ELA Certification

PROCESS DESIGN – DEMAND/DISTRIBUTION PLANNING

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SIC – Stochastic Inventory Control Models

SIC – Standard Industrial Classification

SIX SIGMA

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S&OP - Sales and Operation Planning

TQM – Total Quality Management

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WIP - Work in Progress

SHORT DESCRIPTIONS IN GREEK

ABC - Activity based Costing : Η Κοστολογηση ενός προιοντος γινεται με την αναλυση των δραστηριοτητων που συμμετεχουν στην δημιουργια του προιοντος

ABC Analysis : Κατηγοριοποιηση των προιοντων μια αποθηκης με βαση την συχνοτητα διακινησης του αποθεματος η αλλά κριτηρια σημαντικοτητας **A :** 20% of the items accounts for 80% of the criterio, **B :** 30% of the items accounts for 15% of the criterio and **C :** 50% of the items accounts for 5% of the criterio

ABM - Activity based Management : Η διοικηση επικεντρωνεται αναλογα με την κατηγοριοποιηση ABC, στοχευοντας στις δραστηριοτητες που εχουν δυνατότητα μειωσης κοστους η αυξησης της αξιας προς τον πελατη

AGILE Project Management : is a value-driven approach that allows Project Managers to deliver high-priority, high-quality work. Agile Project Management is about embracing change, even late in the development stage. It is about delivering the features with the greatest business value first, and having the real-time information to tightly manage cost, time and scope. It reduces complexity by breaking down the many-months-long cycle of building requirements for the whole project, building the entire product and then testing to find hundreds of product flaws. Instead small, usable segments of the software product are specified, developed and tested in manageable, two- to four-week cycles.

APS – Advanced planning & Scheduling

Αποκαλειται επισης advanced manufacturing. Βελτιστοποιει την κατανομη πρωτων υλων και παραγωγικης δυναμικοτητας ώστε να επιτευχθει η ζητηση. Εφαρμοζεται όταν οι απλες μεθοδοι (πχ manufacturing resource planning) δεν μπορουν να επιλυσουν προβληματα σε καταστασεις πολυπλοκων trade-offs μεταξυ ανταικρουομενων πρωτεραιοτητων. Στις παραδοσιακες μεθοδους τα υλικα και η δυναμικοτητα προγραμματιζονται ξεχωριστα και δεν μπορουν να προσαρμοστουν στις αλλαγες στην ζητηση, στην δυναμικοτητα των πορων και στην διαθεσιμοτητα υλικων.

ATP - Available to Promise : Η προσεγγιση αυτή δημιουργει αποθεματα που είναι διαθεσιμα στις ποσοτητες και χρονους παραδοσης μια παραγγελιας : ATP = on hand + supply - demand

BEER Game : Βιωματικο παιγνιδι με το οποιο γινεται προσωμοιωση των διαδικασιων μιας εταιρειας. Κάθε μελος αντιπροσωπευει τις Παραγγελιες, Διανομη, Αποθηκευση, ΠΑραγωγη, Προμηθειες, παιρνει αποφασεις και βλεπει τις συνεπειες των αποφασεων του στο συνολικο αποτελεσμα. Ονομαστηκε ετσι γιατι πρωτοπαιχτηκε προσομοιωνοντας μια εταιρεια μπυρας

Benchmarking : Είναι η συγκριτικη μελετη και καταγραφη των πρακτικων που χρησιμοποιουν δυο ομοειδεις επιχειρησεις, η δυο ομοειδη τμηματα μεσα στην ιδια επιχειρηση. Ο σκοπος είναι να εντοπιστουν οι καλες πρακτικες (best practices) που χρησιμοποει η μια ώστε να αντιγραφουν και από την άλλη. Πχ. Τι ειδη στόλων και με τι κοστος απασχολουν οι ανταγωνιστες, τι καναλια διανομης διαθετουν, κλπ

Best practice : Είναι μια διαδικασια, η μεθοδος εργασιας, η καινοτομια που εφαρμοζεται στην αγορα η οποια φαινεται είναι η καλυτερη από ολες τις εναλλακτικες. Συνηθως οι υπολοιποι ενδιαφερονται να εφατρμοσουν και αυτοι τις best practices

BOM - Bill of Material : Λιστα υλικων που απαιτουνται για την παραγωγη ενός προιοντος

BOTTLENECK : Είναι ο συνωστισμος η «μποτιλιαρισμα» που δημιουργειται όταν το επομενο σταδιο μιας διεργασιας μπορει να εξυπηρετησει μικροτερες ροες προιοντων η αιτηματων από αυτές που διεκπεραιωνονται στο προηγουμενο. Πχ, στις παραλαβες μιας αποθηκης που διαθετει κλαρκ για την εκφορτωση των προιοντων, τα κλαρκ μπορουν να εξυπηρετησουν λιγοτερα από τα φορτηγα που προσερχονται με αποτελεσμα να δημιουργειται ουρα φορτηγων. Τα σημεια που δημιουργουνται bottlenecks πρεπει να εντοπιζονται και να σχεδιαζοντυαι λυσεις. Για το παραδειγμα μας : α. Οι οδηγοι ενημερωνονται να προσερχονται ορισμενες ωρες ο καθενας («ραντεβου») και όχι ολοι μαζι, β. Προσλαμβανεται ενας προσθετος FLT οδηγος για 4 ωρες κάθε πρωι. γ. Οι παραλαβες ξεκιναν 1-2 ωρες νωριτερα το πρωι, δ. Η εναρξη των παραδοσεων μετατοπιζετται 1-2 ωρες αργοτερα, ε. εξεταζουμε την αγορα η μισθωση μεγαλυτερων κλαρκ, κλπ

Brainstorming : Είναι μια μεθοδος για την παραγωγη νεων καινοτομικων ιδεων. Οργανωνουμε ένα meeting οπου αφου θεσουμε το προβλημα καλουμε τους συμμετεχοντες να καταθεσουν τις προτασεις τους και τις καταγραφουμε χωρις να τις συζητησουμε, σχολιασουμε εκεινη την στιγμη. Δημιουργουμε ατμοσφαιρα ώστε να μη δισταζει κανενας να πει την σκεψη του και οι υπολοιποι να μη κανουν αποθαρρυντικα σχολια. Στην συνεχεια βαθμολογουμε ολες τις προτασεις και προκυπτουν 2-3 που η ομαδα προκρινει να συζητηθουν στην συνεχεια σε περισσοτερη λεπτομερεια

BUFFER Stock : Είναι το αποθεμα μεταξυ δυο διαδικασιων που χρησιμοποιειται για να αντιμετωπισει αβεβαιοτητες στην εισαγωγη προιοντων από την πρωτη φαση η στην ζητηση προιοντων αππο την δευτερη φαση. Είναι το safety stock που κραταμε στην αποθηκη για να αντιμετωπισουμε καθυστερησεις από τους προμηθευτες η αυξημενη ζητηση από τους πελατες.

BULLWHIT effect : Είναι το φαινομενο του μαστιγιου : Μια μικρη διαταραχη στην αρχη μια διαδιακασιας δημιουργει αυξανομενες διαταραχες στο άλλο της ακρο. Παραδειγμα: Μια αυξημενη παραγγελια, προκαλει υπερεκτιμησεις των αναγκων στην παραγωγη και ακομη μεγαλυτερες στις προμηθειες πρωτων υλων. Αποφευγεται με ακλη επικοινωνια και meetings ολων των εμπλεκομενων τμηματων και επιβεβαιωση ποια είναι μια ρεαλιστικη ζητηση. Αλλιως καλειται **FORRESTER EFFECT**

BUY το order : Η πολιτικη που εφαρμοζεται να αγοραζει μια επιχειρηση πρωτες υλες η ετοιμα προιοντα όταν προκυψει μια παραγγελια

CODP - Customer Order Decoupling Point : Είναι το σημειο εκεινο μεσα στην επιχειρηματικη διαδικασία όπου η μεθοδος puss μετατρεπεται σε pull. Παραδειγμα, μια εταιρεια παραγει μεταλλικα δοχεια με βαση εκτιμηση της ζητησης, αλλά τα βαφει και ετικετοποιει με βαση τις παραγγελιες (pull). Το DP συμβαινει μεταξυ παραγωγης και βαφειου

Continuous Improvement : Είναι η προσεγγιση των συνεχων μικρων βελτιωσεων μια διαδικασιας, σε αντιδιαστολη με τις επαναστατικες αλλαγες (step changes-breakthrough)

CONWIP : CONstant WORK in Progress : Είναι μεθοδος ελεγχου παραγωγης με την οποια στην αρχη της γραμμης παραγωγης ξεκινα η παραγωγη του επομενου τεμαχιου μόνο όταν εξελθει από το τελος της γραμμης ένα τεμαχιο. Έτσι η ποσότητα Work in Progress κρατειται σταθερη και είναι μικροτερη από την WIP κατά την μεθοδο KANBAN

Cost to serve : Κοστολογικο μοντελο βασισμενο στις διεργασιες (process driven accountancy tool) με το οποιο υπολογιζουμε την κερδοφορια από ένα πελατη, εστιαζοντας στις πραγματικες δραστηριοτητες και τα σχετιζομενα αμεσα και εμμεσα κοστη τους για την εξυπηρετηση του. Κάθε προιον και κάθε πελατης επειδη απαιτει και

ξεχωριστες διαδικασιες εχει και διαφορετικο προφιλ κοστους. Πχ, το μεσο κοστος μεταφορας είναι 10 Ε/ Μ3, αλλα είναι διαφορετικογια ένα πελατη στην Αθηνα που παραλαμβανει κάθε μερα 1 Μ3 και διαφορετικο για ένα άλλο πελατη στην Επαρχια που παραλαμβανει μια φορα τον μηνα 30 Μ3 Ε, διοτι εμπλεκονται διαφορετικες διαδρομες, διαφορετικοι χρονοι δρομολογιου και φορτωσης-παραδοσης, κλπ

CPFR - Collaborative Planning, Forecasting and Replenishment : Συνεργαζονται όλα τα τμηματα που είναι υπευθυνα για το Planning, Forecasting, Replenishment (δηλαδη Πωλησεις, Logistics, κλπ) ώστε να ανταλλασσουν στοιχεία και εκτιμησεις για τον βελτιστο σχεδιασμο αυτων των λειτουργιων. Μπορουν να συμμετεχουν και εσωτερικα τμηματα και εξωτερικοι συνεργατες (προμηθευτες, δικτυα πωλησεων, κλπ)

CRP – Capacity Requirements Planning : Διασφαλιζει ότι το MRPII είναι ρεαλιστικο και ότι δεν ξεπερνα την υφισταμενη δυναμικοτητα της παραγωγης

CYCLE TIME : Είναι ο χρονος για να συμπληρωθει μια πληρης διαδικασία παραγωγης ενός προιοντος

CYCLIC PRODUCTION : Μεθοδος παραγωγης που τα προιοντα παραγονται σε επαναλαμβανομενους κυκλους με κάθε κυκλο να περιεχει τις ιδιες ποσοτητες

DEAD STOCKS : Είναι τα αποθεματα που εχουν πολύ μεγαλο διαστημα να κινηθουμ και πιθανοτατα δεν θα κινηθουν στο μελλον. Αυτά τα αποθεματα καταναλωνουν κοστος χωρις να παραγουν κερδος και είναι στοχος για αμεση μειωση. Μεθοδοι για να μειωθουν είναι 1. Επιστροφη στον προμηθευτη, 2. Καταστροφη, 3. Εκποιηση, 4. Πωληση με μεγαλη εκπτωση, 5. Δωρεα.

DECOUPLING POINT : Είναι το σημειο εκεινο μεσα στην επιχειρηματικη διαδικασία όπου η μεθοδος puss μετατρεπεται σε pull. Παραδειγμα, μια εταιρεια παραγει μεταλλικα δοχεια με βαση εκτιμηση της ζητησης, αλλά τα βαφει και ετικετοποιει με βαση τις παραγγελιες (pull). Το DP συμβαινει μεταξυ παραγωγης και βαφειου

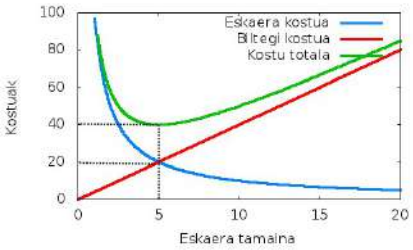
DELFI METHOD : Είναι μια τεχνικη προβλεψεων οπου μια ομαδα από ειδικους (πχ πωλητες) ζητειτε να δωσει τις προβλεψεις της μυστικα. Μετα ανακοινωνονται οι προβλεψεις και ξαναζητειται να δωσουν τις νεες τους προβλεψεις. Οι δευτερες προβλεψεις ειναι απαλλαγμενες από τις ακραιες τιμες. Ετσι πολύ συντομα καταληγουν σε μια κοινη προβλεψη

DRP – Distribution Resource/Requirements Planning : Μεθοδος για τον ελεγχο του αποθεματος και των παραγγελιων προς αναπληρωση του αποθεματος με στοχο να ικανοποιειται η ζητηση

DISTRIBUTION CHANNELS : Είναι τα καναλια διανομης του προιοντος από την παραγωγη στην καταναλωση : level 0 : κατευθειαν, level 1 : Μεσω δικτυου Retail, level 2 : μεσω Wholesale και Retail

ECR : Efficient Customer Response : Κοινη αντιμετωπιση των θεματων της αγορας ενός Τομεα με στοχο την καλυτερη διαχειριση της ζητηση και μειωση του supply cost

EOQ - Economic Order Quantity : είναι η μεθοδος με την οποια η ποσότητα αναπαραγγελιας υπολογιζεται σαν κατασταση trade-off εκεί που το αθροισμα : κοστος παραγγελιας + το κοστος διατηρησης αποθεματος λαμβανει την ελαχιστη τιμη



. **Variables**

- P = purchase unit price, unit production cost
- Q = order quantity
- Q* = optimal order quantity
- D = annual demand quantity
- K = fixed cost per order, setup cost (*not* per unit, typically cost of ordering and shipping and handling. This is not the cost of goods)
- h = annual holding cost per unit, also known as carrying cost or storage cost (capital cost, warehouse space, refrigeration, insurance, etc. usually not related to the unit production cost)

Where:

- **Purchase cost**: This is the variable cost of goods: purchase unit price × annual demand quantity. This is **P × D**
- **Ordering cost**: This is the cost of placing orders: each order has a fixed cost K, and we need to order D/Q times per year. This is **K × D/Q**
- **Holding cost**: the average quantity in stock (between fully replenished and empty) is Q/2, so this cost is **h × Q/2**

EOQ = square root (2DK/h)

EPOS – Electronic Point of Sales : Συστημα για την ηλεκτρονικη καταχωρηση των πληρωμων των πελατων στα καταστηματα λιανικης. Βοηθα στην αυτοματοποιηση της αναπληρωσης των αποθεματων, παραγγελιες στους προμηθευτες, κλπ

ERP - Enterprise Resource planning : Ειναι software σχεδιασμού επιχειρηματικών πόρων, δηλαδή ένα σύστημα λογισμικού με στόχο να λειτουργήσει σαν κορμός για όλη την επιχείρηση.

EXPONENTIAL SMOOTHING : Μεθοδος προβλεψης μελλοντικων τιμων μιας παραμετρου (πχ ζητηση) η οποια λαμβανει υποψη της την πραγματικη τιμη της προηγουμενης περιοδου κατά ένα ποσοστο α (πχ 70%) και κατά το υπολοιπο ποσοστο (1-α%) λαμβανει υποψη την τιμη που προβλεφθηκε στην προηγουμενη περιοδο. Αναλογα με την τιμη που δινουμε στο α, δινουμε και αναλογη βαρυτητα στην προβλεψη η στην πραγματικη τιμη της προηγουμενης περιοδου για την προβλεψη της επομενης περιοδου

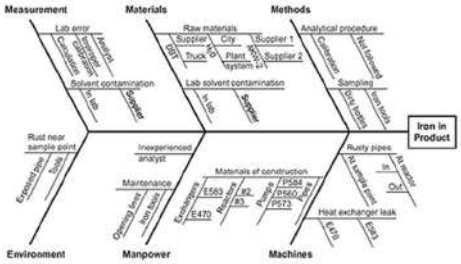
$$s_0 = x_0$$
$$s_t = \alpha x_t + (1-\alpha)s_{t-1},\ t > 0$$

where α is the *smoothing factor*, and $0 < \alpha < 1$.

FAST MOVING : Είναι τα προιοντα που διακινουνται με μεγαλες ταχυτητες. Ειδικα οταν είναι καταναλωτικα τα ονομαζουμε FMCG (Fast Moving Consumer Goods)

FISHBONE (ISHIKAWA) CHART : Διαγραμμα που έχει την μορφη σκελετου ψαριου, όπου το κεφαλι είναι το αποτελεσμα η το προβλημα που θέλουμε να διερευνησουμε (πχ βλαβες σε μια μηχανη) και στα πλευρικα κοκκαλα τις πιθανες αιτιες (πχ εκπαιδευση χειριστων, ελαττωματικο υλικο, καιρικες συνθηκες, διακυμανση τασης, κλπ). Κρατωντας σταθερες τις υπολοιπες αιτιες, μεταβαλλουμε τις συνθηκες σε μια από αυτές (πχ

εκπαιδευμενους χειριστες) και ελεγχουμε αν το αποτελεσμα έχει αλλαξει. Αν δεν εχει αλλαξει, σημαινει ότι δεν οφειλεται το αποτελεσμα στην αιτια που πειραξαμε αλλά στις υπολοιπες. Συνεχιζοντας ετσι βρισκουμε την πραγματικη αιτια.



