monthly replenishment work orders will be generated for this manufacturing plant in the amount required for DC#1.

Shipment History

Shipment history of a similar SKU may be reflected in context to the SKU under planning. The following example applies.



The new SKU, in green, was planned in the same fashion as the purple SKU, however, the SKU sold at a greater velocity, causing shipments (and unexpected manufacturing or DC inter-branch transfers). History shows an adjustment was made in the shipments during period 2 and 3, bringing in line the DC levels with the fulfillment demand for each period.

If need be, the purple SKU plan can be adjusted to reflect the similar SKU's history.

Distribution Demand Planning Model Output

Once the models reflect the goals of the distribution planners, they create orders, with quantities and ship dates supporting the DC requirements. These orders may be maintained and adjusted at any time. The release of these orders is up to the various applications supporting the source of the inventory, being purchasing for Vendor source, Manufacturing or Order Entry for DC transfers.

3.0 Process Flow Charts

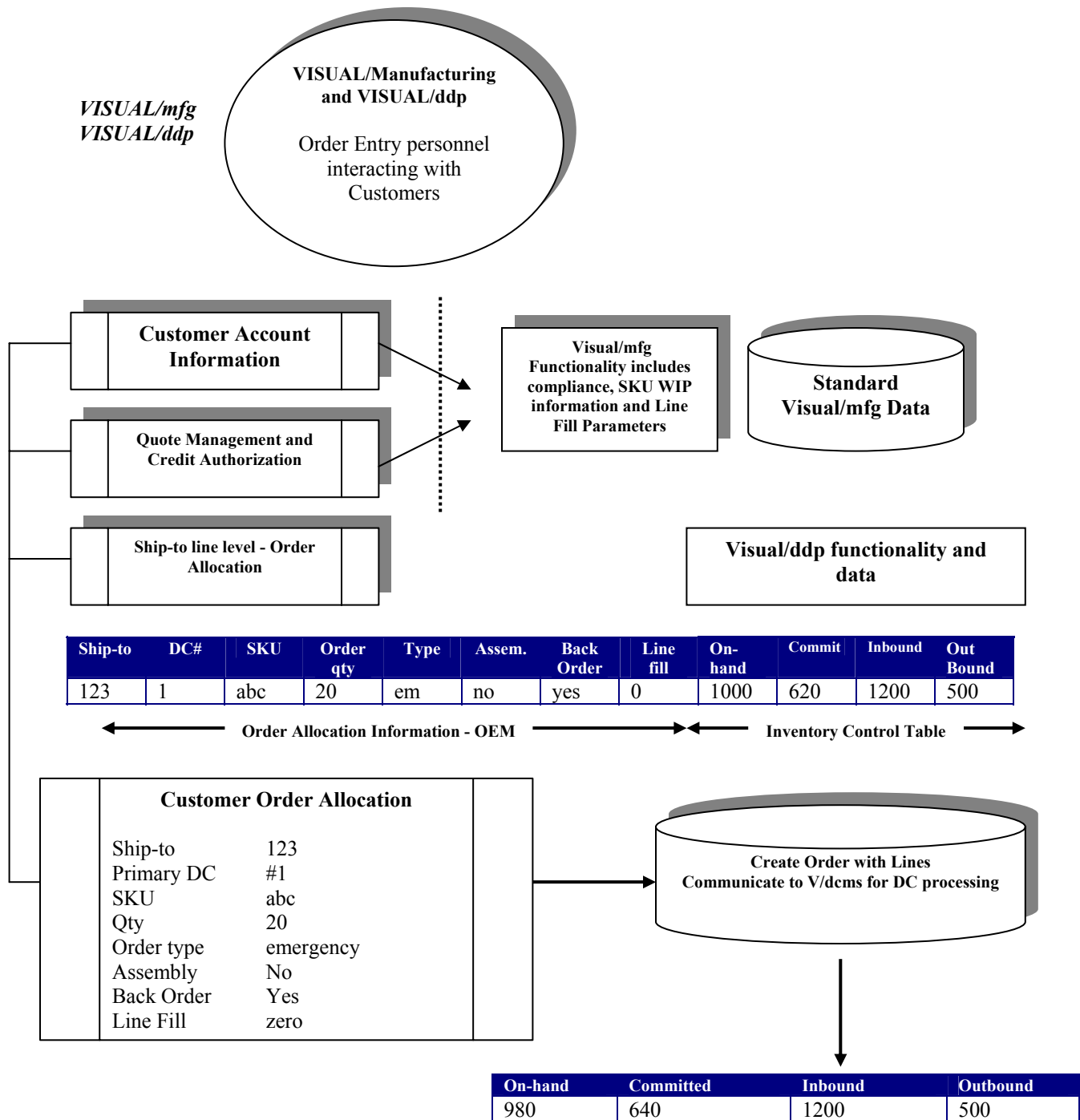
This section presents a high level flow of processes and information between Visual Manufacturing and the Visual/dcms products using the functions in Visual/ddp.

The following process flow charts are:

- Order Allocation
- Allocation of Orders Against Future Receipts
- DC Replenishments - Vendor Source/PO Entry
- DC Replenishments – Interbranch Transfers/Order Entry