FIVE – S (5S) APPROACH : Μεθοδος με προελευση από Ιαπωνια με την οποια έχουμε νοικοκυρεμενη λειτουργια και απαρτιζεται από 5 ενεργειες : **Sort** (όλα με την σωστη σειρα), **Set** in Order (Όλα στην σωστη τους θέση), **Shine** (καθαριοτητα) , **Standardise** (τυποποιηση), **Sustain** (διατηρηση των καλων πρακτικων).
red tag είναι η σημανση των αντικειμενων που δεν χρειαζονται και πρέπει να απομακρυνθουν

FLOW CHART : Διαγραμμα στο οποιο απεικονιζεται η εξελιξη μιας μεταβλητης σε σχεση με μια άλλη, η σε συναρτηση με τον χρονο. Μπορει να είναι σε μορφη καμπυλης, μπαρων, πιττας, κλπ

FLUSHING : Σηματοδοτει τον τροπο αναλωσης των πρωτων υλων σε μια παραγωγικη διαδικασία.
Frontflushing : όταν όλη την ποσότητα πρωτων υλων που χρειαζεται σε μια παραγωγικη δραστηριοτητα την αφαιρω από την αποθηκη και την βαζω στην αρχη της γραμμης παραγωγης, δηλαδη αφαιρειται από το αποθεμα της αποθηκης στην αρχη. **Backflushing** : Όταν η αναλωση γινεται σταδιακα και η μειωση του αποθεματος ολοκληρωνεται με την ολοκληρωση της παραγωγικης διαδικασιας

FORECASTING METHODS : Μεθοδοι προβλεψης της ζητησης. Οι κυριοτερες είναι : 1: Percent Over Last Year, Calculated Percent Over Last Year, 3: Last Year to This Year, 4: Moving Average, 5: Linear Approximation, 6: Least Squares Regression, 7: Second Degree Approximation, 8: Flexible Method, 9: Weighted Moving Average, 10: Linear Smoothing, 11: Exponential Smoothing, 12: Exponential Smoothing with Trend and Seasonality.

FORRESTER EFFECT : Είναι το Bullwhit Effect

JIT - JUST IN TIME : Μεθοδος με την οποια το προιον ετοιμαζεται μολις είναι απαιτητο. Δεν κρατουνται αποθεματα ετοιμων και είναι Pull method. Μειωνονται τα αποθεματα, το κοστος τηρησης η καταστροφης αποθεματων, κλπ αλλά χρειαζεται ευελιξια στην οργανωση για να εφαρμοστει. Προσφερεται για υλικα μεγαλης αξιας, απροβλεπτης ζητησης, τεχνολογικης απαρχαιωσης του προιοντος, προιοντων μικρης διαρκειας ζωης, κλπ

INVENTORY TURNOVER RATIO : Δεικτης που καθοριζει την ταχυτητα κυκλοφοριας του αποθεματος. Δειχνει ποσες φορες γυρνα το αποθεμα μεσα σε ένα χρονο. Είναι το αντιστροφο του δεικτη DSI (**Days Sales Inventory)**
ITR = Inventory Turnover ratio = Ετησιο Κοστος πωληθεντων /μεσο αποθεμα
DSI = Days Sales Inventory = 365/ITR

KAIZEN : Ιαπωνικη φιλοσοφια και πρακτικη που αφορα συνεχεις βελτιωσεις του τροπου εργασιας και αφορα όλα τα σταδια από Παραγωγη-Πωλησεις-Δοιικηση και ολη την ιεραρχια. Στοχευει στην αποφυγη σπαταλης και απωλειων. Περιλαμβανει μεθοδους όπως Quality circles, automation, suggestion systems, just-in-time delivery, Kanban and 5S. Με το KAIZEN θετουμε standards και μετα συνεχως τα βελτιωνουμε.

KANBAN : Συστημα που εφαρμοσε η ΤΟΥΟΤΑ, μεσα απο σηματοδοτηση προκαλει ενεργειες όπως μεταφορα ενός εξαρτηματος, η χορηγηση υλικου από την αποθηκη, κλπ. Για την σηματοδοτηση χρησιμοποιουνται πλαστικες καρτες, μπαλες, αδεια τρολλευ, σημανσεις στο δαπεδο, κλπ. Αποτελεσματικο για να τρεχει τη διαδικασία παραγωγης.

KEIRETSU : Στα Ιαπωνικα σημαινει "group". Ειναι ένα επιχειρηματικο group από κατασκευαστες, 3PLs, Διανομεις, Χρηματοδοτες, που παραμενουν οικονομικα ανεξαρτητοι αλλά συνεργαζονται στενα για να διασφαλισουν την επιτυχια ολων. Αλλιως καλουνται Alliances, Partnerships, extended enterprise. Με την συσταση των KEIRETSU ο καθενας επικεντρωνεται αποτελεσματικα στο αντικείμενο που εξειδικευεται, γινομενος lean, αφηνοντας τους αλλους τομεις στα υπολοιπα μελη.

KPIs : (Key performance Indicators). Είναι δεικτες που απεικονιζουν την αποδοση ενός τομεα μιας επιχειρησης. Με αυτους τους δεικτες, που συνηθως παραγονται κάθε μηνα, τα στελεχη παρακολουθουν την εξελιξη καποιων συντελεστων σε σχεση με τους προηγουμενους μηνες και διερευνουν τις τυχον αποκλισεις για να βρουν τις αιτιες τους τις οποιες πρεπει να θεραπευσουν. Συνηθως χρειαζονται περισσοτεροι του ενός δεικτες για να εχουμε αντικειμενικη παρακολουθηση. Όταν εχουμε μονο ένα δεικτη, υπαρχει η παγιδα να βελτιωνεται αυτος σε βαρος αλλων

LEAD TIME : Είναι ο χρονος που μεσολαβει μεταξυ της στιγμης που αρχιζει μια δραστηριοτητα μεχρι την στιγμή που ολοκληρωνεται. Πχ, Order lead time είναι ο χρονος από την ωρα που τοποθετειτται μια παραγγελια μεχρι την στιγμή που παραλαμβανεται η παραγγελια

LEAN : Τροπος εργασιας ώστε να παραγεται ακριβώς ο,τι χρειαζεται, στην ποσότητα που χρειαζεται, στο χρονο που χρειαζεται και στο σημειο που χρειαζεται. Επιδιωκει την απομακρυνση διαδικασιων, πορων, δαπανων που δεν συνεισφερουν στην δημιουργια αξιας στο προιον όπως βλεπει την αξια ο πελατης

LCC - LIFE CYCLE COST : Είναι προσεγγιση που υπολογιζει το κοστος ενός προιοντος η μιας υπηρεσιας όχι μονο κατά την στιγμη της αγορας του αλλα κατά την διαρκεια της ζωης του. Συνυπολογιζουμε το κοστος λειτουργιας, ενεργειας που καταναλωνεται, συντηρησης, απωλειων πωλησεων, εκποιησης, κλπ. Συνηθως όταν ένα προιον εχει χαμηλο κοστος αγορας εχει υψηλο κοστος Life cycle. Αυτό εκφραζει η ρηση «το ακριβο (αρχικη αγορα) και φτηνο (LCC)». πχ, αυτοκινητο δυνατου brand, εχει μεν υψηλοτερη τιμη, αλλα χαμηλοτερη καταναλωση, λιγοτερη αναγκη συντηρησης και κυριως υψηλοτερη τιμη μεταπωλησης.

MAKE To Order : Η παραγωγη ενός προιοντος η υπηρεσιας ενεργοποιειται όταν μπαινει η παραγγελια. Συνηθως γινεται για προιοντα μικρης ζητησης, πανακριβα που οι πελατες εχουν ειδικες απαιτησεις και προδιαγραφες. Σχετιζεται με την λογικη PULL

MAKE to Stock : Το προιον παραγεται για να αποθηκευτει, ανεξαρτητα από υπαρξη παραγγελιων. Οι ποσοτητες που θα παραχθουν, ο χρονος παραγωγης και οι προδιαγραφες προκυπτουν από προβλεψεις της ζητησης. Συνηθως εφαρμοζεται σε προιοντα μικρης-μεσαιας αξιας, μεγαλης ζητησης, με βεβαιοτητα ως προς την διακυμανση της ζητησης. Σχετιζεται με την λογικη PUSH

METADATA : Τα **μεταδεδομένα** είναι δεδομένα τα οποία περιγράφουν άλλα δεδομένα. Κατά κανόνα, ένα σύνολο μεταδεδομένων περιγράφει ένα άλλο σύνολο δεδομένων, το οποίο αποτελεί μια πηγή. Η βασική χρησιμότητα των μεταδεδομένων είναι να επιταχύνουν και να εμπλουτίζουν την αναζήτηση πηγών (πχ query tools,). Η αναζήτηση με τη χρήση μεταδεδομένων γλιτώνει τον χρήστη από περίπλοκες και χρονοβόρες χειροκίνητες διαδικασίες φιλτραρίσματος πληροφοριών. Παραδειγματα, οι τιτλοι των βιβλιων σε μια Βιβλιοθηκη, τα περιεχομενα ενός βιβλιου, οι τιτλοι εσωτερικων οδηγιων μιας εταιρειας,

MOVING AVERAGE – Forrester rule : Είναι μεθοδος για να προβλεψουμε την τιμη μιας μεταβλητης για ένα επομενο διαστημα, στηριζομενοι στις τιμες που ειχε σε προηγουμενα διαστηματα. Πχ, αν οι πωλησεις ειναν

τιμες κατά τελευταια 4 τριμηνα 1000, 1100, 1050, 1150 τοτε με την μεθοδο αυτή η προβλεψη είναι ο μεσος ορος αυτων των τιμων, δηλ. 1075 τεμ.

MPS - Master Production Schedule : Είναι πλανο για τα προιοντα που πρέπει να παραχθουν σε κάθε χρονικη περιοδο, όπως προιοντα, προσωπικο, αποθεματα. Συσχετιζεται με τη Παραγωγη διοτι καθοριζει τι, ποσο και ποτε θα παραχθει. Ποσοτικοποιει τις διαδικασιας, εξαρτηματα και αλλους πορους που χρειαζονται στην παραγωγη ώστε να βελτιστοποιησει την παραγωγη και να αποφευχθουν bottlenecks

MRP - Material Requirements Planning : Είναι το πλανο των απαιτουμενων υλικων, είναι συστημα προγραμματισμου παραγωγης και ελεγχου αποθεματων που χρησιμοποιειται για την διαχειριση της διαδικασιας παραγωγης. Στοχοι :

- Διασφαλιζει ότι οι πρωτες υλες είναι διαθεσιμες για την παραγωγη και τα προιοντα διαθεσιμα για παραδοση στους πελατες
- Διατηρει τα ελαχιστα αποθεματα
- Προγραμματιζει τις δραστηριοτητες παραγωγης, παραδοσεων και προμηθειων

MRPII - Manufacturing Resource Planning : Είναι επεκταση του MRP (Materials Requirement planning) ενσωματωνοντας δεδομενα παραγωγης και οικονομικα. Το συστημα συγκεντρωνει και επεξεργαζεται δεδομενα για αποτελεσματικη ληψη αποφασεων στον προγραμματισμο, σχεδιαση και κατασκευη, διαχειριση αποθεματων και ελεγχο κοστους. Είναι computer-based και μερος ενός ευρυτερου συστηματος (ERP – Enterprise Resource Planning

ORDER FULFILLMENT : Είναι η ικανοποιηση της ζητησης. Υπάρχουν διαφοροι μεθοδοι αναλογα με τους χρονους P : production lead time και D: Demand Lead time.

- Engineer-to-Order (ETO) (D>>P)
- Build-to-Order (BTO) (D>P)
- Assemble-to-Order (ATO) (D<P)
- Make-to-Stock (MTS) (D=0)

4P : Είναι τα συστατικα ενός Marketing plan, από τα αρχικα Product, Price, Promotion, Position. Ενα Marketing plan πρεπει να οργανωνει : a. Ποιες θα είναι οι προδιαγραφες και τα ειδη του προιοντος, β. ποια θα είναι η τιμολογιακη πολιτικη, γ. πως θα επικοινωνηθει και διαφημιστει, ώστε να μπει στο μυαλο των καταναλωτων, δ. πως θα διακινηθει μεσω των καναλιων διανομης ώστε να τοποθετηθει στα χερια του καταναλωτη.

PARETO Analysis : Ο στοχος της αναλυσης PARETO είναι να διαχωρισει τον πληθυσμο με βαση ένα σημαντικους παραγοντα. Παραδειγμα να διαχωρισει τα αποθεματα με βαση την αξια τους. Ο κανονας αναφερεται ως 80/20. Δηλαδη το 20 % των ειδων αντιστοιχει στο 80% της αξιας τους.

PDCA – Η Μεθοδολογία του Lean : Plan-Do-Check- Act. Καλειται και PDSA (study αντι check). Υποστηριζει το Continuous improvement εφαρμοζοντας τον κυκλο ενεργειων :
PLAN : Σχεδιαζουμε μια πολιτικη, προιον, καμπανια, κλπ
DO : Την εφαρμοζουμε
CHECK : Παιρνουμε feedback από την εφαρμογη, ελεγχουμε τα αποτελεσματατα, εντοπιζουμε τις αποκλισεις και αναλυουμε τις αιτιες τους.
ACT : Με βαση τα πορισματα που βγαλαμε, αποφασιζουμε ενεργειες, όπως αλλαγη των προδιαγραφων, τροποποιηση των τιμων, της συσκευασιας, των καναλιων διανομης, κλπ.
Ο κυκλος αρχιζει από την αρχη υλοποιωντας τις αποφασεις που λαβαμε

PEST - PESTEL Methods : Μεθοδος για να αναλυουμε το περιβαλλον μεσα στο οποιο θελουμε να ιδρυσουμε μια επιχειρηση, να βαλουμε ένα καινουριο προιον, να κανουμε μια επενδυση. Εξεταζουμε διαφορους παραγοντες για να δουμε αν το περιβαλλον είναι ευνοικο η όχι. Οι παραγοντες αυτοι ανηκουν στις κατηγοριες P : Political, E: Economic, S : Social, T : Technological (PEST). Αρκετοι προσθετουν και τις παραμετρους E : Environment, L : Legislation και προκυπτει η μεθοδος PESTEL

POSTPONEMEMT : Είναι η μεταθεση του χρονικου σημειου ολοκληρωσης της παραγωγης ενός προιοντος ώστε να ολοκληρωθει αναλογα με τις παραγγελιες που θα εχουν παραληφθει. Έτσι μειωνουμε το αποθεμα των ετοιμων προιοντων

PROCESS RE-ENGINEERING : Είναι ο ανασχεδιασμος των διεργασιων και των διαδικασιων μιας επιχειρησης η ενός τομεα αυτης ώστε να αντικατασταθουν με άλλες που να είναι πιο λιτες, οικονομικες, ταχειες και να βελτιωνουν το κοστος, την ποιοτητα υπηρεσιων, την εξυπηρετηση του πελατη

PULL : Ειναι η διαδικασία ενεργοποιησης της παραγωγης όταν δοθει μια παραγγελια. Η παραγωγη ελκεται από την πραγματικη ζητηση

PUSH : Ειναι η διαδικασία που η παραγωγη προγραμματιζεται με βαση την προβλεψη της ζητησης

RED FLAG : είναι η σημανση των αντικειμενων που δεν χρειαζονται και πρέπει να απομακρυνθουν**.** Χρησιμοποιειται στα πλαισια του Συστηματος 5s

ROL - Reorder Level : Είναι το επιπεδο αποθεματων στο οποιο τοποθετειται η επομενη παραγγελια για την ανανεωση του αποθεματος. Είναι **: Lead Time X Ημερησια ζητηση + Αποθεμα ασφαλειας**

ROQ - REORDER QUANTITY : Είναι η ποσότητα αναπαραγγελιας. Υπάρχουν διαφοροι μεθοδοι όπως **η Fixed Order Quantity (FOC)** και η **Economic Order Quantity (EOQ)**

SAFETY STOCK : Είναι το αποθεμα που θέλουμε να υπάρχει στην αποθηκη όταν θα παραληφθει η επομενη παραγγελια. Προοριζεται για να καλυπτει τις τυχον διακυμανσεις στην ζητηση και στο lead time

SIC – Stochastic Inventory Control Models : Είναι μοντελα αναπληρωσης των αποθεματων τα οποια θεωρουν ότι η ζητηση ακολουθει στοχαστικη διακυμανση και δεν είναι σταθερη όπως στα μοντελα fixed order quantity η EOQ. Η εφαρμογη τους είναι περιορισμενη λογω της πολυπλοκοτητας και της δυσκολιας να αποτυπωθει η ζητηση με καποια στοχαστικη φορμουλα.

SIX SIGMA : Η μεθοδολογία Six Sigma (6σ) είναι ένας δομημένος τρόπος προσέγγισης για τη μείωση των ελαττωματικών προϊόντων και υπηρεσιών, τη βελτιστοποίηση των διαδικασιών και τη μείωση του κόστους. Χρησιμοποιεί μια σειρά από δοκιμασμένα και μοντέρνα εργαλεία από το χώρο του TQM (Total Quality

Management), της Στατιστικής και του Lean Management. Βασιζεται στην τυπικη αποκλιση σ από την στατιστικη, και σημαινει ότι όταν μια διαδικασια είναι 6σ, τοτε η ποιοτητα των προιοντων η των υπηρεσιων είναι 99,99966% εντος των προδιαγραφων, δηλαδη αριστη. Αυτή η προσεγγιση ειδικα εφαρμοζεται σε προιοντα υψηλων απαιτησεων αξιοπιστιας και ποιοτητας πχ εξαρτηματα αεροπλανων, ιατρικος εξοπλισμος, κλπ

SLOW MOVING : Είναι τα αποθεματα που κινουνται με αργο ρυθμο. Βασικος στοχος είναι να μειωθει το αποθεμα στο εντελως αναγκαιο για να εξυπηρετηθει η ζητηση. Είναι η ενδιαμεση καταστασή μεταξυ Fast Moving και Dead Stocks

S&OP - Sales and Operation Planning : Είναι ένα πλαισιο οργανωσης του supply chain που διασυνδεει τις επιχειρησιακες διαδικασιες, τους δεικτες αποδοσης, τις πρακτικες και τις ικανοτητες των ανθρωπων σε μια ενιαια δομη. Ωφελη : α. επιταχυνει την υλοποιηση συστηματων, β. Υποστηριζει τους μαθησιακους στοχους της οργανωσης, γ. Βελτιωνει το γυρισμα των αποθεματων

TQM – Total Quality Management : Προσεγγιση με την οποια η επιχειρηση προσπαθει να εγκαταστησει ένα κλιμα οπου η οργανωση, με όλα τα τμηματα (Total) συστηματικα και συνεχως βελτιωνει τις λειτουργιες της ώστε να παραδιδει ποιοτικα προιοντα, εγκαιρα και με αξια για τους χρηστες. Η λεξη management υπονοει ότι η διοικηση και τα στελεχη πρεπει να διοικουν την ποιοτητα με καταλληλη χρηματοδοτηση, εκπαιδευση, στελεχωση, στοχοθετηση. Τα τελευταια χρονια επισκιαζεταιαπο το ISO 9000, το Lean manufacturing και το Six sigma

Trade off's : Είναι η συγκριση των οικονομικων επιπτωσεων από δυο αντικρουομενους παραγοντες η πρακτικες, με στο να βρεθει ένα σημειο ισορροπιας μεταξυ τους οπου το αθροισμα των οικονομικων επιπτωσεων είναι το ελαχιστο. Πχ Το συνολικο κοστος της ποιοτητας είναι αθροισμα των παραγοντων «κοστος συντηρησης» και «διοικητικου κοστους εξασφαλισης ποιοτητας». Αυτοι οι παραγοντες εχουν αντιρροπες συνεπειες στο κοστος της ποιοτητας και μας ενδιαφερει να λειτουργουμε σε ένα σημειο που το συνολικο κοστος ελαχιστοποιειται.

Value Chain : Είναι μια σειρα από δραστηριοτητες που εκτελουνται σε μια επιχειρηση με στοχο να τοποθετησουν στην αγορα ένα προιον που να εχει αξια. Βασιζεται στην οπτικη μιας βιομηχανικης εταιρειας να θεωρειται ως ένα συστημα αποτελουμενο από υποσυστηματα που το καθενα εχει inputs, διεργασιες μετασχηματισμου και outputs, τα οποια περιεχουν την αποκτηση και καταναλωση πορων (κεφαλαια, ανθρωπινο δυναμικο, υλικα, μηχανηματα, υποδομες, διοικητικη λειτουργια). Ο τροπος που αυτές οι δραστηριοτητες, που ανηκουν στο value chain, διεκπεραιωνονται εχει μεγαλη σημασια στον καθορισμο του κοστους και επηρεαζει τα κερδη. Στο Value Chain καποιες δραστηριοτητες επηρεαζουν και το κοστος και την αξια του προιοντος, πχ πρωτες υλες, συσκευασια, μεθοδος παραγωγης. Καποιες άλλες επηρεαζουν το κοστος αλλα δεν δημιουργουν αξια για το προιον, πχ η Φυλαξη των εγκαταστασεων, η καθαρισμος των γραφειων

VMI - Vendor Managed Inventory : Η εμπορικη εταιρεια αναθετει στον Παραγωγο η Προμηθευτη των προιοντων να διαχειριζεται τα αποθεματα, να έχει την ευθυνη της αναπληρωσης των αποθεματων. Εφαρμοζεται στα supermarkets, όπου οι Προμηθευτες εχουν επισης την ευθυνη για την συντηρηση και καθαριοτητα των ραφιων, τίς επαφης με τον πελατη και την ενημερωση του. Η εμπορικη εταιρεια έχει ως ωφελη : α. την μειωση του κοστος διατηρησης αποθεματων, β. την μειωση του κοστους των πωλητων, γ. την αποφυγη stockouts, δ. Ο Προμηθευτης αγοραζει πισω οσες ποσοτητες δεν πωλουνται

Work-in-progress : Είναι η εργασια μαζι με το κεφαλαιο, υλικα που εχει επενδυθει ειδη σε φασεις κατά την παραγωγη ενός προιοντος, πριν αυτό ολοκληρωθει ώστε να είναι διαθεσιμο για πωληση. Αυτό το κοστος διαφοροποιειται κάθε στιγμη κατά την διαρκεια αυτης της παραγωγικης διαδικασιας. Προσπαθουμε να μειωσουμε το Work in progress με τις προσεγγισεις lean, Just-in-time, pull, make-to-order, κα.

ΚΘ/09.01.19

DETAILED DESCRIPTION IN ENGLISH

ABC - Activity based Costing

Activity-based costing
Activity-based costing, also known as ABC, is an accounting method that identifies a company's activities and assigns costs to units produced by the company based on the number of activities used by each unit. Activity-based costing first determines the purpose and cost of each activity performed by a company and then assigns a proportionate cost to every individual unit produced based on its consumption of those activities.

Absorption costing
Also known as full costing, absorption costing is an accounting method in which all manufacturing costs are absorbed by the units produced by a given company. In absorption costing, the cost of an individual unit produced will include direct materials, labor, and both fixed and variable manufacturing overhead costs. These costs are not recognized as expenses in the month a company pays for them. Rather, they are recorded as assets in the form of inventory until the units produced are sold. Once this happens, they are charged against a company's cost of goods sold. Absorption costing is typically required for financial and income tax reporting purposes.

Let's say a company manufactures 10,000 units of a particular product with a cost per unit of $10 in direct materials, $8 in direct labor, and $2 in variable manufacturing costs. Let's say the company also has fixed manufacturing overhead costs totaling $40,000 per year.

Under absorption costing, the cost per unit can be calculated as follows: $10 (direct materials) + $8 (direct labor) + $2 (variable manufacturing costs) + $4 ($40,000 per year in fixed manufacturing overhead costs divided by 10,000 units) = $24 per unit.

Differences in approach
Absorption costing and activity-based costing differ in approach. Absorption costing assigns costs to individual units, whereas activity-based costing focuses on company activities as a central cost and then attempts to assign indirect costs to units.

Major advantage of activity-based costing : is that it allows companies to understand the true cost and profitability of individual units produced or services rendered. This increased accuracy is achieved by essentially converting indirect costs to direct costs. In fact, activity-based costing can be applied to all business costs, not just production-related overhead. For instance, a company can assign its marketing costs directly to the individual units it produces. Because of this, activity-based costing can paint a more precise picture than absorption costing. On the other hand, activity-based costing can be an expensive system to implement, and it may not be as useful to companies whose overhead costs are primarily volume-related, or to companies whose overhead represents a small proportion of their overall costs.

Absorption costing, meanwhile, is easier to implement yet recognized as perfectly compliant with generally accepted accounting principles and IRS reporting requirements. The downside, however, is that it may offer less insight to those charged with making strategic decisions regarding production practices and costs

Example

Activity-Based vs Traditional Costing

Assume the Busy Ball Company makes two types of bouncing balls; one has a hollow center and the other has a solid center. The same equipment is used to produce the balls in different runs. Between batches, the equipment is cleaned, maintained, and set up in the proper configuration for the next batch. The hollow center balls are packaged with two balls per package, and the solid center balls are packaged one per package. During the year, Busy Ball expects to make 1,000,000 hollow center balls and 2,000,000 solid center balls. The overhead costs incurred have been allocated to activity pools as follows:

Purchasing of materials	$200,000
Setup of machines	350,280
Packaging	300,000
Testing	270,000
Cleaning and maintenance	288,540
Total overhead costs	$1,408,820

CliffsNotes article continues below

By analyzing the activity pools, the accountants and production managers have identified the cost drivers, estimated the total expected units for each product, and calculated the unit cost for each cost driver.

Activity	*Cost Driver*	*Total Expected Units for Cost Driver (1)*	*Total Cost (2)*	*Unit Cost per Cost Driver (3) = (2) ÷ (1)*
Purchasing of Materials	#purchase orders	100	$200,000	$2,000.00
Set up of Machines	#setups	252	350,280	1,390.00
Packaging	#containers filled	2,500,000	300,000	0.12
Testing	# tests	3,000	270,000	90.00
Cleaning and maintenance	#of runs	252	288,540	1,145.00

The activity by product is shown in the following table.

			Expected Use		ABC Cost Assigned	
Activity	*Cost Driver*	*Unit Cost (3)*	*Hollow Center (4)*	*Solid Center (5)*	*Hollow Center (3) × (4)*	*Solid Center (3) × (4)*
Purchasing	# purchase orders	$2,000.00	50	50	$100,000	$100,000
Setup	# setups	1,390.00	126	126	175,140	175,140
Packaging	# containers filled	0.12	500,000	2,000,000	60,000	240,000
Testing	# tests	90.00	1,000	2,000	90,000	180,000
Cleaning and maintenance	#runs	1,145.00	84	168	96,180	192,360
Totals					$521,320	$887,500

To calculate the per unit overhead costs under ABC, the costs assigned to each product are divided by the number of units produced. In this case, the unit cost for a hollow center ball is $0.52 and the unit cost for a solid center ball is $0.44.

$$\frac{\text{Overhead costs assigned to hollow center balls}}{\text{Number of hollow center balls}} = \frac{\$\,521{,}320}{1{,}000{,}000} = \$0.521$$

$$\frac{\text{Overhead costs assigned to solid center balls}}{\text{Number of solid center balls}} = \frac{\$\,887{,}500}{2{,}000{,}000} = \$0.444$$

Under the traditional method of allocating overhead based on direct labor dollars, the total costs for all balls would be divided by total direct labor dollars for all balls to determine the per unit cost. Estimated direct labor costs for the year are $1,512,000, of which $378,000 is for hollow center balls and $1,134,000 is for solid center balls. The per unit direct labor costs are $0.38 for hollow center balls ($378,000 ÷ 1,000,000) and $0.57 for solid center balls ($1,134,000 ÷ 2,000,000). The per unit cost to produce balls is calculated in two steps:

- Calculate the predetermined overhead rate by dividing total overhead costs by total direct labor dollars.
- Allocate overhead to each type of product by multiplying the overhead cost per direct labor dollar by the per unit direct labor dollars for hollow center balls and for solid center balls.

Step 1: Calculate overhead per direct labor dollar

$$\frac{\text{Total overhead costs}}{\text{Total direct labor dollars}} = \frac{\$1{,}408{,}820}{\$1{,}512{,}000} = \$0.932 \text{ per direct labor dollar}$$

Step 2: Allocation of overhead

Overhead cost per direct labor dollar × Per unit direct labor dollars

Hollow center balls
$0.932 × $0.378 = $0.352 overhead per unit

Solid center balls
$0.932 × $0.567 = $0.528 overhead per unit

A comparison of the overhead per unit calculated using the ABC and traditional methods often shows very different results:

Busy Ball Company 20X0 Overhead per Unit

	ABC	*Traditional*
Hollow Center Ball	$0.52	$0.35
Solid Center Ball	$0.44	$0.53

CliffsNotes article continues below

In this example, the overhead charged to the hollow ball using ABC is $0.52 and much higher than the $0.35 calculated under the traditional method. The $0.52 is a more accurate cost for making decisions about pricing and production. For the solid center ball, the overhead calculated is $0.44 per unit using the ABC method and $0.53 per unit using the traditional method. The reason for the differences is the traditional method determines the cost allocation using direct labor dollars only, so a product with high direct labor dollars gets allocated more of the overhead costs than a product with low direct labor dollars. The number of orders, setups, or tests the product actually uses does not impact the allocation of overhead costs when direct labor dollars are used to allocate overhead.

ABC provides a way to allocate costs more accurately when overhead costs are not incurred at the same rate as direct labor dollars. The more activities identified, the more complex the costing system becomes. Computer systems are needed for complex ABC systems. Some companies limit the number of activities used in the costing system to keep the system manageable. While this approach may result in some allocations being arbitrary, using ABC does provide a more accurate estimate of costs for use in making management decisions.

ABC Analysis

In materials management, the **ABC analysis** (or **Selective Inventory Control**) is an inventory categorization technique. ABC analysis divides an inventory into three categories- "A items" with very tight control and accurate records, "B items" with less tightly controlled and good records, and "C items" with the simplest controls possible and minimal records.

The ABC analysis provides a mechanism for identifying items that will have a significant impact on overall inventory cost, while also providing a mechanism for identifying different categories of stock that will require different management and controls.

The ABC analysis suggests that inventories of an organization are not of equal value. Thus, the inventory is grouped into three categories (**A, B, and C**) in order of their estimated importance.

'A' items are very important for an organization. Because of the high value of these 'A' items, frequent value analysis is required. In addition to that, an organization needs to choose an appropriate order pattern (e.g. 'Just-in- time') to avoid excess capacity. 'B' items are important, but of course less important than 'A' items and more important than 'C' items. Therefore, 'B' items are intergroup items. 'C' items are marginally important.

ABC analysis categories

There are no fixed threshold for each class, different proportion can be applied based on objective and criteria. ABC Analysis is similar to the Pareto principle in that the 'A' items will typically account for a large proportion of the overall value but a small percentage of number of items.
Example of ABC class are

- **'A'** items – 20% of the items accounts for 70% of the annual consumption value of the items.
- **'B'** items - 30% of the items accounts for 25% of the annual consumption value of the items.
- **'C'** items - 50% of the items accounts for 5% of the annual consumption value of the items.

Another recommended breakdown of ABC classes

1. "A" approximately 10% of items or 66.6% of value
2. "B" approximately 20% of items or 23.3% of value
3. "C" approximately 70% of items or 10.1% of value

ABC analysis in ERP packages

Major ERP packages have built in function of ABC analysis. User can execute ABC analysis based on user defined criteria and system apply ABC code to items (parts).

Alternate way of finding ABC analysis:-

The ABC concept is based on Pareto's law. If too much inventory is kept, the ABC analysis can be performed on a sample. After obtaining the random sample the following steps are carried out for the ABC analysis.

- Step 1: Compute the annual usage value for every item in the sample by multiplying the annual requirements by the cost per unit.
- Step 2: Arrange the items in descending order of the usage value calculated above.
- Step 3: Make a cumulative total of the number of items and the usage value.
- Step 4: Convert the cumulative total of the number of items and usage values into a percentage of their grand totals.

- Step 5: Draw a graph connecting cumulative % items and cumulative % usage value. The graph is divided approximately into three segments, where the curve sharply changes its shape. This indicates the three segments A, B and C.

ABM - Activity based Management

All organizations want to perform optimally and avoid or reduce mistakes as much as possible. Activity based management enables an organization to control its activities properly, as a result of which performance and customer-orientation are increased. In 1994, Activity Based Management was set out in more detail by **James Brimson** and **John Antos**.

Activity based management advantages

This management method has proved its value in reducing wastage, improving the (process) quality, shortening of lead times and introducing new products faster. Activity based management was initially mainly used in industrial enterprises. Nowadays, activity based management can be applied to all types of enterprises. Activity based management can be divided into a number of activities. These activities can be assessed on the basis of a cost-benefit analysis.

Value chain

Activity based management establishes relationships between overhead costs and activities so that the costs of products, services or customer segments can be calculated more accurately. This method focuses on the management of activities that reduce costs and improve customer value.

Through the management method all activities within an organization can be identified and evaluated. Using a value chain analysis the strategic and operational decisions within an organization can be improved.

Two types of areas

Activity Based Management can be divided into two areas:

Operational activity based management

´Do things right´; this relates to the implementation of activities. All activities within an organization must lead to improved efficiency. Only activities that add value to a product can be improved. Without added value, such activities must be reduced for cost-saving purposes.

Strategic activity based management

This relates to the decision of which products the organization will develop and what type of activities will be used to achieve this. It is also possible to analyse and calculate customer profitability in advance. This identifies the most profitable customers so that the organization can focus on them more.

Risk

A risk with this management method is that some activities have implicit values, so that they are not immediately identifiable as a financial added value. A pleasant workplace can help retain good staff but this cannot be qualified as an additional value in operational ABM. A customer who does not generate a profit could still open up new leads and prospects despite the fact that strategic ABM identifies him as a low value customer. Managers should recognize and interpret these implicit values and learn to use ABM as a neutral starting point. ABM gives managers an understanding of costs and helps teams to make certain decisions that benefit the whole organizations and not just their own activities.

APS – Advanced planning & Scheduling

Also known as **advanced manufacturing**) refers to a manufacturing management process by which raw materials and production capacity are optimally allocated to meet demand. APS is especially well-suited to environments where simpler planning methods cannot adequately address complex trade-offs between competing priorities.

Traditional production planning and scheduling systems (such as manufacturing resource planning) use a stepwise procedure to allocate material and production capacity. This approach is simple but cumbersome, and does not readily adapt to changes in demand, resource capacity or material availability. Materials and capacity are planned separately, and many systems do not consider material or capacity constraints, leading to infeasible plans. However, attempts to change to the new system have not always been successful, which has called for the combination of management philosophy with manufacturing.

Unlike previous systems, APS simultaneously plans and schedules production based on available materials, labor and plant capacity.

APS has commonly been applied where one or more of the following conditions are present:

1. make to order (as distinct from make to stock) manufacturing
2. capital-intensive production processes, where plant capacity is constrained
3. products 'competing' for plant capacity: where many different products are produced in each facility
4. products that require a large number of components or manufacturing tasks
5. production necessitates frequent schedule changes which cannot be predicted before the event

Advanced planning & scheduling software enables manufacturing scheduling and advanced scheduling optimization within these environment

ATP - Available-to-promise

Available-to-promise (**ATP**) is a business function that provides a response to customer order enquiries, based on resource availability. It generates available quantities of the requested product, and delivery due dates. Therefore, ATP supports order promising and fulfillment, aiming to manage demand and match it to production plans.

Available-to-promise functions are IT-enabled and usually integrated in enterprise management software packages. However, ATP execution may need to be adjusted for the way a certain company operates.

The Available to Promise formula is: **ATP = on hand + supply - demand**

on hand = nettable quantity on hand
supply = planned orders, scheduled receipts (purchase orders, purchase requisitions, and discrete jobs), suggested repetitive schedules
demand = sales orders, component demand (from planned orders, discrete jobs, and suggested repetitive schedules); excludes forecasted demand or manual entries

Suppose you want to see the available to promise information on item A for period 1. After running a plan, you get the following information for item A:

	Beginning Inventory	Period 1	Period 2	Period 3	Period 4
Forecasts		20	40		40
Manual Entries		50		40	10
Sales Orders		40	20		50
Scheduled Receipts		110	40	30	50
Planned Orders		20			50
Nettable On Hand	20				
ATP		110	20	30	50

Back flushing :

is nothing but automatic goods issue. System will automatically posts the goods issue when you confirm the operations.You have no need to make manual issue. It will reduce the effort.