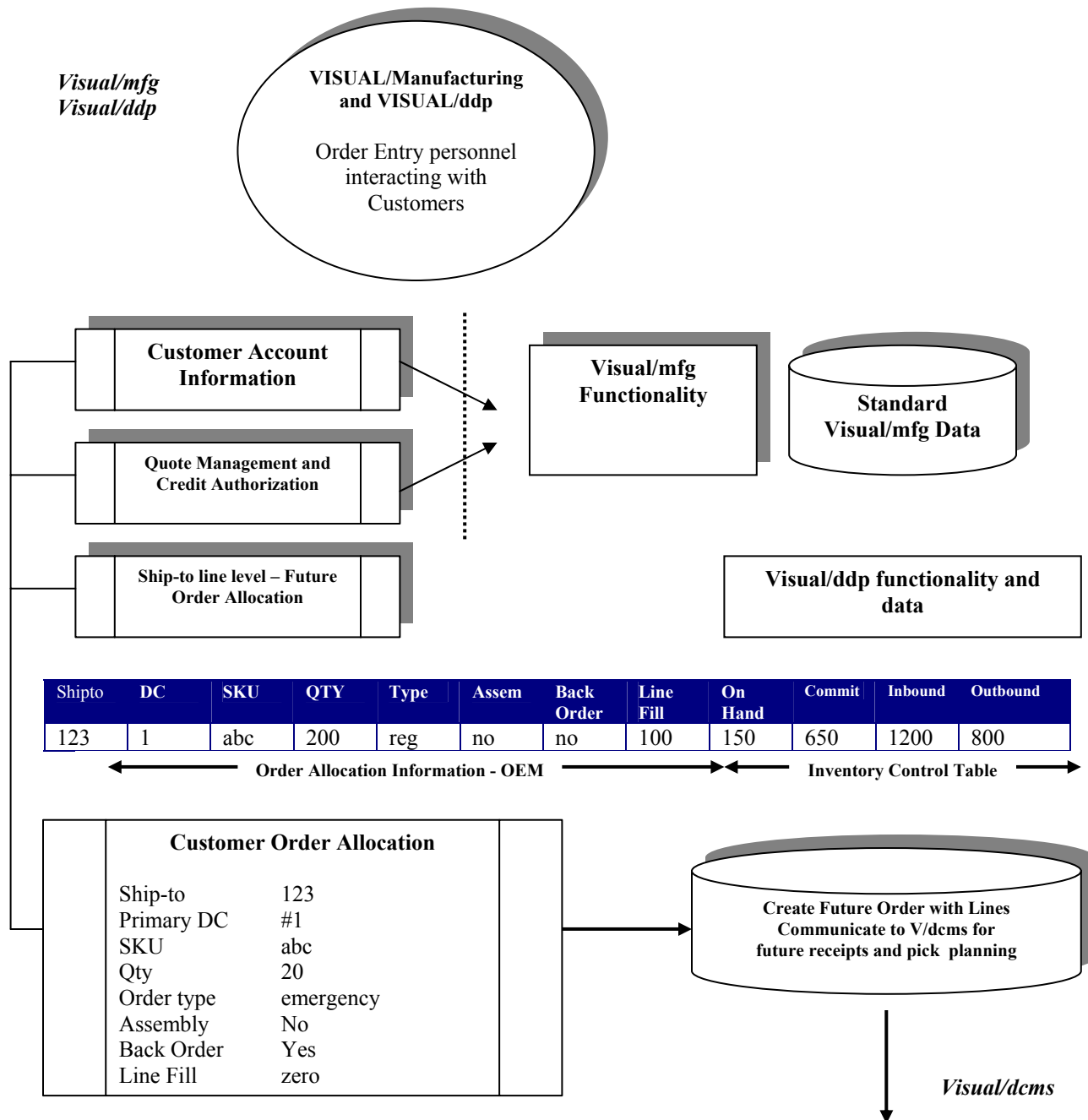
Not described are EDI or Demand Planning. Karen Phelan has an EDI chart that should be inserted into this document (and was not available 2-23-98) and demand planning requires additional review relative to existing functionality currently supported by Visual/mfg.

Order Allocation



Once the order has been created, the inventory control table values for DC #1 change to reflect the order. The on-hand available amount decreases to reflect the allocation, the committed increases to reflect the order amount. The inbound does not change. Receipts impact its values. The outbound does not change until the order has been processed and the trailer departs. Once the trailer departs the outbound increases by 20 units and the committed decreases by 20 units.

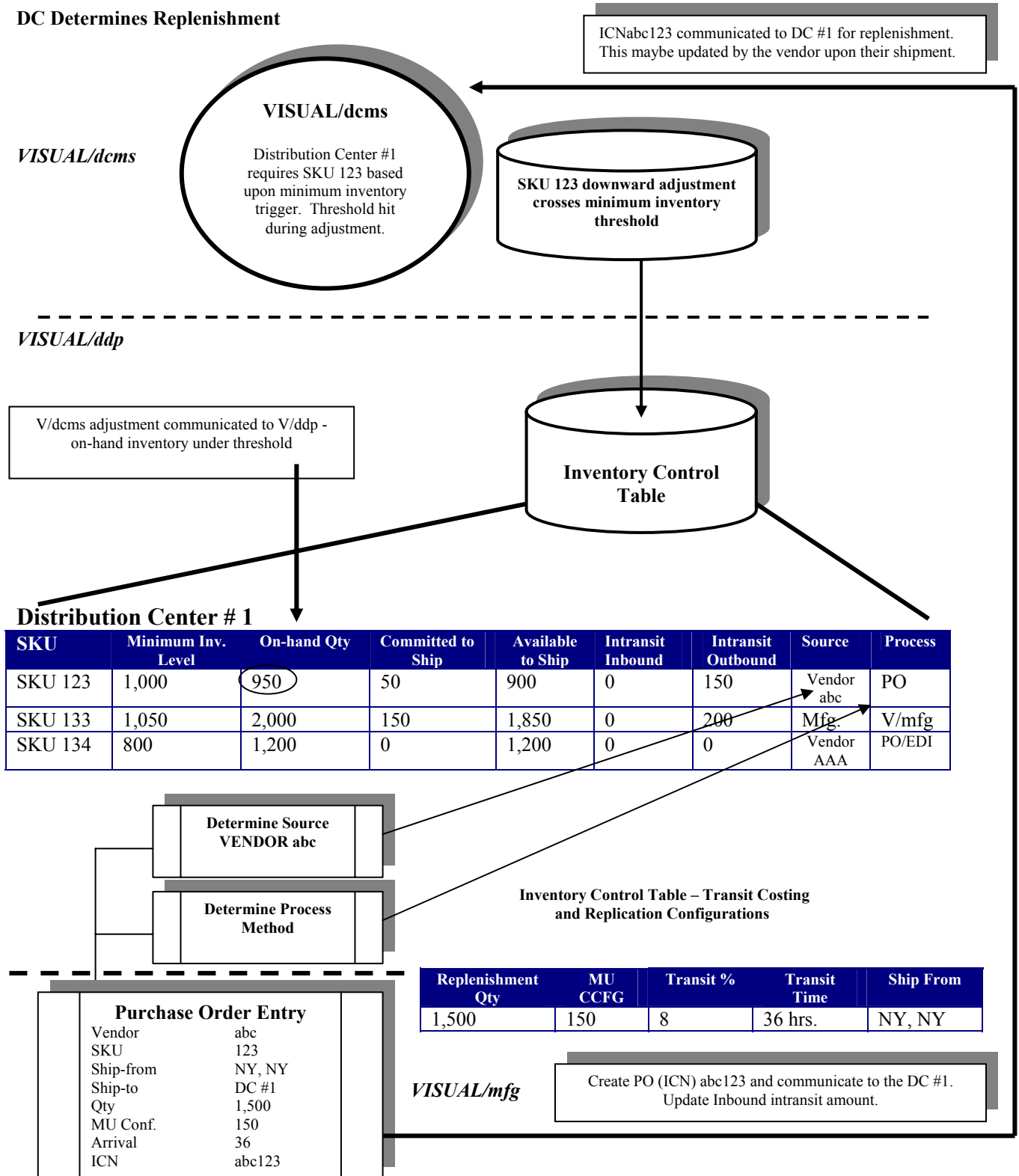
Order Allocation Against Future Receipts



The required inventory is not available for allocation. The customer's line fill rate is 100% and they will back order. The customer service person is able to inquire into the incoming ICN's (PO's) and determine a receipt date for the SKU. If acceptable to the customer, a commitment is made against the incoming ICN. These values are maintained as commitments to incoming inventory, and not mixed with current commitments to inventory already in the DC. Once the inventory arrives, the DC may either cross-dock the items, or putaway the inventory for standard order planning and pick processing. **NOTE: Alternate DC points functions may apply – see DC replenishments.**