BEER GAME

Beer Game is a game which represents a business. Created in MIT in 1960. Is used to demonstrate the basic principles of Supply chain management. Need groups of 4 persons minimum. At the end of each round the team discuss and concludes what were the results of their decisions and takes decisions for the next round based on the conclusions. The aim of the game is the players to understand the Distribution Dynamics in the productions and distribution of a products, eg. Beer and to fulfill the orders ate the lowest implications on stocks and on back-orders.

There are 4 stages in the game : Supplier, Manufacturer, Distributor, Retailer. Retailer gets a card in which an order is written and gives to the manufacturer. He considers the stocks and gives and order to the Supplier and

schedules the production when he receives the raw material. There is a cost associated to each back-order and a cost for excessive inventory.

Normally more teams are playing the game and winner is the team with the lowest total cost

Benchmarking

Best practice

BOM - Bill of materials

A **bill of materials** or **product structure** (sometimes **bill of material**, **BOM** or **associated list**) is a list of the raw materials, sub-assemblies, intermediate assemblies, sub-components, parts and the quantities of each needed to manufacture an end product. A BOM may be used for communication between manufacturing partners, or confined to a single manufacturing plant. A bill of materials is often tied to a production order whose issuance may generate reservations for components in the bill of materials that are in stock and requisitions for components that are not in stock.

A BOM can define products as they are designed (engineering bill of materials), as they are ordered (sales bill of materials), as they are built (manufacturing bill of materials), or as they are maintained (service bill of materials or pseudo bill of material). The different types of BOMs depend on the business need and use for which they are intended. In process industries, the BOM is also known as the *formula*, *recipe*, or *ingredients list*. The phrase "bill of material" (or BOM) is frequently used by engineers as an adjective to refer not to the literal bill, but to the current production configuration of a product, to distinguish it from modified or improved versions under study or in test.

In electronics, the BOM represents the list of components used on the printed wiring board or printed circuit board. Once the design of the circuit is completed, the BOM list is passed on to the PCB layout engineer as well as component engineer who will procure the components required for the design.

Modular BOM

BOMs are of hierarchical nature, with the top level representing the finished product which may be a sub-assembly or a completed item. BOMs that describe the sub-assemblies are referred to as **modular BOMs**. An example of this is the NAAMS BOM that is used in the automotive industry to list all the components in an assembly line. The structure of the NAAMS BOM is System, Line, Tool, Unit and Detail.

The first hierarchical databases were developed for automating bills of materials for manufacturing organizations in the early 1960s. At present, this BOM is used as a data base to identify the many parts and their codes in automobile manufacturing companies.

A bill of materials "implosion" links component pieces to a major assembly, while a bill of materials "explosion" breaks apart each assembly or sub-assembly into its component parts.

A modular BOM can be displayed in the following formats:

- A single-level BOM that displays the assembly or sub-assembly with only one level of children. Thus it displays the components directly needed to make the assembly or sub-assembly.
- An indented BOM that displays the highest-level item closest to the left margin and the components used in that item indented more to the right.
- Modular (planning) BOM

A BOM can also be visually represented by a product structure tree, although they are rarely used in the workplace. For example, one of them is Time-Phased Product Structure where this diagram illustrates the time needed to build or acquire the needed components to assemble the final product. For each product, the time phased product structure shows the sequence and duration of each operation.

BOTTLENECK

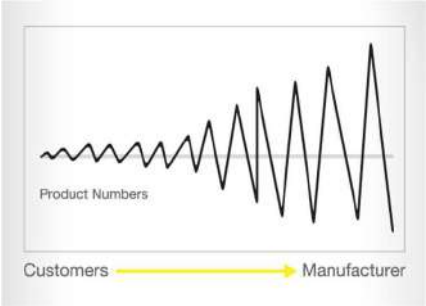
Brainstorming

BUFFER

BULLWHIP EFFECT

Through the numerous stages of a supply chain; key factors such as time and supply of order decisions, demand for the supply, lack of communication and disorganization can result in one of the most common problems in supply chain management. This common problem is known as the bullwhip effect; also sometimes the whiplash effect. In this blog post we will explain this concept and outline some of the contributing factors to this issue.

What is the bullwhip effect?



The bullwhip effect can be explained as an occurrence detected by the supply chain where orders sent to the manufacturer and supplier create larger variance then the sales to the end customer. These irregular orders in the lower part of the supply chain develop to be more distinct higher up in the supply chain. This variance can interrupt the smoothness of the supply chain process as each link in the supply chain will over or underestimate the product demand resulting in exaggerated fluctuations.

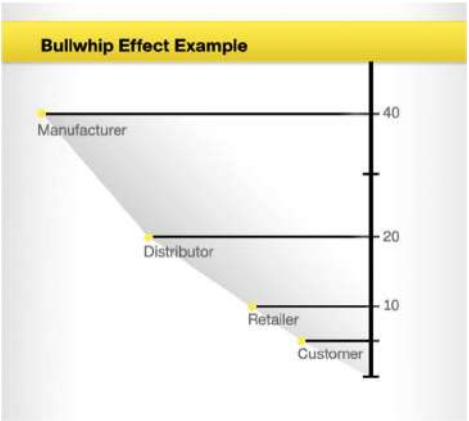
What contributes to the bullwhip effect?

There are many factors said to cause or contribute to the bullwhip effect in supply chains; the following list names a few:

- **Disorganization** between each supply chain link; with ordering larger or smaller amounts of a product than is needed due to an over or under reaction to the supply chain beforehand.
- **Lack of communication** between each link in the supply chain makes it difficult for processes to run smoothly. Managers can perceive a product demand quite differently within different links of the supply chain and therefore order different quantities.
- **Free return policies**; customers may intentionally overstate demands due to shortages and then cancel when the supply becomes adequate again, without return forfeit retailers will continue to exaggerate their needs and cancel orders; resulting in excess material.
- **Order batching**; companies may not immediately place an order with their supplier; often accumulating the demand first. Companies may order weekly or even monthly. This creates variability in the demand as there may for instance be a surge in demand at some stage followed by no demand after.
- **Price variations** – special discounts and other cost changes can upset regular buying patterns; buyers want to take advantage on discounts offered during a short time period, this can cause uneven production and distorted demand information.
- **Demand information** – relying on past demand information to estimate current demand information of a product does not take into account any fluctuations that may occur in demand over a period of time.

Example of the bullwhip effect

Let's look at an example; the actual demand for a product and its materials start at the customer, however often the actual demand for a product gets distorted going down the supply chain. Let's say that an actual demand from a customer is 8 units, the retailer may then order 10 units from the distributor; an extra 2 units are to ensure they don't run out of floor stock.



The supplier then orders 20 units from the manufacturer; allowing them to buy in bulk so they have enough stock to guarantee timely shipment of goods to the retailer. The manufacturer then receives the order and then orders from their supplier in bulk; ordering 40 units to ensure economy of scale in production to meet demand. Now 40 units have been produced for a demand of only 8 units; meaning the retailer will have to increase demand by dropping prices or finding more customers by marketing and advertising.

Although the bullwhip effect is a common problem for supply chain management understanding the causes of the bullwhip effect can help managers find strategies to alleviate the effect. Hopefully this blog post has given you a simple understanding of the term.

BUY

CHANNELS OF DISTRIBUTION of Goods: Zero, One and Two Level Channels

Production is for consumption. Having produced the products, these need to be made available to the final users of the products, i.e., the consumers scattered in large geographical areas. Since, many a times it becomes extremely difficult, if not impossible, to reach the customers on its own, the firm needs the help of marketing intermediaries, like wholesalers and retailers, to make their products reach to the ultimate consumers.

These intermediaries serve as channels to make the product reach to the consumers. The way products reach to the ultimate consumers is called 'distribution channels' or 'marketing channels.' Let us consider a few definitions on distribution channels.

According to the Committee on Definitions of the American Marketing Associations (1960):

"A channel of distribution or marketing channel is the structure of intra- company organisation units and extra-company agents and dealers, wholesalers and retailers, through which a commodity, product or service is marketed."

R. S. Davar observes, "Distribution as an operation or a series of operations which physically bring goods manufactured or produced by any particular manufacturer into the hands of the final consumer or user."

In fact, channels of distribution are like pipelines that take the right quantities of the right product to the right location where the target consumer want them at the right time. In view of this, physical distribution, i.e. to move the product from the place of production to the place of ultimate consumers assumes significance in making marketing meaningful and successful.

In this article, therefore, deals with the process how products go through this channel from the producer to the final user. These distribution channels, in a way, refer to the methods of marketing also. In view of the number of intermediaries involved in distribution channels, these can be classified into three broad categories.

These are:

1. Zero-Level Channel:

When the distribution of the product is direct from the producer to the consumer or the user. This is also called direct selling.

2. One-Level Channel:

When the product is not sent directly from the producer to the consumer but the producer sells the product to the retailer who, in turn, sells to the consumer. This channel is also known as distribution through retailers.

3. Two-Level Channel:

When there are two levels of different kinds of intermediaries between the producer and the consumer. In other words, under this channel, the manufacturer sells the product to the Wholesaler, he sells to the retailer and who finally sells to the consumer. This is also called as distribution through wholesalers and retailers. All these three channels can better be understood with the following Figure 32.2 also.

Let us discus these in some more details.

1. Direct Selling:

This method is also referred to as producer to consumer channel. Under this channel, the producer of goods attempts to make a direct contact with the ultimate user of goods by several methods of selling including door-to-door sales-persons. This method is most common in industrial marketing particularly in respect of capital goods like industrial chemicals, heavy equipment's, etc.

Direct selling offers the following advantages to the producers:

(i) Close relationship to the consumers makes the producer constantly aware of changes and other consumer's needs.

(ii) Profit does not go to the middle-man.

(iii) Goods get to the consumer more quickly because they do not have to travel through the intermediaries or middlemen.

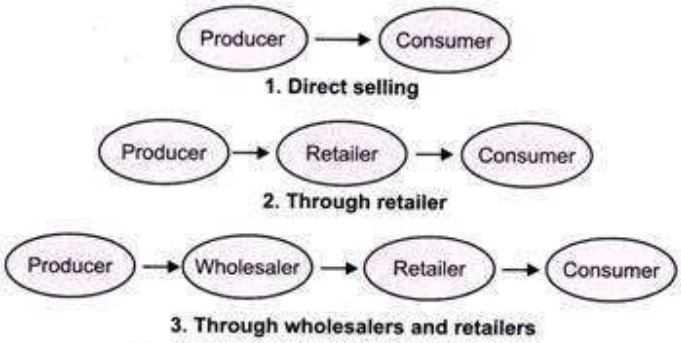


Figure 28.2: Channels of Distribution

Despite these apparent advantages, direct selling has not become a powerful channel. According to an estimate, even less than 3 per cent of total consumer sales are made in this channel (Diamond and Pintel 1986: 223).

This is due to the following reasons:

(a) The producer has to spend a handsome amount in the training, maintaining and supervising large number of sales staff.

(b) It involves cumbersome difficulties in providing and maintaining inventories of goods at many locations to assure prompt delivery to the customers.

2. Producer to Retailer to Customer Channel:

This is a kind of indirect selling. This channel avoids wholesalers. It is suitable when products are perishable and speed in distributions is extremely essential. The goods that are frequently sold in this channel are fashion merchandise, products requiring installation, high value goods, etc.

3. Producer to Wholesaler to Retailer to Consumer Channel:

This channel is also known as the traditional channel. This is also the most common method of distribution under which the producer sells to the wholesaler who, in turn, sells to the retailer, who finally sells to the consumer. In this system, the wholesaler is granted a certain portion of the total profit, in turn for which he or she buys stores, sells, delivers and extends credits. This channel is invariably used in respect of groceries, drugs, drug goods, etc.

This channel option is particularly suitable to the following types of producers:

1. Who lack in financial resources;

2. Whose product line is narrow; and

3. Whose products are not subject to fashion changes and physical deterioration but are durable.

Despite these features, this channel suffers from certain limitations also but not confined to the following only:

(i) An over-dependence on wholesalers causes him/her i.e., the producer to lose contact with the dealers:

(ii) The wholesalers may have different products of different producers to sell. In such case, the wholesaler might be quiet unable to push up the sales of one specific product produced by a producer.

After going through the above description, an inevitable question arises in the mind is which one channel of distribution is the most suitable channel for distributing the products of a small enterprise

Characteristics of the Push and Pull Parts of he Supply Chain

	Push	Pull
Objective	Min. Cost	Max. Service Level

Complexity	High	Low
Focus	Resource Allocation	Responsiveness
Lead Time	Long	Short
Process	Supply Chain Planning	Order Fulfillment

CODP - Customer Order Decoupling Point

The Customer Order Decoupling Point refers to the point in the value chain of mass customization at which a customer triggers the production activities. All activities before the CODP are drive by a firm's market research and planning department. This point, (also known as the freeze point, order penetration point), is the fork dividing customer-dependent and customer-independent production.

CONWIP

CONWIP (**CONstant work in process**) are pull-oriented production control systems. Such systems can be classified as pull and push systems (Spearman et al. 1990[1]). In a push system, the production order is scheduled and the material is pushed into the production line. In a pull system, the start of each product assembly process is triggered by the completion of another at the end of production line. This pull-variant is known for its ease of implementation.

CONWIP is a kind of single-stage kanban system and is also a hybrid push-pull system. While Kanban systems maintain tighter control of system WIP through the individual cards at each workstation, CONWIP systems are easier to implement and adjust, since only one set of system cards is used to manage system WIP.[2] CONWIP uses cards to control the number of WIPs. For example, no part is allowed to enter the system without a card (authority). After a finished part is completed at the last workstation, a card is transferred to the first workstation and a new part is pushed into the sequential process route. In their paper, Spearman et al. (1990) used a simulation to make a comparison among the CONWIP, kanban and push systems, and found that CONWIP systems can achieve a lower WIP level than kanban systems.

Continuous Improvement

Cost to serve

Cost to Serve is a process-driven accountancy tool to calculate the profitability of a customer account, based on the actual business activities and overhead costs incurred to service that customer.[1]
In the context of supply chain management it can be used to analyse how costs are consumed throughout the supply chain. It shows that each product and customer demands different activities and has a different cost profile. The product and customer profiles are often illustrated using a Pareto analysis curve which highlights those that contribute most to the company's profit and those that erode it.
Unlike Activity Based Costing (ABC), Cost to Serve is not resource-intensive and focuses on aggregate analyses around a blend of cost drivers.

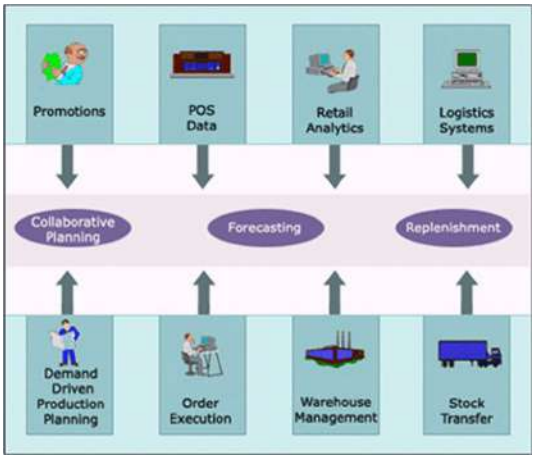
It gives an integrated view of costs at each stage of the supply chain providing a fact-based view to unravel the complexity of multiple supply chains and channels to market. It enables a focus on both long-term decisions and the prioritisation of short-term actions. Businesses are able to reposition customers and services, and how they are served to improve overall margin.

CPFR - Collaborative Planning, Forecasting and Replenishment

The importance of communication and collaboration can never be stressed enough in a supply chain. A well-documented example is of Volvo and green cars. In the 80's, Volvo had a growing inventory of green cars. To reduce this growing inventory, a promotional campaign was initiated which turned out to be a huge success. The production department saw the sales of green cars pick up and assuming that demand has increased, they started producing more green cars. This again resulted in a growing inventory of green cars and negating the entire motive behind the campaign. This example shows that if different entities collaborate and communicate in their functioning, the situation is always much better. A similar issue is faced in supply chains where lack of communication results in increasing demand variability through the supply chain popularly referred to as the "Bullwhip Effect". The point here is that the left hand HAS to know what the right hand is doing. Collaborative Planning, Forecasting and Replenishment (CPFR®) is an attempt to address this issue.

Collaborative Planning, Forecasting and Replenishment (CPFR®) is a business practice that combines the intelligence of multiple trading partners in the planning and fulfillment of customer demand. The Voluntary Interindustry Commerce Standards (VICS) Association published guidelines for implementing CPFR in 1998 (updated in 2001) and it has been in various stages of implementation at different companies since then.

CPFR is one of a series of supply chain initiatives like JIT (Just-In-Time), ECR (Efficient Customer Response) and VMI (Vendor Managed Inventory) driven by organizations to make their supply chains more responsive and keep all the supply chain members in tune with the end customer demand, both in terms of the product and its volumes. By ensuring end-to-end communication, the occurrence of the "Bullwhip Effect" is prevented thus reducing inventory levels across the chain. It also allows partners to visualize the bigger picture in terms of the entire supply chain rather than their enterprise alone. As partner collaboration is initiated right from the planning till the replenishment stage, the supply chain as a whole is in a better position to respond to exceptional circumstances making it a more proactive entity rather than a reactive one. On a more abstract level, CPFR aims at creating an environment of trust between trading partners where the benefits of sharing information are known. The role of CPFR in various stages of supply chain activity is aptly represented in the figure below.



The VICS Association provides information about the structure of CPFR activities and guidelines for implementing them. According to them, CPFR comprises of four main collaboration activities: 1) Strategy and Planning 2) Demand and Supply Management 3) Execution and 4) Analysis.
Implementation of all four activities is not necessary for implementing CPFR and a subset of these activities can also be implemented.

1) Strategy and Planning:

This activity establishes the ground rules for the collaborative relationship. It determines the product mix and placement and develops event plans for the period.

2) Demand and Supply Management:

This activity estimates consumer demand and order and shipment requirements over the planning horizon.

3) Execution:

In this activity, orders are placed, shipments are placed and delivered, products are received and stocked, sales transaction are recorded and payments are made.

4) Analysis:

In this activity, planning and execution are monitored for exceptions, results are aggregated and key performance metrics are calculated. The insight thereof is shared between the partners and plans are adjusted for improving results.

Implementation

To derive maximum benefits from CPFR, it needs to be implemented in a well-defined structure. A step-wise implementation of CPFR is outlined in the following manner.

- Formally establish an agreement with your trading partners and identify key performance indicators consistent with the purpose of collaboration.
- Formalize the roles and responsibilities of each partner in the CPFR process.
- Develop a collaborative business plan that is consistent with the goals of individual partners and the supply chain alike.
- Develop a sales forecast for the collaborative initiative and identify key exceptions along with methods to address those exceptions.
- Execute the collaborative plan and address any exceptions that arise in a manner decided before hand

Value Proposition

The greatest value of CPFR is derived from the reduction in inventory levels and eliminating out-of-stock situations. Moreover, replenishment cycles get smaller as supply chains get more responsive to end customer demand making it more competitive. As out-of-stock situations are eliminated, sales increase especially in the retail goods industry. As inventory levels are reduced, warehousing costs are also reduced which can result in significant savings. In summary, the supply chain becomes more customer-driven than before and realizes significant advantages from such collaborative activities.

The purpose behind CPFR or any other collaborative activity in a supply chain is to leverage the competencies of each trading partner in a manner where the entire supply chain benefits. Even if trading partners do not implement CPFR in the structured manner defined by VICS, an environment of trust and a collaborative interaction can greatly benefit each one of them

CRP - Capacity Requirements Planning

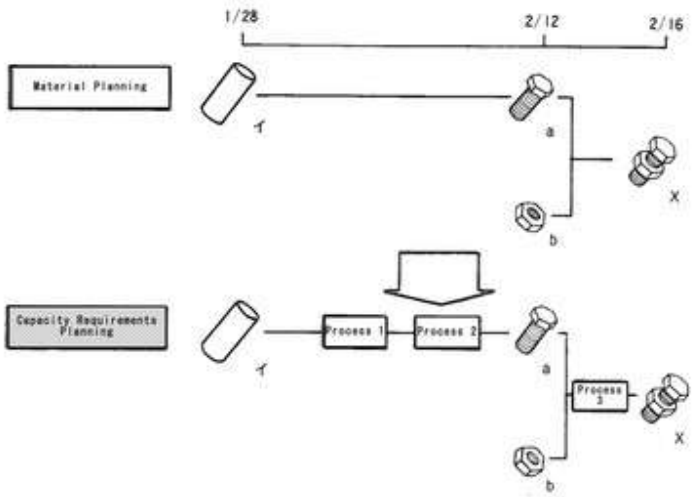
DEFINITION

An accounting method used to determine the available production capacity of a company. Capacity requirement planning first assesses the schedule of production that has been planned upon by the company. Then it analyzes the company's actual production capacity and weighs the two against each other to see if the schedule can be completed with the current production capacity.

Capacity requirements planning is an important part of ensuring that a company can meet production expectations. If a firm fails to take this step before production, it may find itself unexpectedly unable to produce the amount of goods that it has agreed to make with its current facilities. This can obviously be disastrous for the firm if it is unable to meet the requirements of a contract or other formal production agreement.

Capacity Requirements Planning CRP

The manufacturing order planned through the material planning (MRP or parts explosion) is usually submitted to the administration division or the person in charge of administration that comprehensively control the manufacturing division, and the validity of its capacity and load is first determined. The manufacturing order is created for each item using B/M based on the production schedule through the material planning, and thus at this point the concept of process is not existing yet. But items are actually produced through a number of processes. Capacity Requirements Planning refers to the planning where the load for each process is grasped according to the manufacturing order, the adjustments are made, and then the work of each process is planned.



It is necessary to set the capacity after considering the current situation, in order to make Capacity Requirements Planning more practical. In this planning, the following three capacities are used:

Standard Capacity:

the ability to produce items in a standard process. The standard capacity is usually set for each process, and such time margin as morning meeting time and break time as well as attendance rate are also considered. In addition, Capacity may be registered for each operation date.

Maximum Capacity:

the ability to produce the maximum quantity/quality of items in a process. It can be set according to the actual performance or as an overload tolerance.

Set Capacity:

the ability to be set based on the relationship between the maximum capacity and load.

When setting the capacity, such factors as overtime work, shift, and the increase or decrease in staff transfer are considered.

Generally, capacity demand plan can be divided into four functions.

Process spread:

MRP calculate the amount of items required, but the actual operation instruction is for each process,Therefore, items level plan need to be broken down into process level plan.This subdivide function is called process spread.

Load accumulation:

Orders generated during process spreading called work orders. The work time that calculated when process spreading is recorded into work orders, the time is seen as the job load, calculate the load of each project.
This function is called load accumulation.

Load adjustment:

Load adjustment happens in the earliest start time (get ready materials, the earliest time you can get to work) to latest start time (the latest start time that do not occur late delivery) scale.

Ability adjustment:

In case that unable to deal with by adjusting the load, overtime work, change shift, outsourcing...est. can be considered.

On base of these functions and planner's adjustment to calculate capacity demand. work orders that generated in the plan, will be succeeded to the work plan.

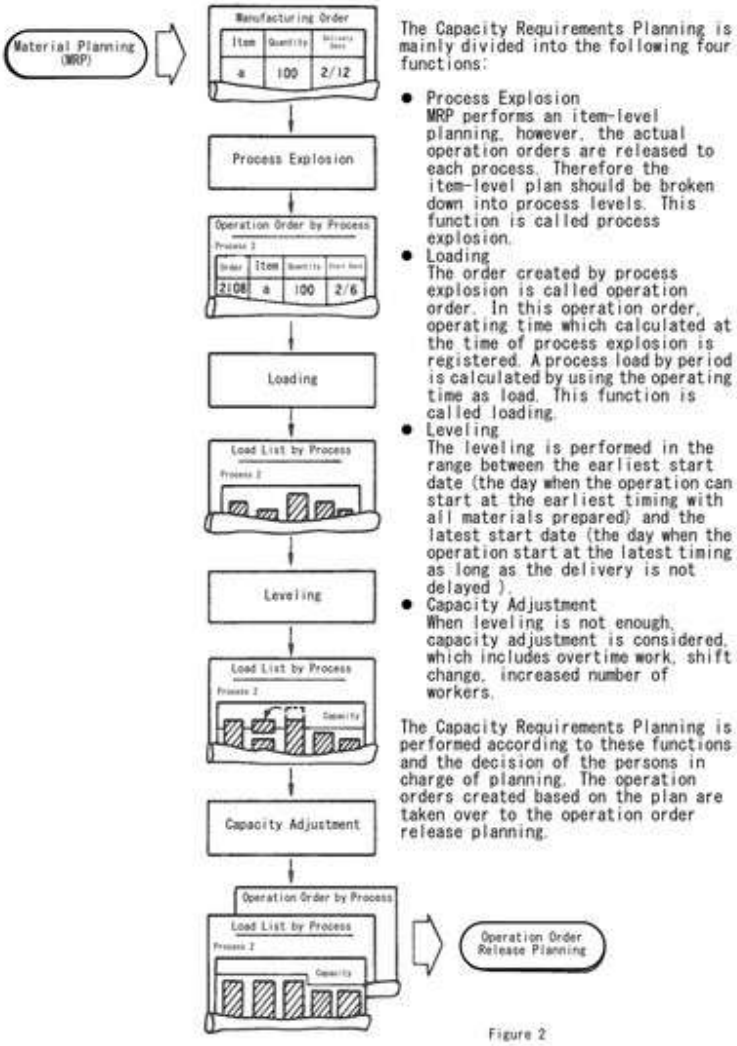


Figure 2

CYCLE TIME

Lead Time and Cycle Time are two important metrics in Lean and process improvement in general. However, many people do not seem to understand the difference and their relationship. In fact, many use them interchangeably. This can lead to confusion in understanding the true problems in a process, and worse, poor decisions in process improvement.

You may notice that this link is not on Lean or Six Sigma but general business (operations) management. These terms and concepts are not developed by, or limited to, Lean or Six Sigma.

Lead Time – Cycle Time : Difference and relationship.

1. Lead Time and Cycle Time don't have the same unit although their names are both "Time." Lead Time is measured by elapsed time (minutes, hours, etc.), whereas Cycle Time is measured by the amount of time per unit (minutes/customer, hours/part, etc.). It does not make any sense to add one to, or subtract one from, another.

2. Cycle Time is actually a measure of Throughput (units per period of time), which is the reciprocal of Cycle Time. This relationship is analogous to Takt Time (amount of time per unit), which is the reciprocal of customer demand rate (units per period of time). Note that by definition, Cycle Time (or Takt Time) is an average value.

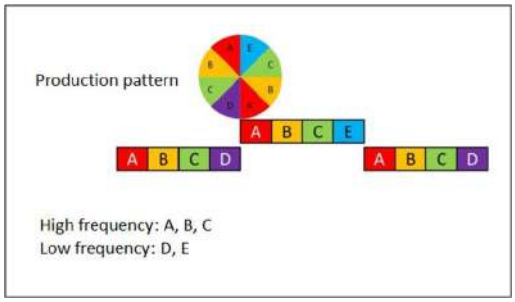
3. Lead Time and Cycle Time are related by Work-in-progress (WIP) in the entire process, in a relationship described by the Little's Law:

Lead Time = Cycle Time * WIP

CYCLIC PRODUCTION .

What is cyclic production?

According to the dictionary, a cycle is a "period, time circuit, characterized by the same sort of events". The word cycle is stemming from the Greek word "kúklos", meaning wheel, circuit, circular course. When designing a cyclic production system, a period is defined wherein the same products are produced in a fixed sequence. The next picture is an example of a production cycle.



The advantages of cyclic production

A repeating cycle provides many opportunities for optimization. Numerous repetitions result in a strong learning curve in the organization. Just imagine, every time again an identical production plan that you communicate to your shop floor and your suppliers. Every time the same sequence in change-overs of your resources, similar events at equal time intervals, (almost) equal quantities in the cycle, etc. The list of potential advantages is long:

- Shorter change-over times
- Less mistakes during change-overs
- Higher quality
- Higher line speeds

- Reliable production
- Reliable deliveries
- Less safety stock
- Less cycle stock

Moreover, cyclic production can prevent interference. Interference is when a number of products are requiring the same production resource at the same moment in time. The consequence is large, unreliable lead times. A fixed cycle evades these issues by tuning workload in line with the resource capacity. In many manufacturing environments these benefits from repetition will prevail over the advantages of flexibility.

Application of cyclic production

Which items qualify for production in a cycle? Perhaps you think that only a small, selected group of items can be considered. The opposite is true. You can select your items by taking certain product characteristics into account. The demand pattern is especially important. Items with limited demand variation are clear candidates. The small spread around the average demand makes it quite easy to determine a fixed production quantity. This, combined with a relatively low safety stock, will lead to a proper service level. The good news is that in most companies, many items fall into this category. By far, most fast moving items have such a limited demand variation. For example, if the fast moving items make up for 80% of the volume, then the bulk of your product flows could be produced in such an efficient cycle! Toyota goes very far with this. They produce items with low demand fluctuation in a completely Fixed Repeating Schedule. Hereby items with limited demand fluctuation are planned in a completely fixed production cycle and items with large demand fluctuations are placed in a fully separated flow. This opens up the possibilities to exploit the 'Economies of repetition' to the full with the large flow, with next to it a very flexible operation for the non-cyclic production.

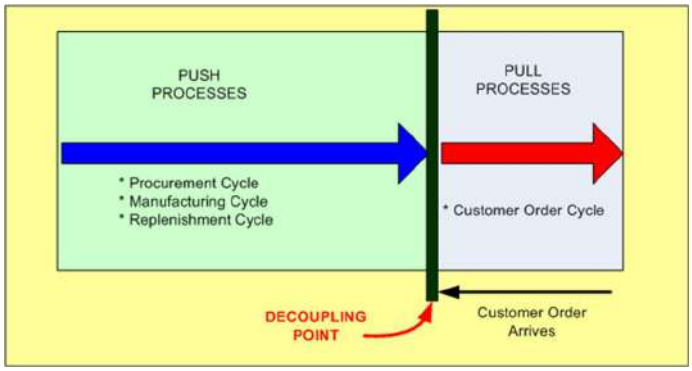
But, also for the items with significant demand fluctuation there are opportunities to include them in a cyclic production pattern. With this comes the challenge, because demand is fluctuating, to align production quantities with demand. This can be done by using capacity stock. When using capacity stock, during times of low demand, certain pre-defined fast moving items are produced somewhat more and during busy periods somewhat less. This enables cyclic production also for items with high demand fluctuation.

DEAD STOCKS

DECOUPLING POINT (Push-Pull boundary) - Customer Order Decoupling Point (CODP)

- The two portions of the supply chain interact at the push-bull boundary or Decoupling Point
- Decoupling Point is the point at which real demand penetrates upstream in a supply chain .
- It is the point at which market ``pull'' meets upstream ``push''.
- It separates that part of the supply chain geared towards directly satisfying customers' orders from that part of the supply chain based on planning
- At this point there is an adequate Buffer Inventory that results from the coordination of the two parts of the supply chain.

- Buffer inventory is the output generated via push strategy but, at the same time, forms an input to the order fulfillment of push-based portion of the supply chain.
- In real-world supply chains there are actually Two Decoupling Points:
  - The ``Material'' decoupling point where strategic inventory is held in as generic a form as possible. This point ideally should lie as far downstream in the supply chain and as close to the final marketplace as possible
  - The ``Information'' decoupling point is the point to which information on real final demand penetrates. It should lie as far as possible upstream in the supply chain .



Delphi method

The **Delphi method** (/ˈdɛlfaɪ/ ***DEL-fy***) is a structured communication technique or method, originally developed as a systematic, interactive forecasting method which relies on a panel of experts.[1][2][3][4] The experts answer questionnaires in two or more rounds. After each round, a facilitator or change agent[5] provides an anonymised summary of the experts' forecasts from the previous round as well as the reasons they provided for their judgments. Thus, experts are encouraged to revise their earlier answers in light of the replies of other members of their panel. It is believed that during this process the range of the answers will decrease and the group will converge towards the "correct" answer. Finally, the process is stopped after a predefined stop criterion (e.g. number of rounds, achievement of consensus, stability of results) and the mean or median scores of the final rounds determine the results.[6]

Delphi is based on the principle that forecasts (or decisions) from a structured group of individuals are more accurate than those from unstructured groups.[7] The technique can also be adapted for use in face-to-face meetings, and is then called mini-Delphi or Estimate-Talk-Estimate (ETE). Delphi has been widely used for business forecasting and has certain advantages over another structured forecasting approach, prediction markets.[8]

DRP - Distribution Resource/Requirements Planning

Distribution resource planning (DRP) is a method used in for planning orders within a supply chain. DRP enables the user to set certain inventory control parameters (like a safety stock) and calculate the time-phased inventory requirements. This process is also commonly referred to as ***distribution requirements planning***.

DRP uses several variables:

- the required quantity of product needed at the beginning of a period
- the constrained quantity of product available at the beginning of a period

- the recommended order quantity at the beginning of a period
- the backordered demand at the end of a period
- the on-hand inventory at the end of a period

DRP needs the following information:

- the demand in a future period
- the scheduled receipts at the beginning of a period
- the on-hand inventory at the beginning of a period
- the safety stock requirement for a period

DISTRIBUTION CHANNELS

Are the channels via which the product is moved from production to consumption : level 0 : directly, level 1 : Via Retail network, level 2 : via Wholesalers, distributers, agents and retailers. Coffee does not reach the consumer before first going through a channel involving the farmer, exporter, importer, distributor and the retailer.

Business-to-business (B2B) distribution occurs between a producer and industrial users of raw materials needed for the manufacture of finished products. For example, a logging company needs a distribution system to connect it with the lumber manufacturer who makes wood for buildings and furniture.

Business-to-customer (B2C) distribution occurs between the producer and the final user. For instance, the lumber manufacturer sells lumber to the furniture maker, who then makes the furniture and sells it to retail stores, who then sell it to the final customer

FACTORS which should be taken into account in choosing the best distribution channel :

1. The nature of the product

- Technical/complex? Complex products are often sold by specialist distributors or agents
- Customised? A direct distribution approach often works best for a product that the end consumer wants providing to a distinct specification
- Type of product – e.g. convenience, shopping, speciality
- Desired image for the product – if intermediaries are to be used, then it is essential that those chosen are suitable and relevant for the product.

2. The market

- Is it geographically spread?
- Does it involve selling overseas (see further below)
- The extent and nature of the competition – which distribution channels and intermediaries do competitors use?

3. The business

- Its size and scope – e.g. can it afford an in-house sales force?
- Its marketing objectives – revenue or profit maximisation?
- Does it have established distribution network or does it need to extend its distribution option
- How much control does it want over distribution? The longer the channel, the less control is available

4. Legal issues

- Are there limitations on sale?
- What are the risks if an intermediary sells the product to an inappropriate customer?

ECR

Efficient Consumer Response (**ECR**) is a joint trade and industry body working towards making a sector as a whole more responsive to consumer demand and promote the removal of unnecessary costs from the supply chain.

There are four focus areas under ECR: demand management, supply management, enablers and integrators, which are intended to be addressed as an integrated set. These form the basis of the ECR Global Scorecard

EOQ - Economic Order Quantity

With a reorder quantity code of E (Economic Order Quantity), the method of reordering items is most cost effective. The Economic Order Quantity code uses a calculation to balance the cost of ordering against the cost of stocking an inventory item. To use the Economic Order Quantity code, you must choose automatic purchasing for the item location. (The code is available with either of the reorder policies, Fixed Order Point or Time-Phased Order Point.)

The Economic Order Quantity is the quantity needed on a purchase order when the stock-on-hand for an item falls below the reorder point set at the item location. You can enter the Economic Order Quantity manually or run a batch program to perform the calculation, *Economic Order Quantity and Reorder Calculation* **(IC120)**. The Economic Order Quantity calculation uses the following formula:

EOQ = square root of [(2 times the annual demand quantity times the fixed order preparation cost) divided by (the carrying item unit cost)"

ImportantThe calculation provided by the EOQ formula ONLY replaces the reorder point for an item if you define EOQ as the reorder quantity code and update the reorder point when you run *Economic Order Quantity and Reorder Calculation* **(IC120)**.