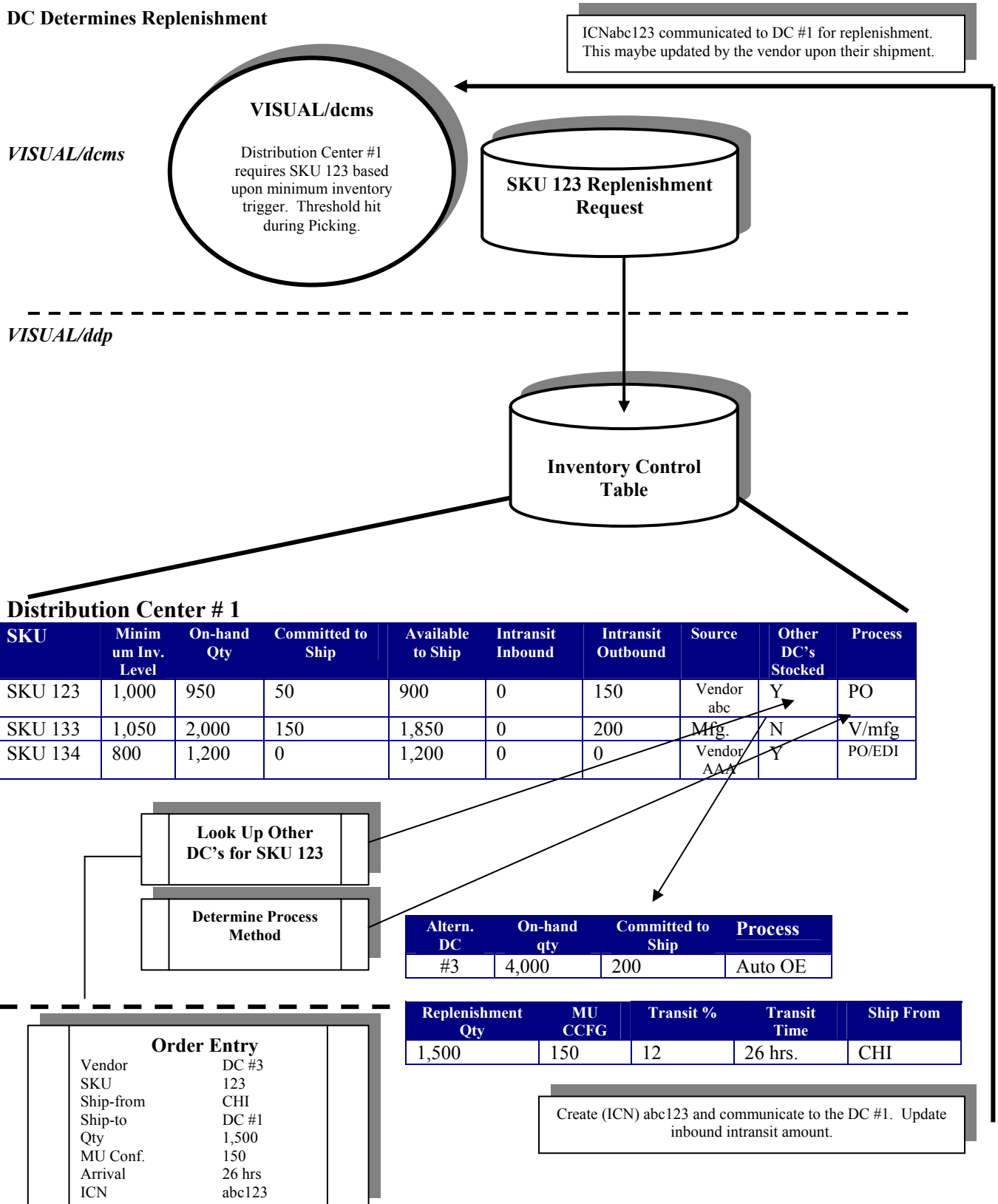
Distribution Center Replenishments – Vendor Source/PO Entry

DC Determines Replenishment



Distribution Center Replenishments – Inter-branch Transfers - Order Entry

DC Determines Replenishment



4.0 Transaction Level Briefs

This section reviews the parameters and the transactions, logically grouped. While these transaction level briefs do not detail the systems screens and user interaction, they do specify the behavior of the transactions functions.

The following transactions by group are described:

- Customer/Ship-to Parameters
- Vendor/Supplier Parameters
- Work in Process/Value Added Service Parameters
- Inventory Control Table Values
- Order Allocation
- Transportation Management
- Safety Stock/DC Replenishment
- Demand Planning
- Interfaces With VISUAL/dcms
 - Customer Order Tracking
 - Information Maintenance
- Communications

4.1 Customer/Ship-to Parameters

There are various parameters used at the customer and ship-to level assisting in distribution planning and allocation interaction with customers.

4.1.1 Customer Ship-to	Each customer in VISUAL Manufacturing must support multiple Ship-tos, designated by: • a key code, • contact, and • address destination. The ship-to is used during order entry allowing for multiple ship-to's per order at the ERP level.
4.1.2 Priority Customers	Each customer/Ship-to must support a priority code, set by the user. The priority code is used to delegate inventory quantities during allocation. The default should be set per customer, with additional priorities set for ship-to's. The operational purpose in setting ship-to level priorities include store openings, back order processing, etc.
4.1.3 Ship-to / Distribution Center relationships	Each ship-to has a primary DC. In instances where a customer requires other DC's due to less-than-full-line DC's or inventory shortages, alternate DC lookup using preferred alternate DC's is supported.
4.1.4 Customer / Ship-to Fill Rate	Fill rate assists in determining the "go no go" of an order based upon one of two factors: • Aggregate Inventory Quantity for the whole order: • Line Level Inventory Quantity During order entry, unavailable inventory accumulates as is systemically checked against the fill rate threshold. If the unavailable inventory for the order is reached, the entire order may be canceled. If the unavailable inventory reaches the line level, only that line is canceled.
4.1.5 WIP/VAS and Compliance	Ship-to parameters exist for WIP/VAS and compliance labeling. The WIP/VAS is allowed for each DC which provides these services only. Additionally, the WIP/VAS parameter is SKU based in that the customer may only require certain SKU's to under go value added services. During order allocation, SKUs requested that have WIP/VAS histories with the customer/ship-to should prompt for the services. Also, within the customer/ship-to structure, operationally, some ship-to's may require compliance labeling while others do not. Hence the need to condition at the ship-to level.
4.1.5.1 WIP/VAS Specifications	During order entry, specifications' regarding the work committed in WIP/VAS is keyed into the system using standard text entry. This information is line level specific.

4.2 Vendor/Supplier Parameters

For release 1.0 of VISUAL/ddp, Vendor/Supplier parameters are kept at a minimum, focusing basically on QA and WIP/VAS. In the future, QA parameters may be set based upon vendor compliance information generated by the IQS Quality application.

4.2.1 QA Vendor Receipts	Receipts from specific vendors may or may not undergo QA in VISUAL/dcms based upon a QA parameter set in VISUAL Manufacturing. The QA parameter may also be integrated in the future using vendor compliance tracking in IQS Quality software. (This is not release 1.0 functionality) In addition to QA flagging, percentage of QA receipt
4.2.2 ICN WIP/VAS	Specific receipts may require WIP/VAS in the distribution center. Whereas VISUAL/dcms maintains SKU level parameters, these may be overridden with the existence of ICN level WIP/VAS communicated from the ERP. Operationally, these parameters assist in final finishing of inventory from manufacturing.