Some considerations to note about the formula:

- The annual demand quantity is the item quantity you expect to have in the warehouse over a year's time. In other words, the quantity that comes into the warehouse while the item continues to be consumed from its location. The quantity can come from past demand, from past demand with this year's expected demand, or from firm orders. Be aware that the annual demand quantity and the carrying item unit cost need to be in the same unit of measure.
- The fixed order preparation cost is the cost that does not change with an order's size. For example, such costs could include order research and administration, forms for picking and shipping, and prorated maintenance fees for software and hardware. The possible sources for these fixed costs are labor figures (from Lawson Human Resources) and general ledger accounts. Variable costs, such as the cost of picking, packing, and shipping, should not be included.
- The carrying item unit cost represents the cost of doing business: paying for rent and insurance, utilities, spoilage, and so on. Together, these costs are what's needed to be able to stock the items at the warehouse.

EPOS Systems - Electronic Point of Sales

Modern businesses are increasingly looking for ways to save money, speed up productivity and increase sales. Any business or retailer nowadays has to have their finger on the pulse of what is the quickest, best and most cost-effective way to run their business on a day-to-day level.

That's where the EPOS system comes in. Its combination of up-to-the-minute technology, reliability and efficiency have made it an increasingly popular choice for businesses up and down the country. Here's a bit about it.

WHAT IS AN EPOS SYSTEM?

EPOS stands for Electronic Point of Sale digital system and is a computerised system used in shops, restaurants and other retail outlets. Essentially it's an electronic way of letting people pay for goods or services. EPOS systems have a variety of uses such as –

- Helping to improve the way a business performs
- Allows information and stock to be stored securely
- Information can be retrieved immediately as and when needed
- Allows a business to see what products are in demand
- It can print out receipts and vouchers for customers
- It can also be linked to a company website or any terminal within the business

HOW DO EPOS SYSTEMS WORK?

EPOS systems comprise of computer hardware, peripherals and software perfectly suited to a point of sales environment. For example, some of the most common components to an EPOS system are cash draws, chip and pin, customer displays, keyboards, printers and weighing scales.

It's a system that can support data entry through a variety of devices such as computer keyboards, touchscreen monitors and barcode scanners.

It gives the retailer tremendous flexibility in choosing specific peripherals for their business – ie: in a high demand environment such as a supermarket, an EPOS system can be configured to work in tandem with barcode scanners to ensure price accuracy and allowing the staff to work quickly.

EPOS systems can also be adapted to suit a variety o different working environments to ensure that the system is uniquely suited to a particular business. It can be used for :

- Recording sales
- Updating stock levels
- Providing accurate pricing information
- Enable fast and efficient customer service
- Keeping track of sales and taxes

WHAT ARE THE BENEFITS OF USING AN EPOS SYSTEM?

There are a number of long-term benefits to using the system. These include :

- It ensures accurate pricing
- Faster transactions
- Reduces human error
- Improves data integrity
- Prices can be changed easily for special offers
- Provides accurate sales reporting
- Enables constantly updated inventory for accounting, marketing and sales

At a time when companies and businesses are trying to be as cash-savvy and save as much money as they can, it's also important to consider the long-term cost-saving that using an EPOS system can glean. It can create noticeable savings on employee time and accounting, improve efficiency of stock control, and be the starting point to create a database for customers and their behaviour.

The most important thing about EPOS systems is that they can be tailored to your individual and specific business needs. Along with store purchases, online ordering, telephone sales, catalogues and the like, EPOS is another vital addition in the list of multi channel retailing that ultimately offers benefit after benefit for your company and your customers.

ERP - Enterprise Resource Planning :

Είναι software σχεδιασμού επιχειρηματικών πόρων, δηλαδή ένα σύστημα λογισμικού με στόχο να λειτουργήσει σαν κορμός για όλη την επιχείρηση. Το ERP ενσωματώνει βασικές επιχειρηματικές και διοικητικές διαδικασίες για τη παροχή μιας αφ' υψηλού εικόνας στο τι γίνεται στην επιχείρησή σας. Το ERP καταγράφει τα οικονομικά της επιχείρησης, τα δεδομένα των ανθρώπινων πόρων και (αν είναι εφικτό) όλες τις κατασκευαστικές πληροφορίες, όπως η θέση στην αποθήκη και πότε πρέπει να μεταφερθεί ένα εξάρτημα από τις αποθήκες στο κατάστημα πωλήσεων. Ο ηγέτης στο ERP με το μεγαλύτερο μερίδιο, και εφευρέτης της αγοράς σε ένα βαθμό, είναι η Γερμανική SAP AG με το λογισμικό R/3. Άλλοι μεγάλοι παίκτες είναι PeopleSoft Inc., Oracle Corp., Baan Co. NV and J.D. Edwards & Co.

EXPONENTIAL SMOOTHING

Exponential smoothing is a rule of thumb technique for smoothing time series data, particularly for recursively applying as many as three low-pass filters with exponential window functions. Such techniques have broad application that is not intended to be strictly accurate or reliable for every situation. It is an easily learned and easily applied procedure for approximately calculating or recalling some value, or for making some determination based on prior assumptions by the user, such as seasonality. Like any application of repeated low-pass filtering, the observed phenomenon may be an essentially random process, or it may be an orderly, but noisy, process. Whereas in the simple moving average the past observations are weighted equally, exponential window functions assign exponentially decreasing weights over time. The use of three filters is based on empirical evidence and broad application.

Exponential smoothing is commonly applied to smooth data, as many window functions are in signal processing, acting as low-pass filters to remove high frequency noise. This method parrots Poisson's use of recursive exponential window functions in convolutions from the 19th century, as well as Kolmogorov and Zurbenko's use of recursive moving averages from their studies of turbulence in the 1940s. See Kolmogorov-Zurbenko filter for more information.

The raw data sequence is often represented by $\{x_t\}$ beginning at time $t = 0$, and the output of the exponential smoothing algorithm is commonly written as $\{s_t\}$, which may be regarded as a best estimate of what the next value of x will be. When the sequence of observations begins at time $t = 0$, the simplest form of exponential smoothing is given by the formulae:[1]

$$s_0 = x_0$$
$$s_t = \alpha x_t + (1-\alpha)s_{t-1}, \ t > 0$$

where α is the *smoothing factor*, and $0 < \alpha < 1$.

The simple moving average

Intuitively, the simplest way to smooth a time series is to calculate a simple, or unweighted, moving average. This is known as using a rectangular or "boxcar" window function. The smoothed statistic s_t is then just the mean of the last k observations:

$$s_t = \frac{1}{k}\sum_{n=0}^{k-1} x_{t-n} = \frac{x_t + x_{t-1} + x_{t-2} + \cdots + x_{t-k+1}}{k} = s_{t-1} + \frac{x_t - x_{t-k}}{k},$$

where the choice of an integer $k > 1$ is arbitrary. A small value of k will have less of a smoothing effect and be more responsive to recent changes in the data, while a larger k will have a greater smoothing effect, and produce a more pronounced lag in the smoothed sequence. One disadvantage of this technique is that it cannot be used on the first $k - 1$ terms of the time series without the addition of values created by some other means. This means effectively extrapolating outside the existing data, and the validity of this section would therefore be questionable and not a direct representation of the data.

It also introduces a phase shift into the data of half the window length. For example, if the data were all the same except for one high data point, the peak in the "smoothed" data would appear half a window length later than when it actually occurred. Where the phase of the result is important, this can be simply corrected by shifting the resulting series back by half the window length.

A major drawback with the SMA is that it lets through a significant amount of the signal shorter than the window length. Worse, it actually inverts it. This can lead to unexpected artifacts, such as peaks in the "smoothed" result appearing where there were troughs in the data. It also leads to the result being less "smooth" than expected since some of the higher frequencies are not properly removed.

The weighted moving average

A slightly more intricate method for smoothing a raw time series $\{x_t\}$ is to calculate a weighted moving average by first choosing a set of weighting factors

$\{w_1, w_2, \ldots, w_k\}$ such that $\sum_{n=1}^{k} w_n = 1$

and then using these weights to calculate the smoothed statistics $\{s_t\}$:

$$s_t = \sum_{n=1}^{k} w_n x_{t+1-n} = w_1 x_t + w_2 x_{t-1} + \cdots + w_k x_{t-k+1}.$$

In practice the weighting factors are often chosen to give more weight to the most recent terms in the time series and less weight to older data. Notice that this technique has the same disadvantage as the simple moving average technique (i.e., it cannot be used until at least *k* observations have been made), and that it entails a more complicated calculation at each step of the smoothing procedure. In addition to this disadvantage, if the data from each stage of the averaging is not available for analysis, it may be difficult if not impossible to reconstruct a changing signal accurately (because older samples may be given less weight). If the number of stages missed is known however, the weighting of values in the average can be adjusted to give equal weight to all missed samples to avoid this issue.

Basic exponential smoothing

The use of the exponential window function is first attributed to Poisson as an extension of a numerical analysis technique from the 17th century, and later adopted by the signal processing community in the 1940s. Here, exponential smoothing is the application of the exponential, or Poisson, window function. Exponential smoothing was first suggested in the statistical literature without citation to previous work by Robert Goodell Brown in 1956, and then expanded by Charles C. Holt in 1957. The formulation below, which is the one commonly used, is attributed to Brown and is known as "Brown's simple exponential smoothing". All the methods of Holt, Winters and Brown may be seen as a simple application of recursive filtering, first found in the 1940s to convert FIR filters to IIR filters.

The simplest form of exponential smoothing is given by the formula:

$$s_t = \alpha \cdot x_t + (1 - \alpha) \cdot s_{t-1}$$

where α is the *smoothing factor*, and $0 < \alpha < 1$. In other words, the smoothed statistic s_t is a simple weighted average of the current observation x_t and the previous smoothed statistic s_{t-1}. The term *smoothing factor* applied to α here is something of a misnomer, as larger values of α actually reduce the level of smoothing, and in the limiting case with $\alpha = 1$ the output series is just the same as the original series. Simple exponential smoothing is easily applied, and it produces a smoothed statistic as soon as two observations are available.

Values of α close to one have less of a smoothing effect and give greater weight to recent changes in the data, while values of α closer to zero have a greater smoothing effect and are less responsive to recent changes. There is no formally correct procedure for choosing α. Sometimes the statistician's judgment is used to choose an appropriate factor. Alternatively, a statistical technique may be used to *optimize* the value of α. For example, the method of least squares might be used to determine the value of α for which the sum of the quantities $(s_{n-1} - x_{n-1})^2$ is minimized.

Unlike some other smoothing methods, such as the simple moving average, this technique does not require any minimum number of observations to be made before it begins to produce results. In practice, however, a "good average" will not be achieved until several samples have been averaged together; for example, a constant signal will take approximately $3/\alpha$ stages to reach 95% of the actual value. To accurately reconstruct the original signal without information loss all stages of the exponential moving average must also be available, because older samples decay in weight exponentially. This is in contrast to a simple moving average, in which some samples can be skipped without as much loss of information due to the constant weighting of samples within the average. If a known number of samples will be missed, one can adjust a weighted average for this as well, by giving equal weight to the new sample and all those to be skipped.

This simple form of exponential smoothing is also known as an exponentially weighted moving average (EWMA). Technically it can also be classified as an Autoregressive integrated moving average (ARIMA) (0,1,1) model with no constant term.

Time Constant

The time constant of an exponential moving average is the amount of time for the smoothed response of a unit set function to reach $1 - 1/e \approx 63.2\,\%$ of the original signal. The relationship between this time constant, τ, and the smoothing factor, α, is given by the formula:

$$\alpha = 1 - e^{\frac{-\Delta T}{\tau}}$$

Where ΔT is the sampling time interval of the discrete time implementation. If the sampling time is fast compared to the time constant then

$$\alpha \approx \frac{\Delta T}{\tau}$$

Choosing the initial smoothed value

Note that in the above definition s_1 is being initialized to x_0. Because exponential smoothing requires that at each stage we have the previous forecast, it is not obvious how to get the method started. We could assume that the initial forecast is equal to the initial value of demand; however, this approach has a serious drawback. Exponential smoothing puts substantial weight on past observations, so the initial value of demand will have an unreasonably large effect on early forecasts. This problem can be overcome by allowing the process to evolve for a reasonable number of periods (10 or more) and using the average of the demand during those periods as the initial forecast. There are many other ways of setting this initial value, but it is important to note that the smaller the value of α, the more sensitive your forecast will be on the selection of this initial smoother value s_1.[7]

Optimization

For every exponential smoothing method we also need to choose the value for the smoothing parameters. For simple exponential smoothing, there is only one smoothing parameter (α), but for the methods that follow there is usually more than one smoothing parameter.

There are cases where the smoothing parameters may be chosen in a subjective manner — the forecaster specifies the value of the smoothing parameters based on previous experience. However, a more robust and objective way to obtain values for the unknown parameters included in any exponential smoothing method is to estimate them from the observed data.

The unknown parameters and the initial values for any exponential smoothing method can be estimated by minimizing the SSE. The errors are specified as $e_t = y_t - \hat{y}_{t|t-1}$ for t=1,…,T (the one-step-ahead within-sample forecast errors). Hence we find the values of the unknown parameters and the initial values that minimize

$$SSE = \sum_{t=1}^{T} (y_t - \hat{y}_{t|t-1})^2 = \sum_{t=1}^{T} e_t^2$$ [8]

Unlike the regression case (where we have formulae that return the values of the regression coefficients which minimize the SSE) this involves a non-linear minimization problem and we need to use an optimization tool to perform this.

Why is it "exponential"?

The name 'exponential smoothing' is attributed to the use of the exponential window function during convolution. It is no longer attributed to Holt, Winters & Brown.

By direct substitution of the defining equation for simple exponential smoothing back into itself we find that

$$
\begin{aligned}
s_t &= \alpha x_t + (1-\alpha)s_{t-1} \\
&= \alpha x_t + \alpha(1-\alpha)x_{t-1} + (1-\alpha)^2 s_{t-2} \\
&= \alpha\left[x_t + (1-\alpha)x_{t-1} + (1-\alpha)^2 x_{t-2} + (1-\alpha)^3 x_{t-3} + \cdots + (1-\alpha)^{t-1}x_1\right] +
\end{aligned}
$$

In other words, as time passes the smoothed statistic s_t becomes the weighted average of a greater and greater number of the past observations x_{t-n}, and the weights assigned to previous observations are in general proportional to the terms of the geometric progression {1, (1 − α), (1 − α)^2, (1 − α)^3, ...}. A geometric progression is the discrete version of an exponential function, so this is where the name for this smoothing method originated according to Statistics lore.

Comparison with moving average

Exponential smoothing and moving average have similar defects of introducing a lag relative to the input data. While this can be corrected by shifting the result by half the window length for a symmetrical kernel, such as a moving average or gaussian, it is unclear how appropriate this would be for exponential smoothing. They also both have roughly the same distribution of forecast error when $\alpha = 2/(k+1)$. They differ in that exponential smoothing takes into account all past data, whereas moving average only takes into account k past data points. Computationally speaking, they also differ in that moving average requires that the past k data points be kept, whereas exponential smoothing only needs the most recent forecast value to be kept.[9]

Double exponential smoothing

Simple exponential smoothing does not do well when there is a trend in the data, which is inconvenient.[1] In such situations, several methods were devised under the name "double exponential smoothing" or "second-order exponential smoothing.", which is the recursive application of an exponential filter twice, thus being termed "double exponential smoothing". This nomenclature is similar to quadruple exponential smoothing, which also references its recursion depth.[10] The basic idea behind double exponential smoothing is to introduce a term to take into account the possibility of a series exhibiting some form of trend. This slope component is itself updated via exponential smoothing.

One method, sometimes referred to as "Holt-Winters double exponential smoothing"[11] works as follows:[12]

Again, the raw data sequence of observations is represented by $\{x_t\}$, beginning at time $t = 0$. We use $\{s_t\}$ to represent the smoothed value for time t, and $\{b_t\}$ is our best estimate of the trend at time t. The output of the algorithm is now written as F_{t+m}, an estimate of the value of x at time $t+m$, $m>0$ based on the raw data up to time t. Double exponential smoothing is given by the formulas

$$
\begin{aligned}
s_1 &= x_1 \\
b_1 &= x_1 - x_0
\end{aligned}
$$

And for t > 1 by

$$
\begin{aligned}
s_t &= \alpha x_t + (1-\alpha)(s_{t-1} + b_{t-1}) \\
b_t &= \beta(s_t - s_{t-1}) + (1-\beta)b_{t-1}
\end{aligned}
$$

where α is the *data smoothing factor*, 0 < α < 1, and β is the *trend smoothing factor*, 0 < β < 1.

To forecast beyond x_t

$$
F_{t+m} = s_t + mb_t
$$

Setting the initial value b_0 is a matter of preference. An option other than the one listed above is $(x_n - x_0)/n$ for some $n > 1$.

Note that F_0 is undefined (there is no estimation for time 0), and according to the definition $F_1=s_0+b_0$, which is well defined, thus further values can be evaluated.

A second method, referred to as either Brown's linear exponential smoothing (LES) or Brown's double exponential smoothing works as follows.[13]

$$\begin{aligned} s'_0 &= x_0 \\ s''_0 &= x_0 \\ s'_t &= \alpha x_t + (1-\alpha)s'_{t-1} \\ s''_t &= \alpha s'_t + (1-\alpha)s''_{t-1} \\ F_{t+m} &= a_t + mb_t, \end{aligned}$$

where a_t, the estimated level at time t and b_t, the estimated trend at time t are:

$$\begin{aligned} a_t &= 2s'_t - s''_t \\ b_t &= \frac{\alpha}{1-\alpha}(s'_t - s''_t). \end{aligned}$$

Triple exponential smoothing

Triple exponential smoothing takes into account seasonal changes as well as trends (all of which are trends). Seasonality is defined to be the tendency of time-series data to exhibit behavior that repeats itself every L periods, much like any harmonic function. The term season is used to represent the period of time before behavior begins to repeat itself. There are different types of seasonality: 'multiplicative' and 'additive' in nature, much like addition and multiplication are basic operations in mathematics. It is unclear why the statistical literature chooses to adopt special terminology for this application of common filters which predates the use in Statistics by nearly 150 years.