4.3 WIP/VAS Parameters

Work in Process / Value Added Services (WIP/VAS) is a major trend in warehousing for companies providing customization services against their components or inventory. While not complete manufacturing in nature, WIP/VAS requires the management of inventory moving into and out of service sections in a warehouse. WIP/VAS starts during order entry, where these services are offered to customers.

4.3.1 WIP/VAS Relationships with Specific DC's	WIP/VAS must be allowed only for DC's able to manage the services. For release 1.0, this relationship will be managed by the users of the systems. During order entry, for ship-tos being fulfilled from DC with WIP/VAS, the order entry personnel using VM will be presented WIP/VAS options, enabling the "selling" of these services. At the order line level, the WIP/VAS service is noted on the order with specifications.
4.3.2 WIP/VAS Cost Impact	Each service may (or may not) incur additional service charges. These service charges are presented during order entry and impact the invoicing of the order.

4.4 Inventory Control Table Values

Central to order allocation and material planning for the supply chain is the values maintained in the Inventory Control Table (ICT). The ICT maintains the inventory values at the “Enterprise” level, meaning the accumulation of inventory across multiple locations within the warehouse.

Imperative in the design and function of the VISUAL/dcms is the ability to maintain these values in real-time, keep them in complete synch with the warehouse(s), and adjust these values and ascertain inventory valuation after physical inventory is completed.

4.4.1 Current On-Hand Quantities	Maintained per SKU per DC, current on-hand inventory quantities are based upon updates from the DC. These quantities initially are established using Physical Inventory, where the aggregate SKU quantities are communicated to the VISUAL/ddp from the VISUAL/dcms. Adjustments to Stock, Notifications of Receipts as generated by the VISUAL/dcms, establish the true values of current on-hand inventory. Additionally, inventory transactions adjusting these quantities may be used by authorized personnel, however, they should be discouraged. All adjustments to stock made by VM precluding the use of V/dcms are managed using current VM functions and impact inventory values only in warehouses managed by VM. This value represents both committed/not-yet-shipped and uncommitted inventory.
4.4.2 Committed to Order Quantities	Per DC, SKU quantities committed to orders that have not yet left the DC are maintained. This figure is adjusted upward once allocation of inventory to an order is complete, as well as adjusted downwards after shipments have departed the DC, as recognized through acknowledgments of shipments, communicated from V/dcms or through VM shipping functions. Committed to order quantities may be drilled down to reflect the orders and their associated sets of information assisting in customer order entry monitoring and further order maintenance against already placed order that have yet to ship.
4.4.3 Available for Shipment Quantities	Per DC, the quantity of each SKU that has not been allocated to orders is maintained as available for shipment. This is the value that order entry personnel primarily focus on during order allocation. Committed-to-Orders decreases this value. Adjustments to Stock may decrease or increase this value. Acknowledgement of Receipt increase this value.

4.4.4 Intransit Quantities per DC	Intransit quantities per DC represent SKU quantities destined for the DC (Inbound) that have yet to be received, or outbound SKU quantities that have left the DC but have not been reconciled. Inbound tracking is by Inbound Control Numbers (ICN) and outbound tracking is by Outbound Control Numbers (OCN). Not maintained in the ICT, but highly important to distribution processes are the ASN information sets associated with the ICN and OCN information. In cases of Inter-branch Transfers there is both an ICN and OCN set for the same order. Intransit quantities per DC represent SKU quantities destined for the DC (Inbound) that have yet to be received, or outbound SKU quantities that have left the DC but have not been reconciled. Inbound tracking is by Inbound Control Numbers (ICN) and outbound tracking is by Outbound Control Numbers (OCN). Not maintained in the ICT, but highly important to distribution processes are the ASN information sets associated with the ICN and OCN information. In cases of Inter-branch Transfers there is both an ICN and OCN set for the same order. For inbound inventory, future allocations against stock may be generated and reviewed.
4.4.5 Additional Classifications	Classifications other than Available for Shipment are maintained in the Inventory Control Table. These classifications are user defined and typically represent On-Hold classification inventory, with further definition of the on-hold status being QA Inspection, Damaged, Returned Inventory, etc. These values are established through adjustments to stock and receipts of QA inventory. The only time On-Hold inventory is used for shipment is in returns-to-vendor processing. IN cases such as these, material planning may send inventory back to suppliers through creating orders for shipments of inventory recognized in this class group.

4.5 Order Allocation

Order allocation of stocked inventory is central to order management process. From the view point of the enterprise, order management goes beyond allocating the stock into offering services and added profit generating sales. Allocations is central to this endeavor.

4.5.1 Priority Customers	Priority's assist in categorizing customers and/or ship-to for reasons of allocation of stock that may become scarce. Priorities default at the customer level, with overrides at the customer's ship-to levels. During order entry, priorities are come into play when commitments to stock reach a disbursement point set for the SKU. In instances where the inventory requested by the customer reaches or exceeds the disbursement point for all customer and their orders in the priority group, the order line will be denied allocation.
4.5.1.1 Establish SKU Disbursements	Disbursements of inventory are managed at the SKU level, SKU Family Group level or for all SKUs. Disbursements are set as percentages of the available for shipment quantities. As orders are taken for customers within specific priority groups, the disbursement threshold nears.
4.5.2 Present/Capture WIP/VAS	During order entry, WIP/VAS services for the Customer Ship-to/SKU are presented and if required, flagged. These services may only be offered if the DC fulfilling the order provides these services.
4.5.3 Substitution	In instances where allocation has failed, due to stock outs or priority problems, a list of available SKUs and their descriptions is displayed.
4.5.4 Alternate Sources of Inventory	During order entry where sufficient SKU quantities are unavailable from the customer's primary source DC, alternate sources are displayed, if they exist. These sources must fall under business rules including, but not limited to other DC's, manufacturing or other outside sources for the desired inventory. Source determination lists in priority sequence the source or sources for a stocked SKU. Source determination assists in evaluating Inter-branch transfers, purchases from outside vendors or manufacturing of SKUs. Per user, alternate source selection is allowed/disallowed, based upon the source type (DC vs. outside vendor), lead times and/or transit costing factors.
4.5.5 Final Allocation	Once inventory is deemed suitable for shipment to the customer, it is allocated and communicated to the VSUAL/dcms with the desired ship date.
4.5.6 Order Types	Orders may be flagged as a specific "type" such as emergency, or will-call order. These types are defined in VM and match specific business objectives of the enterprise and the warehouse. Certain order types must be present in VM such as promotional and emergency orders due to specific logic in the VISUAL/dcms.

4.5.7 Allocations Against Future Receipts	Inventory intransit from either manufacturing or from suppliers may be allocated to orders. VM will ensure the desired ship date is later than the receive date and the inventory on the ICN has the associated OCN (order number) pending. The allocation of “future inventory’s” value is maintained is separate values and does not confuse the inventory seen as landed in the DC.
4.5.8 Flow Through Orders	Orders may be processed for non-existing inventory, or against future receipts, with the expressed direction to flow the inventory through the facility. PO’s need not be present for this function, yet the function will force PO’s or manufacturing work orders to be generated for the order. These orders are communicated with the ICN and line level information and processed by V/dcms during receipt of the specified ICN. Earlier receipts of the same stock are not processed for the order, the order must wait for the specific ICN receipt to occur.
4.5.9 Cross Dock Orders	Highly similar to the Flow Through Order are cross docked orders, where orders may be taken as “back orders”, with no specific ICN directed to link to the order. This method of processing allows for the order to be fulfilled from <u>any</u> receipt of stock, excepting linked stock, as described above. The order will sit on the VISUAL/dcms until the stock is available in receipts.

4.6 Customer Order Tracking and Maintenance

Once orders pass allocation and are communicated to the VISUAL/dcms, visibility into the orders status in processing is required. Due to the potential for consequential transaction volumes between the VISUAL/dcms and VM, status communication regarding orders will be limited to:

- Passed Allocation / In Distribution Processing
- Trailer Departed

Deeper levels of DC operations’ detailed order status information may be attained through VM to V/dcms pass through techniques and user authorization to key inquiry transactions. In addition to order monitoring, order maintenance may be required to existing orders.

4.6.1 Order Monitoring	Order monitoring is maintained through order entry personnel keying specific order numbers or customer/Ship-to ID’s into the VM. All orders that have “Passed Allocation / In Distribution Processing” are derived from committed to order quantities, or from future receipts. Trailer departure is communicated to VM from V/dcms in real time and represents orders that have left the premises. Information about the actual shipment and carrier information is available at the container level due to V/dcms creating ASN information. Inquiry functions should be in place to allow for customer specific presentation of these shipping details.
4.6.2 Order Additions	Order additions represent new lines being added to orders. The new order lines are subject to allocation, however, the earlier order which passed allocation and was communicated to the VISUAL/dcms is no longer subject to allocation in cases where line fill rates may fail.

4.6.3 Consolidate	Order additions typically are communicated with a consolidate flag set on. Consolidation drives a process within VISUAL/dcms where the order or subsequent orders will be treated as one order for distribution processing. This is highly economical. However, there are instances where the customer may choose not to consolidate orders for reasons of PO level reconciliation. VM supports this though setting the consolidate flag off.
4.6.4 Order Changes/Deletions	Order changes may be communicated to the VISUAL/dcms. The changes will occur based upon the disposition of the order in the planning cycle. Given orders are not planned for wave generation, they may be changed or deleted. In cases where orders have passed this point in VISUAL/dcms, the change/deletion request is rejected, and the order must be deleted or changed using VISUAL/dcms functions. Any changes or deletions of orders will affect the inventory values in the V/ddp ICT.
4.6.5 Fail To Allocate Orders	Due to the dynamic operational nature of the warehouse, order allocation may pass, yet inventory may become on-hold quickly thereafter. These orders will undergo a secondary allocation check during order planning in the VISUAL/dcms upon the first selection of orders by ship-date. Order failing soft allocation at this point will be communicated back to VM for customer service to manage.

4.7 Transportation Management

Transportation is managed in two distinctly differing fashions. If the customer pays for the transportation, the order entry management personnel do carrier selection. If the transportation is paid for by the enterprise, the transportation duties often fall to a “transportation” department where carrier selection and routing become more critical to profitability. In both instances, for enterprises which operate multiple DC’s and inter-branch transfers are the norm, transportation costs and planned as closely as possible, and the need to review and manage IBT shipments before they depart the DC is critical.

4.7.1 Interfaces to Tracer Research or other Transportation Management Systems (TMS)	VISUAL/dcms and VISUAL Manufacturing both will interface to TMS. For order management, the interface will primarily be for carrier selection based upon customer preference and cost. Secondly (and not considered in release 1.0) will be routing management. For the DC, TMS will be used for parcel manifesting and tracking of parcel containers.
4.7.2 Carrier Selection	Based upon cube and / or weight of an order, and the customers preferred arrival time, the TMS can suggest the lowest cost shipping method and provide pre-payment costs for the shipment.
4.7.2.1 SKU cube and weight	For the above carrier selection to work, VM must track the cube and weight of each SKU at the lowest shipping unit. This information must be accumulated across the quantity of all SKUs in an order and passed to the TMS, enabling freight charge and carrier determination.

4.7.3 Parcel Manifesting	This is not VM level functionality, and only concerns V/dcms. Containers (Movable Units) are picked to orders and weighed by the TMS in order to determine or associate parcel tracking numbers and manifests.
NOTE:	There will be considerable functionality added to this area after the initial release of VM 6.0 and V/dcms 1.0.
4.7.4 Transit Costing/Time Factors	For shipments from alternate sources (DCs, Manufacturing Drop Ships or Suppliers), Transit Cost and Time factors need to be calculated. Currently, it is unclear as to this being TMS functionality, or parameters in VISUAL. This will be decided after TMS review.

4.8 Safety Stock / DC Replenishments

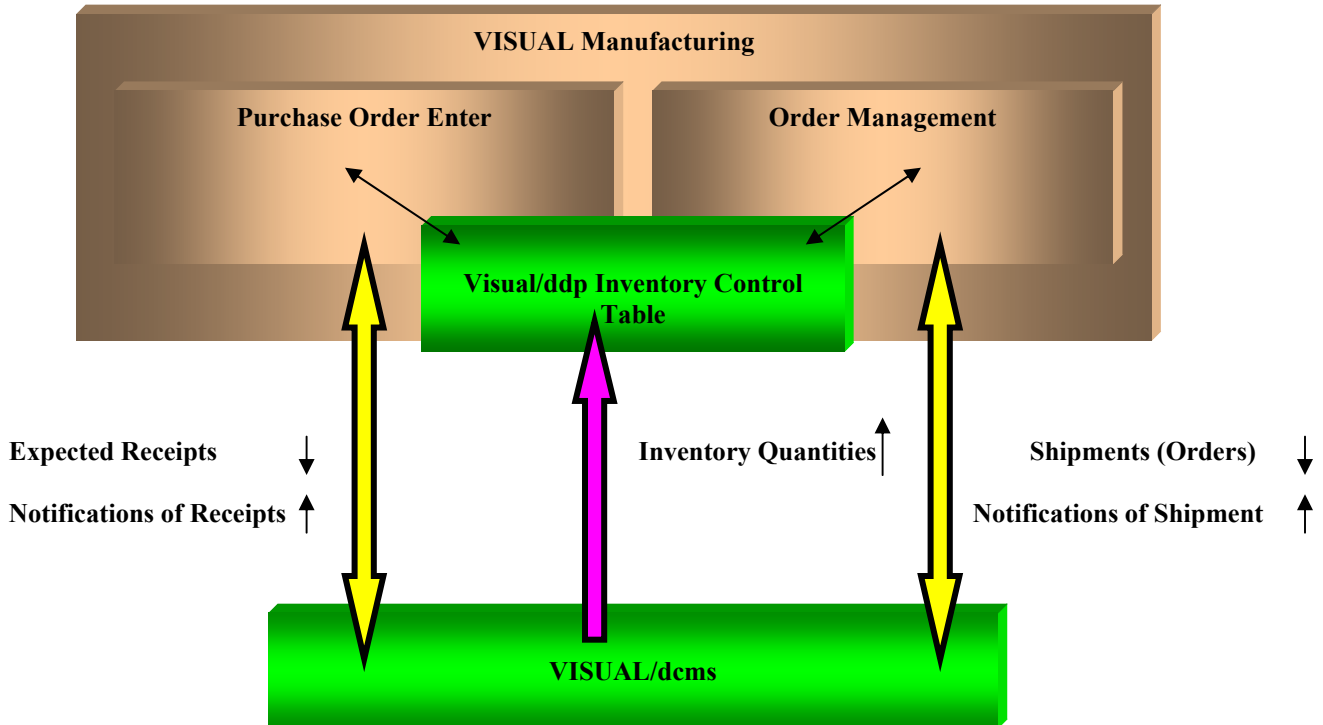
Material planning personnel in the enterprise consider the re-order point for SKUs or SKU families with the intention of the system re-ordering inventory once the available quantities fall to or below the re-order point.