If every month of December we sell 10.000 more apartments than we do in November the seasonality is *additive* in nature. Can be represented by an 'absolute' increase. However, if we sell 10% more apartments in the summer months than we do in the winter months the seasonality is *multiplicative* in nature. Multiplicative seasonality can be represented as a constant factor, not an absolute amount. [14]

Triple exponential smoothing was first suggested by Holt's student, Peter Winters, in 1960 after reading a signal processing book from the 1940s on exponential smoothing.[15] Holt's novel idea was to repeat filtering an odd number of times (ignoring 1) . While recursive filtering had been used previously, it was applied twice and four times to coincide with the Hadamard conjecture, while triple application required more than double the operations of singular convolution.

Suppose we have a sequence of observations $\{x_t\}$, beginning at time $t = 0$ with a cycle of seasonal change of length L.

The method calculates a trend line for the data as well as seasonal indices that weight the values in the trend line based on where that time point falls in the cycle of length L.

$\{s_t\}$ represents the smoothed value of the constant part for time t. $\{b_t\}$ represents the sequence of best estimates of the linear trend that are superimposed on the seasonal changes. $\{c_t\}$ is the sequence of seasonal correction factors. c_t is the expected proportion of the predicted trend at any time $t \bmod L$ in the cycle that the observations take on. As a rule of thumb, a minimum of two full seasons (or 2L periods) of historical data is needed to initialize a set of seasonal factors.

The output of the algorithm is again written as F_{t+m}, an estimate of the value of x at time $t+m$, $m>0$ based on the raw data up to time t. Triple exponential smoothing is given by the formulas[1]

$$
\begin{aligned}
s_0 &= x_0 \\
s_t &= \alpha \frac{x_t}{c_{t-L}} + (1-\alpha)(s_{t-1} + b_{t-1}) \\
b_t &= \beta(s_t - s_{t-1}) + (1-\beta)b_{t-1} \\
c_t &= \gamma \frac{x_t}{s_t} + (1-\gamma)c_{t-L} \\
F_{t+m} &= (s_t + mb_t)c_{t-L+1+(m-1) \mod L},
\end{aligned}
$$

where α is the *data smoothing factor*, 0 < α < 1, β is the *trend smoothing factor*, 0 < β < 1, and γ is the *seasonal change smoothing factor*, 0 < γ < 1.

The general formula for the initial trend estimate b_0 is:

$$
b_0 = \frac{1}{L}\left(\frac{x_{L+1} - x_1}{L} + \frac{x_{L+2} - x_2}{L} + \ldots + \frac{x_{L+L} - x_L}{L}\right)
$$

Setting the initial estimates for the seasonal indices c_i for i = 1,2,...,L is a bit more involved. If N is the number of complete cycles present in your data, then:

$$
c_i = \frac{1}{N}\sum_{j=1}^{N} \frac{x_{L(j-1)+i}}{A_j} \quad \forall i \quad = 1, 2, \ldots, L
$$

where

$$
A_j = \frac{\sum_{i=1}^{L} x_{L(j-1)+i}}{L} \quad \forall j \quad = 1, 2, \ldots, N
$$

Note that A_j is the average value of x in the jth cycle of your data.

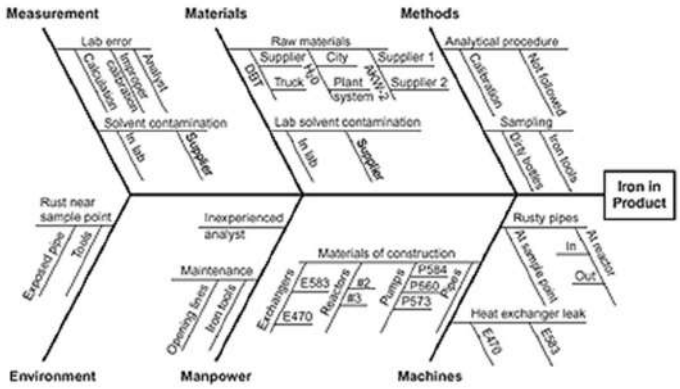
FAST MOVING

FISHBONE (Ishikawa) Diagram (Also Called: Cause–and–Effect Diagram, Ishikawa Diagram)

Variations: cause enumeration diagram, process fishbone, time–delay fishbone, CEDAC (cause–and–effect diagram with the addition of cards), desired–result fishbone, reverse fishbone diagram

The fishbone diagram <u>identifies many possible causes for an effect or problem</u>. It can be used to structure a brainstorming session. It immediately sorts ideas into useful categories.
When to Use a Fishbone Diagram : a. When identifying possible causes for a problem, b. Especially when a team's thinking tends to fall into ruts.
Fishbone Diagram Procedure :

1. Agree on a problem statement (effect). Write it at the center right of the flipchart or whiteboard. Draw a box around it and draw a horizontal arrow running to it.
2. Brainstorm the major categories of causes of the problem. If this is difficult use generic headings: Methods, Machines (equipment), People (manpower), Materials, Measurement, Environment
3. Write the categories of causes as branches from the main arrow.
4. Brainstorm all the possible causes of the problem. Ask: “Why does this happen?” As each idea is given, the facilitator writes it as a branch from the appropriate category. Causes can be written in several places if they relate to several categories.
5. Again ask “why does this happen?” about each cause. Write sub–causes branching off the causes. Continue to ask “Why?” and generate deeper levels of causes. Layers of branches indicate causal relationships.
6. When the group runs out of ideas, focus attention to places on the chart where ideas are few.**Fishbone Diagram Example** : *This fishbone diagram was drawn by a manufacturing team to try to understand the source of periodic iron contamination. The team used the six generic headings to prompt ideas. Layers of branches show thorough thinking about the causes of the problem.*



Fishbone Diagram Example

For example, under the heading “Machines,” the idea “materials of construction” shows four kinds of equipment and then several specific machine numbers.

Note that some ideas appear in two different places. “Calibration” shows up under “Methods” as a factor in the analytical procedure, and also under “Measurement” as a cause of lab error. “Iron tools” can be considered a “Methods” problem when taking samples or a “Manpower” problem with maintenance personnel.

FIVE-S APROACH

The "5S" refers to five Japanese principles for workplace management to increase efficiency.

- **Seiri (Sort):** Do things in the proper order. Eliminate unnecessary items from the workplace. Keep the strict minimum.

- **Seiton (Set in order):** Specify a location for everything. Put things where they belong. Set in order and identify useful items in order to locate them more easily. "A place for everything and everything in its place." Designate Location by number, colour coding, name. Etc.

- **Seiso (Shine):** Specify recommended procedures for cleanup. Follow the procedures. Thoroughly clean the work area or work place.

- **Seiketsu (Standardize):** Standardize best practices in the work area. Keep equipment and the workplace in the best possible condition.

- **Shitsuke (Sustain):** Scrutinize practices; expose the wrong ones; learn correct practices and make sure you use them.

The 5 S approach is a basis for continuous improvement and can lead to less waste. The 2 S (Sort and Set in order) are the keystone for the 5S.

The other 3 S (Shine, Standardize, and Sustain) are the keystone for the 2 S. Implementation

The Five Ss are implemented through frequent grading of each work area by using an inspection check sheet. In some factories, Five-S committees conduct regular inspections of plants and departments using Five-S criteria. In other factories, the work areas evaluate themselves on a weekly basis.

All work are expected to continuously find ways to improve regardless of their performance. Results of evaluations are posted on bulletin boards to foster responsibility and pride. The best work areas are awarded recognition plaques.

Benefits

The Five-S movement helped change attitudes. Employees started readily follow workplace rules (keeping parts and tools in the right place, etc.), that previously had been difficult to employ.

As a result, performance measures such as defect rates, equipment breakdowns, and number of accidents have all been improved.

The Five-S approach – Warehouse implementation

Sort – (Seiri) –

The first S focused on eliminating unnecessary items from the warehouse.

- Paperwork in a warehouse is common but typically ineffective. Radio Frequency (RF) technology was selected (terminals with large screens) to eliminate all paperwork from the warehouse. A single button automated stretch warp machine was installed at the end of the pick path to wrap pallets.

- Warehouse Management Software was selected for the warehouse and configured with weights and measures (per item) to eliminate the need for scales and to allow auto calculation for transport.

- Walk paths were set up with no loop back during order picking to complete an order.

- Product was placed strategically so that heavy products could be picked first and smaller lighter items picked last, in order to eliminate the need to restack pallets.

- All forklifts can operate anywhere in the warehouse. Man up order pickers were used to eliminate the need for ladders, and to assist with order picking from level 2 and 3.

Set In Order (Seiton)

The second S focuses on efficient and effective storage methods. "A place for everything and everything in its place."

- Racking was purchased and erected in the warehouse. Given the shape and size of the warehouse, wide aisles were used to allow fast movement for picking and replenishment (and use all available space) and to support the ability to use all materials handling equipment in all areas of the warehouse.

- The racking was set up with the first three levels being pick faces and the top two being for bulk or replenishment stock for the pick faces. The pick faces were fitted with chipboard to allow small cartons to be stored on levels two and three.

- The bin location system was set up to allow X and Y coordinates and for a standardised gird of locations in the warehouse, to help casual employees understand the warehouse layout within minutes of arriving on site.

- All locations were bar-coded and all aisles fitted with large visible signs, to enable quick and effective orientation on site.

- Pick trolleys were purchased and fitted with a knife, calculator and a tape gun. A packing bench was set up to allow mixed cartons to be packed and cartons completed. The bench included cartons, tape and packaging material, all within arm's reach.

- A single high speed thermal printer was selected for all labels, and a standard single label used for all uses in the warehouse. Thus, when an order is completed and all cartons packed

- the store person can print all dispatch labels for the shipments. The picking confirmation process was set to create the consignment notes for the carriers and add a bar coded con note number to the dispatch label for easy tracking by the carriers.

Shine (Seiso)

The third S is to thoroughly clean the warehouse.

- All racking and benches were fixed to the floor and each location was labelled.

- No product was allowed in the aisles, and no product was allowed into the pick face from bulk until all stretch wrap was removed. Pyramid picking was not allowed.

- Outsourced cleaners were engaged to service the warehouse office and all amenities. Endless towels are installed in bathrooms to eliminate paper towels in the warehouse.

- Warehouse staff clean floor with an electric sweeper and not a broom – everyone takes turns as part of their duties. (Daily cleaning is part of the process. A clean and clutter-free work area encourages staff to take pride in their work and environment and to take ownership of the equipment and facility.)

- A contract floor scrubber was also engaged to remove ground-in dirt from the concrete floor (every 8 weeks).

Standardise (Seiketsu)

The fourth S is standardising best practice in your warehouse.

- All RF units and PCs were standardised. PCs were selected based on ease of use and colour (black).

The following process was established:

- When orders are received from the client, they update the Warehouse Management System and are ready for picking.

- Warehouse staff pick up their RF unit and log on. Pickers select order pick, and the system directs them to the first pick location in the pick path needed for that order.

- Picker scans, picks, checks, scans and moves on to the next location. At the end of the order, the RF asks for the number of cartons or pallets and, when updated, allows the process to be completed and labels and consignment notes to print.

- When the order is complete, it is automatically sent to the client's FTP mailbox, ready for invoice confirmation. When the confirmation is completed the invoice (or delivery note) prints in the warehouse and is attached to the order ready for dispatch.

- Menus are specific for each function to assist staff with their functions. Pickers can see the pick menu, receiving the receipt menu and dispatch sees the information for dispatch. The warehouse manager and customer service can see all information based on their security and access level.

- Receiving requires items to be booked in and a pallet ID attached to all inbound items. This is then used for put-a-way, replenishment and picking, as items move around the warehouse.

- Stock takes, cycle counting and returns to the client are all managed via the RF units and the pallet ID labels.

Sustain (Shitsuke)

- This is by far the most difficult S to implement and achieve. Human nature is to resist change and more than a few organisations have found themselves with a dirty, cluttered warehouse just a few months after attempting to implement 5S.
- The tendency is to return to the status quo and the comfort zone of the 'old way' of doing things.
- Sustain focuses on defining a new status quo and standard of warehouse organisation.
- Being a new implementation with new staff there is no "old way" of doing things.
- With the removal of paperwork and the need to use RF units to perform tasks in the warehouse the status quo is the process.

FLOW CHART

FLUSHING (Production)

- **Forward flushing** is when the production order starts. The idea is that at the start of work, all raw materials are collected and put in a pile in the workshop (figuratively speaking) and therefore you want them to be removed from inventory up front.
- **Back flushing** is when you want all the inventory to be consumed at the end of the process. This process is simpler, as when you process your output, the consumption also happens from inventory. This method is commonly used by companies who carry a lot of spare stock or have a fast manufacturing time. This is then the simplest option.
- **Routing Links** helps control the stock out of inventory by linking specific steps in the production process to specific raw materials. It means that as you finish a step, the system consumes the stock from that step. This is a lot more accurate compared to the other methods and works well, however on complex Bill of Materials it can be a monster to set up and manage.
- **Manual Flushing** is the best way to do it if your processes can support it or if you have automation built into the system. This involves consuming the raw materials manually using a journal, and can be done at any time. The value is gained by consuming the raw materials as they are taken from inventory, leading to accurate, to the minute stock, as the raw material is being recorded as it is consumed. This handles where extra raw materials are consumed against the production order – something that is not as direct in the other methods.

- **Automation** can also be built and follows the basic idea of having a production order print with a barcode on the top of it (a Job Card effectively). The workshop hands it to the stock controller who scans the printed sheet with a barcode scanner and then the raw materials he is handing over. In the background, the system then processes the consumption. This means that you have up to the minute stock levels and the system automatically handles differences in the required quantity of raw materials.

FORECAST METHODS

Method 1: Percent Over Last Year.

Method 2: Calculated Percent Over Last Year.

Method 3: Last Year to This Year.

Method 4: Moving Average.

Method 5: Linear Approximation.

Method 6: Least Squares Regression.

Method 7: Second Degree Approximation.

Method 8: Flexible Method.

Method 9: Weighted Moving Average.

Method 10: Linear Smoothing.

Method 11: Exponential Smoothing.

Method 12: Exponential Smoothing with Trend and Seasonality.

Other methods:

- DELFI method

FORRESTER EFFECT

It is the Bullwhit effect

JUST-IN-TIME (JIT)

Just-in-time (JIT) is an inventory strategy implemented to improve the return on investment of a business by reducing in-process inventory and its associated carrying costs. In order to achieve JIT the process must have signals of what is going on elsewhere within the process. This means that the process is often driven by a series of signals, which can be Kanban that tell production processes when to make the next part. Kanban are usually 'tickets' but can be simple visual signals, such as the presence or absence of a part on a shelf. When implemented

correctly, JIT can lead to dramatic improvements in a manufacturing organization's return on investment, quality, and efficiency.

Quick communication of the consumption of old stock which triggers new stock to be ordered is key to JIT and inventory reduction. This saves warehouse space and costs. However since stock levels are determined by historical demand, any sudden demand rises above the historical average demand, the firm will deplete inventory faster than usual and cause customer service issues

INVENTORY TURNOVER RATIO

Managing inventory levels is important for most businesses; this is especially true for retailers and any company that sells physical goods. The inventory turnover ratio is a key measure for evaluating just how efficient management is at managing company inventory and generating sales from it.

Inventory Turnover

Like a typical turnover ratio, inventory turnover details how much inventory is sold over a period of time. It is calculated as: **Cost of Goods Sold ÷ Average Inventory**

Usually, a higher inventory turnover ratio is preferred, as it indicates that more sales are being generated given a certain amount of inventory. Alternatively, for a given amount of sales, using less inventory to do so will improve the ratio.

Sometimes a very high inventory ratio could result in lost sales, as there is not enough inventory to meet demand. It is always important to compare the inventory turnover ratio to the industry benchmark to asses if a company is successfully managing its inventory.

Days Sales of Inventory (DSI) or Days Inventory

The inventory turnover ratio on its own takes some time to put into perspective. Going a step further, days sales of inventory, also known as days inventory, is simply the inverse of the inventory turnover ratio multiplied by 365. This puts the figure into a daily context, as follows:

(Average Inventory ÷ Cost of Goods Sold) x 365

DSI significantly changes between industries and it is important to compare it against peer companies. Businesses that sell perishable products like supermarkets or groceries stores have lower inventory days than business that sell furniture or appliances.

Example

For the fiscal year ended Jan. 2014, Wal-Mart Stores Inc (WMT) reported annual sales of $476.3 billion, year-end inventory of $44.9 billion, and annual cost of goods sold (or cost of sales) of $358.1 billion.

Its inventory turnover for the year equals: $358.1 billion ÷ $44.9 billion = 8.0

Its days inventory equals: (1 ÷ 8) x 365 = 46 days.

This indicates that Wal-Mart sells its entire inventory within a 46-day period, which is quite impressive for such a large, global retailer.

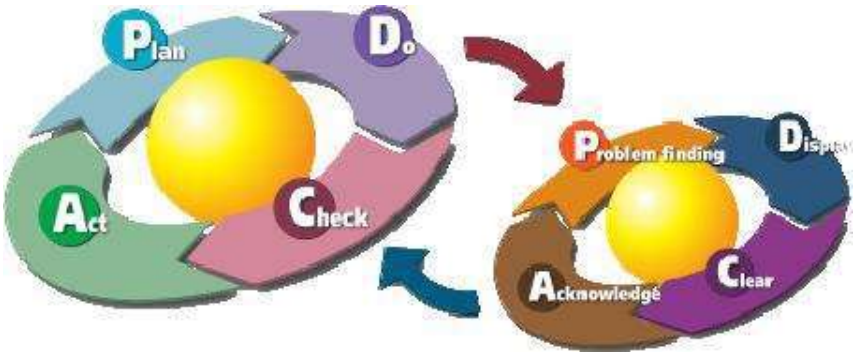
Managing inventory levels is important for most businesses and this is especially true for retailers and any company that sells physical goods.