4.8.1 Setting Re-Order Points	For release VM 6.0, re-order point settings manual by SKU or SKU family group. Re-order points are set as safety stock replenishment quantities. In the future, demand planning in the APS engine will define safety stock re-order points through algorithms using order service levels, lead time and deployment.
4.8.2 Preferred Replenishment Configurations	In order to maximize the DC operations use of racking, configurations detailing case pack quantities, as well as pallet configuration (CCFG) are maintained. In doing so, re-order points may be derived from these values.
4.8.3 Procurement Generation	Each SKU has a primary source, be it manufacturing or an outside supplier. Additionally factored it to procurement generation must be the additional warehouses in the enterprise supporting IBTs. During order allocation, inventory committed to orders may fall below the safety stock re-order point. VM will determine the source and create PO's, WO's or IBT's for the required inventory. In the future, these procurements will be communicated to suppliers via EDI or the internet. Currently, they will generate a replenishment report and use current VM ordering techniques.
4.8.4 Procurement Amount	The procurement amount is of consequential concern to the enterprise. The effort is to order amounts ensuring the highest level of service in combination with the highest number of turns. In doing so, significant savings are realized. This is considered shortening the cash to cash cycle. VM's procurement amount will be manually set in release VM 6.0. In the future, it should be det by APS. The procurement amount must factor the preferred replenishment configurations in order to maximize distribution handling as well as turns.
4.8.5 Supplier Capabilities	Each supplier has differing systems and the ability to manage EDI or the internet, or neither must be flagged in VM. In doing so, the communication of PO's using the proper technology is automated.

4.9 Interfaces and Data Maintenance

As presented, in order to manage allocations to orders and DC replenishments, information interfaces must occur between VISUAL/Manufacturing's functions, specifically Purchasing and Order Management and VISUAL/Distribution functions, specifically Visual/ddp and Visual/dcms.

The movement of the application information occurs between VISUAL/Manufacturing and VISUAL/distribution. The following figure represents the functional areas of interface.



4.9.1 Expected Receipts	Host to WMS Expected receipts are generated by the VISUAL/Manufacturing Purchase Order Management system and communicated to the VISUAL/dcms. This information contains the primary information elements: • PO Header and type of receipt (vendor, manufacturing, returns, inter-branch transfer, etc.) • PO line and expected receipt qty per SKU • PO messages Distribution uses this information for <u>receipts</u> planning and processing purposes. Additionally, this information may be used for “Flow through” decision support. This information may be maintained by the V/M until the Inbound Control Number is opened signaling receipts processing. At this point, attempted maintenance fails. This information is often referred to as PO level Advanced Shipping Notification (ASN) information -- meaning the ICN receipts information, as established by the shipper (vendor, manufacturer or Inter-branch transfer). ICN’s created by manufacturing or inter-branch transfers have an accompanying order, for which stock was pulled in response to the DC replenishment. The receiving DC only sees the ICN, while the pulling DC only sees the OCN. This information may also be maintained by the various shipping entities using actual container level ASN information where the system introduces a detailed carton (container) level of information describing the license plate, and the SKUs and quantities within each license plated container. This information is communicated to the receiving DC’s system based upon the picking and shipping activities of the vendor, manufacturer or Inter-branch transfer point. This information is termed Container Level ASN information. The use of container level ASN is standard today for companies using WMS systems across a network of DCs. Container ASN eliminates the need for detailed check-in of product and expedites finished goods putaway or flow-through stock management through scanning the license plate during receipts without detailed check-in processing.
4.9.2 Acknowledgements of Receipts	WMS to Host During receipts of ICNs in V/dcms, the SKU and quantity information is established and communicated to the V/M application, in order to reconcile the receipt to the expected receipt information. This information is vital to Accounts Payable. Additionally, this information is updated on the Inventory Control Table, increasing the On-Hand quantities for the SKU being received. For Vendor Managed Inventory (VMI) programs, receipts from specific vendors do not trigger payment transactions, only acknowledgment of what was actually received (SKU quantities). The form of the acknowledgement is based upon the vendor’s IS capability, though usually EDI.
4.9.3 Inventory Quantities and Adjustments	WMS to Host The absolute “owner” of inventory is the VISUAL/dcms. The inventory records and values as maintained at the Inventory Control Table are completely derivative of the transactions processed in the distribution center communicating

	inventory levels to the VISUAL/ddp's Inventory Control Table. This rule ensures inventory physically stored at the DC is mirrored by the values maintained in the VISUAL/ddp. Thus, all order allocations, purchasing, manufacturing for DC replenishments and inter-branch transfer decisions are predicated on absolute finished goods information. All adjustments to stock, based upon cycle counts or physical inventories potentially update the inventory levels in the Inventory Control Table.
4.9.4 Shipments and Orders	Host to WMS Shipments information may be orders conditioned by order type. Order Types include, but are not limited to, Inter-branch transfers emergencies, Return to Vendor, WIP orders, etc. All orders communicated to the DC result in picking and shipping inventory. Orders may be maintained by further communications from VISUAL/Manufacturing until the order has been selected by the Planning functions of VISUAL/dcms for shipment. Maintenance of information to orders reaching this status fails. Order information is communicated to the VISUAL/dcms in the form of: • Order Header • Order Line detailing SKU quantities and any WIP Processes or other detailed data • Order Messages
4.9.5 Acknowledgements of Shipments	WMS to Host All orders resulting in Shipments are communicated by to the VISUAL/Manufacturing in the form of Notifications of Shipments. This information is used to create Advanced Shipping Notification (ASN) supporting the receiving entity being either the customer, or inter-branch transfers. Vendors receive this information for Returns-to-Vendor. As previously described, the results of picking activity results in container level ASN, able to be communicated to customers via EDI, or inter-branch transfers using the corporate network. ASN information is integrated directly into EDI at the VM level. Notifications of Shipments affect the inventory maintained at the VISUAL/ddp, reducing the on-hand inventory for the shipping DC.

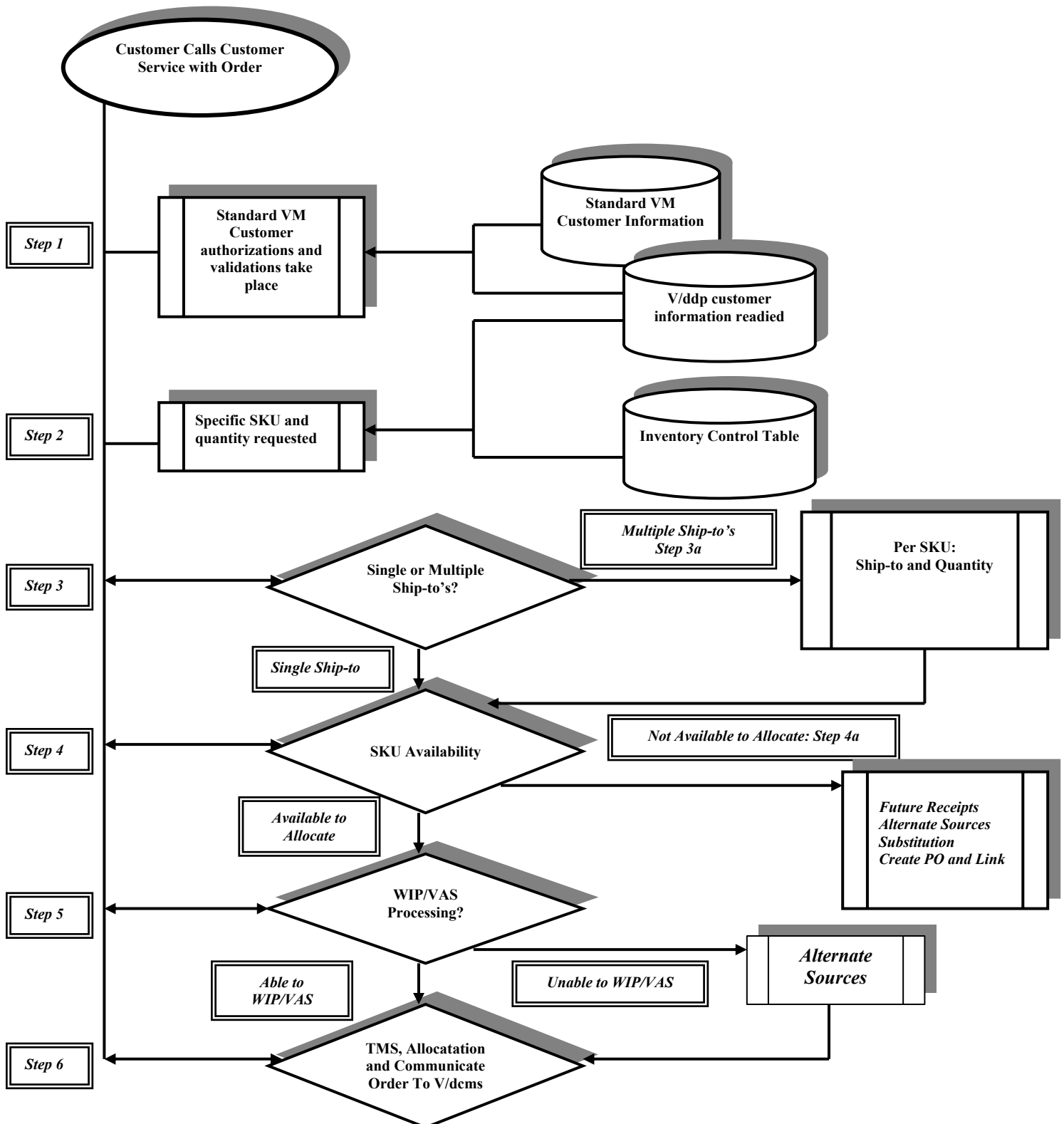
4.9.6 Communications Techniques	All communications between the VM and V/dcms applications are in real time, with the ability to adjust communication frequency. The intention is to allow the enterprise to have visibility into the DC and the on-hand available inventory as frequently as possible. V/dcms is designed to be sold with ERP system other than VM. Therefore it is imperative that the style of communication between systems not be solely based upon proprietary designs and technologies between VM and V/dcms.
4.9.7 Data Maintenance	There are a number of files that populate the V/dcms from the enterprise (VM). The intention is to associate the responsible business practice with the appropriate application, and maintain a sole source of data maintenance, based upon business disciplines. Examples include SKU creation – this is not the distribution centers job, it is the material planners job, therefore enterprise level SKU information starts, and is maintained by Material Planner/Purchasing personnel. However, SKU information about slotting, IMU configurations and zone preferences are distribution operations intensive, and these information sets are developed by the DC personnel.
4.9.8 Customer/Ship-to File	Host to WMS Each customer and their associated Ship-to's, with the contact and shipping address information is communicated to the V/dcms from the host.
4.9.9 Carrier Maintenance File	Host to WMS Any and all carriers used by the enterprise is communicated to the V/dcms for entry into the carrier file.
4.9.10 SKU Maintenance	WMS to Host SKUs may be created in VISUAL/dcms locally, even though it is highly discouraged. All locally created SKUs will be communicated to the host.
4.9.11 SKU Maintenance	Host to WMS All SKUs created on the host are communicated to the V/dcms previous to orders or receipts for the SKU. New SKU will be reported on by the VISUAL/dcms supporting added parameter definition and entry.
4.9.12 ICN/OCN Entry	WMS to Host Local entry of ICN's and / or OCN's is available on the VISUAL/dcms. Use of these transactions are discouraged. All locally created ICN/OCN information is communicated to the host and affect the inventory quantities in the same manner as if they were created at the host. There is the real possibility that OCN's created at the WMS level may adversely impact allocations to orders.

5.0 Screen Dialogues

Relative to users of V/ddp, the greatest interaction is during real-time order allocation and TMS interaction and Customer Order Tracking and Maintenance. The screen dialogues herein are focused in these areas of the system only.

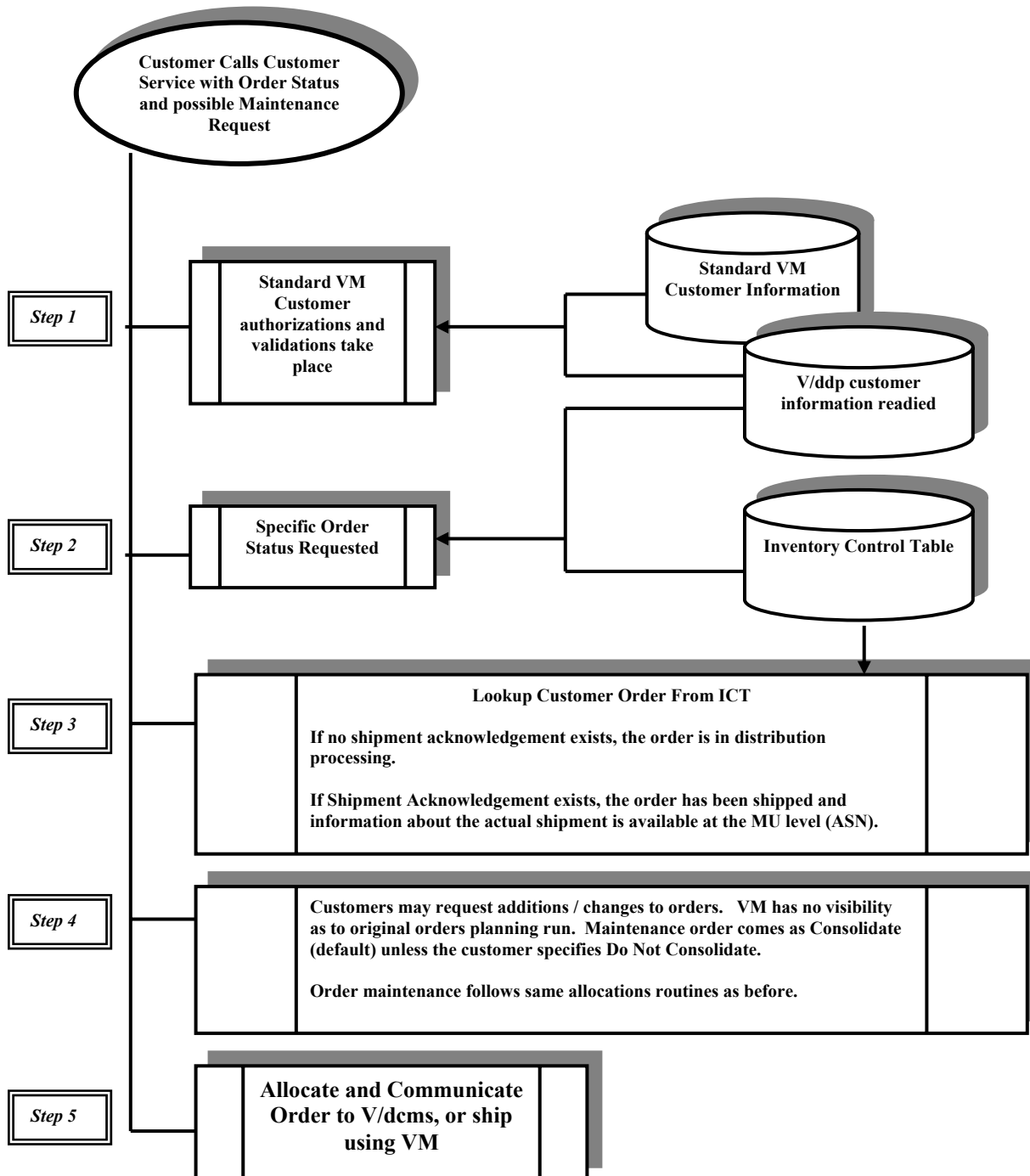
The transaction flow is represented in the following flow chart and screen dialogue.

Order Allocation Transaction Flow : includes TMS interaction.



Operation	Dialogue	Validation
Customer calls customer service to place an order	OE enters customer name	Standard V/M customer validation
		New V/ddp defaults will apply: • Primary DC • Customer Priority • Customer Fill Rates • Customer Compliance Labeling
Customer places order for SKU/Quantity	Is this SKU quantity for one Ship-to point? <u>Yes</u>	• Source DC determined • Priority Disbursements of SKUs readied for allocation • WIP/VAS capability determined
	Is this SKU quantity for multiple Ship-to points? <u>Yes</u> . Which Ship-to's please?	Validate each ship-to exists. Prepare to add new Ship-tos. Per Ship-to point, determine: • Source DC • Priority disbursements of SKUs readied for allocation • WIP/VAS capability
SKU Availability Determined per SKU for each Ship-to's sources	Systemic checks with messages	Priority Customer Check
		On-Hand Available Check
		Fill Rate Check
		WIP/VAS for SKU/Customer
If Availability Fails	System response: Availability denied Courses of Action include:	
	Alternate Source of Inventory:	If inventory available, determine transit cost factors and lead time difference Determine possible IBT replenishment
	Future Receipts	Allocate to Future Receipts Create a PO and link Flow Through to the Order
	Substitutions	Present a table of SKU alternatives that are predetermined as available
Available Inventory Exists	Check for Compliance and WIP/VAS processing typically requested by this customer	Based upon Customer / Ship-to and SKUs commonly order by the customer.
	Suggest additional services available for the SKU based upon the DC's abilities – Take Specifications	Based upon the DC servicing the order
		Present WIP/VAS service cost
Transportation Check	Customer Requests Freight Costs and time to deliver	Shipping time entered into TRACER e.g. next day air, priority overland, etc.
		V/ddp accumulates SKU/qty cube and weight and presents line level freight cost details based upon different ship methods
		V/ddp accumulates entire shipment cost and presents information to OE.
Confirm Order	OE person may confirm entire order, or delete/change specific SKU lines, as well as add new lines.	Validate order types (e.g. will call or emergency)

Customer Service Order Monitoring and Maintenance



6.0 Glossary

Allocation

The commitment of available inventory to orders using Order Management System (OMS) functionality.

ASN (Advanced Shipment Notification)

Order, Order line and carton or pallet level details regarding the actual fulfillment of an order by a warehouse. Typically ASN data is sent to the customer using EDI before the shipment arrives enabling the customer to reconcile the receipt against the shipment.

Compliance Labeling

A process in the warehouse of labeling the outbound cartons or pallets (moveable units) with a bar coded label specific to a customer requirement. In the warehouse, there may be many differing label requirements.

DC (Distribution Center)

Modern term used for warehouse.

DC Replenishment

Inventory demand fulfillment for a DC or warehouse.

EDI (Electronic Data Interchange)

A method of communicating information from enterprise to enterprise for purchases, orders and the acknowledgements of both relative to inventory. EDI is a principal component in supply-chain architectures.

ERP (Enterprise Resource Planning)

A family of software which enables the day-to-day operations of a company.

Flow-Through

A distribution process involving direct linkage between specific receipts of inventory and shipments.

Hard Allocation

The commitment of available SKU to a specific order, reserving inventory in one or more uniquely identified locations within a single warehouse.

Host

The software and/or hardware platform where information originates. ERP systems typically are referred to as the *host*.

Movable Unit

A uniquely identified, barcode labeled carton, pallet or single item tracked in a DC using VISUAL/dcms.

Radio Frequency (RF)

A mobile device used to direct users in the warehouse and collect information in real time.

Slot Level Replenishment

Warehouse operations technique of filling forward pick slots with bulk inventory in reserve.

Soft Allocation

The commitment of available SKU to orders, based upon total quantities across all locations within a single warehouse.

Supply-Chain

Industry term for company to company interaction with the objective of planning and executing inventory movement in response to fulfillment (demand) and replenishment (supply). Related terms include Supply and Demand Management.

TMS (Transportation Management Systems)

A family of software focused on transportation management, carrier selection, routing and rates.

Value-Added-Services (VAS)

Services performed on inventory in the warehouse in response to customer requests. Also considered order customization.

Velocity

Term used for the frequency of inventory used for fulfillment. Velocity is tracked at both order lines and units.

Work-in-Process (WIP)

Term used for the

WMS (Warehouse Management System)

WMS is distribution automation software and typically represents RF enabled functions to systemically task users in an optimized manner. VISUAL/dcms is a WMS.