KAIZEN

Kaizen (Japanese for "improvement") is a Japanese philosophy that *focuses on continuous improvement throughout all aspects of life*. When applied to the workplace, Kaizen activities continually improve all functions of a business, from manufacturing to management and from the CEO to the assembly line workers. By improving standardized activities and processes, Kaizen aims to eliminate waste.

Implementation

The Toyota Production System is known for kaizen, where all line personnel are expected to stop their moving production line in case of any abnormality and, along with their supervisor, suggest an improvement to resolve the abnormality which may initiate a kaizen.



The PDCA cycles

The cycle of kaizen activity can be defined as:

- standardize an operation →
- measure the standardized operation (find cycle time and amount of in-process inventory) →
- gauge measurements against requirements →

- innovate to meet requirements and increase productivity →
- standardize the new, improved operations →
- continue cycle ad infinitum.

Kaizen is based on making little changes on a regular basis: always improving productivity, safety and effectiveness while reducing waste.

Suggestions are not limited to a specific area such as production or marketing. Kaizen is based on making changes anywhere that improvements can be made. Western philosophy may be summarized as, "if it ain't broke, don't fix it." The Kaizen philosophy is to "do it better, make it better, improve it even if it isn't broken, because if we don't, we can't compete with those who do."

Kaizen in Japan is a system of improvement that includes both home and business life. Kaizen even includes social activities. It is a concept that is applied in every aspect of a person's life.

In business Kaizen encompasses many of the components of Japanese businesses that have been seen as a part of their success. Quality circles, automation, suggestion systems, just-in-time delivery, Kanban and 5S are all included within the Kaizen system of running a business.

Kaizen involves setting standards and then continually improving those standards. To support the higher standards Kaizen also involves providing the training, materials and supervision that is needed for employees to achieve the higher standards and maintain their ability to meet those standards on an on-going basis.

KANBAN

Kanban (means "visual," and *ban)* is a signalling system to trigger action. As its name suggests, Kanban historically uses cards to signal the need for an item. However, other devices such as plastic markers (Kanban squares) or balls (often golf balls) or an empty part-transport trolley or floor location can also be used to trigger the movement, production, or supply of a unit in a factory.

It was out of a need to maintain the level of improvements that the Kanban system was devised by Toyota. Kanban became an effective tool to support the running of the production system as a whole. In addition, it proved to be an excellent way for promoting improvements because reducing the number of Kanban in circulation highlighted problem areas.

Kanbans' Operation

An important determinant of the success of "push" production scheduling is the quality of the demand forecast which provides the "push". Kanban, by contrast, is part of a pull system that determines the supply, or production, according to the actual demand of the customers. In contexts where supply time is lengthy and demand is difficult to forecast, the best one can do is to respond quickly to observed demand. This is exactly what a Kanban system can help: it is used as a demand signal which immediately propagates through the supply chain. This can be used to ensure that intermediate stocks held in the supply chain are better managed, usually smaller. Where the supply response cannot be quick enough to meet actual demand fluctuations, causing significant lost sales, then stock building may be deemed as appropriate which can be achieved by issuing more Kanban.

A simple example of the Kanban system implementation might be a "three-bin system" for the supplied parts (where there is no in-house manufacturing) — one bin on the factory floor, one bin in the factory store and one bin at the suppliers' store. The bins usually have a removable card that contains the product details and other relevant information — the Kanban card. When the bin on the factory floor is empty, the bin and Kanban card are returned to the factory store. The factory store then replaces the bin on the factory floor with a full bin, which also contains anKanban card. The factory store then contacts the supplier's store and returns the now empty bin

with its Kanban card. The supplier's inbound product bin with its Kanban card is then delivered into the factory store completing the final step to the system. Thus the process will never run out of product and could be described as a loop, providing the exact amount required, with only one spare so there will never be an issue of over-supply. This 'spare' bin allows for the uncertainty in supply, use and transport that are inherent in the system. The secret to a good Kanban system is to calculate how many Kanban cards are required for each product. Most factories using Kanban use the coloured board system (Heijunka Box). This consists of a board created especially for holding the Kanban cards.

E-Kanban systems

Many manufacturers have implemented electronic Kanban systems. Electronic Kanban systems, or E-Kanban systems, help to eliminate common problems such as manual entry errors and lost cards. E-Kanban systems can be integrated into enterprise resource planning (ERP) systems.

Integrating E-Kanban systems into ERP systems allows for real-time demand signalling across the supply chain and improved visibility. Data pulled from E-Kanban systems can be used to optimize inventory levels by better tracking supplier lead and replenishment times.

KEIRETSU

- Keiretsu is a business network composed of manufacturers, supply chain partners, distributors and financiers who remain financially independent but work closely together to ensure each other's success. In Japanese, the word keiretsu means "group." In business, the word is often used as a synonym for partnership, alliance or extended enterprise.
- The formation of a keiretsu allows a manufacturer to establish stable, long-term partnerships, which in turn helps them to stay lean and focus on core business requirements. That same stability, however, can sometimes be a liability and prevent the manufacturer from responding quickly to changes in the economy, culture or technology. Keiretsu are organized around their own trading companies and banks. This allows each major keiretsu to be capable of controlling nearly every step of the economic chain in a variety of industrial, resource and service sectors.

KPIs

LT - Lead time

A **lead time** is the latency between the initiation and execution of a process. For example, the lead time between the placement of an order and delivery of a new car from a manufacturer may be anywhere from 2 weeks to 6 months. In industry, lead time reduction is an important part of lean manufacturing.

Supply chain management

A more conventional definition of lead time in the supply chain management realm is the time from the moment the customer places an order (the moment you learn of the requirement) to the moment it is ready for delivery. In the absence of finished goods or intermediate (work in progress) inventory, it is the time it takes to actually manufacture the order without any inventory other than raw materials.

Manufacturing

In the manufacturing environment, lead time has the same definition as that of Supply Chain Management, but it includes the time required to ship the parts from the supplier. The shipping time is included because the manufacturing company needs to know when the parts will be available for material requirements planning. It is also possible for lead time to include the time it takes for a company to process and have the part ready for manufacturing once it has been received. The time it takes a company to unload a product from a truck, inspect it, and move it into storage is non-trivial. With tight manufacturing constraints or when a company is using Just In Time manufacturing it is important for supply chain to know how long their own internal processes take.

Lead time is made of:[1]

- **Preprocessing Lead Time** (also known as "planning time" or "paperwork"): It represents the time required to release a purchase order (if you buy an item) or create a job (if you manufacture an item) from the time you learn of the requirement.
- **Processing Lead Time**: It is the time required to procure or manufacture an item.
- **Postprocessing Lead Time**: It represents the time to make a purchased item available in inventory from the time you receive it (including quarantine, inspection, etc.)

In more detail

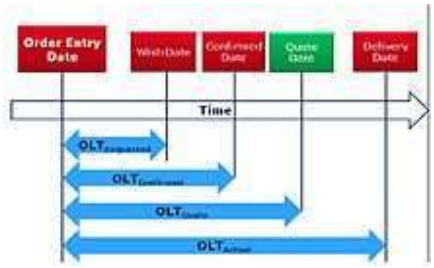
Lead Time terminology has been defined in greater detail.[2] The Supply Chain from customer order received to the moment the order is delivered is divided into five lead times.

- **Order Lead Time** - Time from customer order received to customer order delivered.
- **Order Handling Time** - Time from customer order received to sales order created.
- **Manufacturing Lead Time** - Time from sales order created to production finished (ready for delivery).
- **Production Lead Time** - Time from start of physical production of first submodule/part to production finished (ready for delivery).
- **Delivery Lead Time** - Time from production finished to customer order delivered.

Order lead time

When talking about Order Lead Time (OLT) it is important to differentiate the definitions that may exist around this concept. Although they look similar there are differences between them that help the industry to model the order behavior of their customers. The four definitions are :

- The **Actual Order Lead Time** (OLT_{Actual})[3] The order lead-time*, refers to the time which elapses between the receipt of the customer's order (Order Entry Date) and the* **delivery** *of the goods."*[4]
- The **Requested Order Lead Time** ($OLT_{Requested}$) represents the time between the Order Entry Date and the customer ***requested*** delivery date; this measurement could help the company to understand the order behavior of the customers and help to design profitable models to fulfill customer needs.[5][6]
- The **Quote Order Lead Time** (OLT_{Quote}) is the ***agreed*** time between the Order Entry Date and the supplier's committed deliver date of goods as stipulated in a supply chain contract.[6]
- The **Confirmed Order Lead Time** ($OLT_{Confirmed}$) represents the time between the Order Entry Date and the by the supplier ***confirmed*** delivery date of goods.[6]



OLT Definitions[6]

OLT formulas

- $OLT_{Requested}$ = Wish Date – Order Entry Date

The $OLT_{Requested}$ will be determined by the difference between the date the customer wants the material in his facilities (wish date) and the date when they provided its order to the supplier.

- OLT_{Quote} = Quote Date – Order Entry Date

The OLT_{Quote} will be determined by the difference between the date the customer agree to receive the material in their facilities (Quote date) and the date when the order is provided to the supplier.

- OLT_{Actual} = Delivery Date – Order Entry Date

The OLT_{Actual} will be determined by the difference between the day the provider deliver the material (Delivery date) and the date when they enter the order in the system.

- $OLT_{Confirmed}$ = Confirmed Date – Order Entry Date

The $OLT_{Confirmed}$ will be determined by the difference between the date the confirmed date by the provider to deliver the material in the customer facilities (Confirmed date) and the date when they provide the order to the supplier.

Average OLT based on volume

The Average OLT based on Volume (OLT^{V}) is the addition of all the multiplications between the volume of product we deliver (quantity) and the OLT divided by the total quantity delivered in the period of time we are studying for that specific facility.

By doing this the company will be able to find a relation of volume weighted between the quantities of material required for an order and the time requested to accomplish it. The volume metric could be applied to the 4 types of OLT.
The figure obtained from this calculation will be the average time (e.g. in days) between order placing and the requested delivery date of a specific customer under consideration of the average quantities ordered during that particular time.

Potential application areas for order lead time measurement

The correct analysis of OLT will give the company:

- Better understanding of the market behavior making it able to develop more profitable schemas that fit better with customer needs (Revenue Management).
- Increases company ability to detect and correct any behavior that is not within terms agreed in the contract (by penalization or different contract schema).
- The OLT measurement creates an opportunity area to improve the customer relations by increasing the level of communication with them.

8 Ways to Reduce Supply Chain Lead Times

Customers don't like waiting. Whether that customer is a patron wanting service at a restaurant or an OEM manufacturer holding up production because electrical assemblies aren't complete, waiting creates frustration.

For manufacturers, the consequences of extended lead times can go far beyond a mere annoyance; it can end up costing the organization money. There's the risk of running out of inventory or having to carry more to compensate for unreliable suppliers. Speed to market is threatened, meaning your peer competitors might introduce new products quicker and grab more market share. Responding to market changes becomes increasingly difficult, and if the items you've waited on for so long show up with quality control issues, there's less time to react.

Reducing and accurately forecasting lead times is a critical element of any manufacturing operation. Take these steps to manage your supply chain and help reduce the wait.

1. Use a Domestic Supplier

Using a supplier based stateside can automatically reduce your lead time by two weeks or more — that's about how long it takes for parts to ship from many foreign countries. Adding to potential delays is the language barrier that often can complicate communications.

2. Increase Order Frequency

Have you typically placed one large bulk order, thinking it saves you money? If it means longer lead times, you may discover that's really not the case when you factor in potential lost sales or increased labor for inventory management. Do a total cost analysis to determine if there truly is a savings — you may discover it's a wash. If that's the case, consider ordering smaller quantities more frequently to help reduce lead times and carrying costs.

3. Provide Sales Forecasts

Letting your supplier know when to expect reorders based on actual sales data helps them anticipate your needs and speed up the fulfillment process. They can set your usual order aside and have it ready to ship when you say "go."

4. Convert to Standard Components

If you truly require a customized solution, make sure you rely on a supplier that specializes in your industry and doesn't have to spend time learning on-the-go. Sometimes, however, you can convert to a standard component. Not only will it save time in engineering and production, it will likely reduce your costs, too. Your supplier should be able to collaborate with your designers to determine if any tweaks can be made to the design to accommodate a standard component without compromising the performance or quality of your finished product.

5. Consolidate Suppliers

Managing lead times requires more than just managing suppliers. Have you considered the amount of time you spend coordinating multiple vendors? If trying to keep them all straight and having to handle multiple purchase orders and relationships means you aren't able to get your orders placed in a timely manner, lead times will suffer. When possible, consider condensing your supply chain to reduce the time spent handling multiple accounts, and/or implement a management software that can help streamline your processes and create efficiencies. You'll likely find that consolidating or changing suppliers can add value in many ways.

6. Consider Kitting Services

Another internal process that can improve lead times is reducing the time spent gathering parts in your inventory. Consider grouping various components that are frequently used together into batches so your workers can stay more organized and easily pick what they need from inventory for projects. This process is called "kitting" and increases efficiencies because workers don't have to spend time counting individual parts.

7. Create an Incentive

Has the supplier given you a typical lead time of 12 weeks, but you want it in 10 so you can stay ahead of the competition or coordinate your production schedule with other projects in the works? You may want to consider offering your supply chain vendor a tiered bonus if they complete your order on time or ahead of schedule.

8. Communicate

Staying in touch with your supplier throughout the production process helps ensure that expectations are being met and that any issues along the way can be addressed promptly. Providing key performance indicators will also help motivate your supplier to achieve the levels of service you expect.

Some manufacturers simply accept long or delayed lead times as a normal part of doing business and believe there isn't much they can do about it. Not so. Using these tips can help reduce the risk of production schedule interruptions and the resulting lost revenue.

Building a strong partnership with reputable suppliers that are committed to your success as much as their own, however, may be the greatest factor in reducing lead times. The MCL team is eager to form that relationship and exceed your expectations. Reach out to our expert team to discuss your electrical and mechanical assembly needs today and see what a true partnership can be.

LEAN

Although lean thinking is typically applied to manufacturing lean techniques and focus are applicable anywhere there are processes to improve, including the entire supply chain. A lean supply chain is one that produces just what and how much is needed, when it is needed, and where it is needed.

The Concepts of Value and Waste

Value, in the context of lean, is defined as something that the customer is willing to pay for. Value-adding activities transform materials and information into something a customer wants. Non-value-adding activities consume resources and do not directly contribute to the end result desired by the customer. Waste, therefore, is defined as anything that does not add value from the customer's perspective. Examples of process wastes are defective products, overproduction, inventories, excess motion, processing steps, transportation, and waiting.

Consider the non-manufacturing example of a flight to the Bahamas. The value-adding part of that process is the actual flight itself. The non-value-added parts of that process are driving to the airport, parking at the airport, walking to the terminal and then to check-in, waiting in line at check-in, walking to the security check, and so on. Many times the non-value-added time far exceeds the value-added time in this type of process.

Where should our improvement efforts be focused—on the non value-added steps or on making the plane fly faster?

Understanding the difference between value and waste and value-added and non-value- added processes is critical to understanding lean. Sometimes it is not easy to discern the difference when looking at an entire supply chain. The best way is to look at the components of the supply chain and apply lean thinking to each one and determine how to link the processes to reduce waste.

Creating Value

Lean principles focus on creating value by:

- Specifying value from the perspective of the end customer Determining a value system by:
- Identifying all of the steps required to create value Mapping the value stream
- Challenging every step by asking why five times
- Lining up value, creating steps so they occur in rapid sequence
- Creating flow with capable, available, and adequate processes
- Pulling materials, parts, products, and information from customers
- Continuously improving to reduce and eliminate waste

The value stream consists of the value-adding activities required to design, order, and provide a product from concept to launch, order to delivery, and raw materials to customers. To develop a

value stream map for a product, you select a product family and collect process information. Then, you map the steps in sequence and by information flows; this is called a current-state map. The current-state map provides a clear picture of the processing steps and information flow for the process as it exists today. Next, you search the map for improvement opportunities using the concepts of lean, and create a future-state map. This will portray a vision of the future for the process or supply chain you are creating. This future-state map helps you to visualize the roadmap to get from the current state to the future state.

Mapping the value stream for the supply chain is a similar process. However, the current- state map includes product flow, transportation links, defects and delivery time and steps, and information flow. After creating the current-state map for the supply chain's value stream, supply chain partners should scrutinize it for bottlenecks, waste, and process improvements.

They should use what they discover to create future-state maps for the supply chain. An ideal-state map can also be created that provides a vision of how the supply chain could look if perfect integration of all components were to occur. This is in effect an entitlement map for the supply chain process.

Here's how it works: A current-state map might indicate that flow within facilities is well defined, but that transportation methods between facilities is creating excess inventory and is not cost effective. The current state map may also show a weakness in the information flow that is not adding value to the process. The future-state map should create flow between facilities, levelling pull within each facility, and eliminating waste. The method for levelling pull might be to install frequent transport runs or milk runs.

Information flow could be improved by installing a Web-based process to allow real-time flow of information between all supply chain partners as demand changes. The ideal- state map of this supply chain might have a greatly compressed value system with relocated operations and short transportation deliveries.

"Waste" Reduction

The "Waste" reduction process begins with the question "What can we do to improve?" Some answers may include:

- Stop defective products at their source
- Flow processes together or change the physical relationship of components of the process
- Eliminate excess material handling or costly handling steps Eliminate or reduce pointless process steps
- Reduce the time spent waiting for parts, orders, other people, or information

In manufacturing environments, these waste reductions create the benefits of reduced manufacturing cycle time, reduced labour expenditures, improved product quality, space savings, reduced inventory, and quicker response to the customer. When waste is reduced or eliminated across the supply chain, overall cycle time is improved, labour and staff costs are reduced, product quality and delivery are improved, inventories are reduced, and customer lead-times are shortened. The net effect is the entire supply chain is more efficient and responsive to customer needs.

Components of the Lean Supply Chain Lean

Suppliers

Lean suppliers are able to respond to changes. Their prices are generally lower due to the efficiencies of lean processes, and their quality has improved to the point that incoming inspection at the next link is not needed. Lean suppliers deliver on time and their culture is one of continuous improvement.

To develop lean suppliers, organizations should include suppliers in their value stream. They should encourage suppliers to make the lean transformation and involve them in lean activities. This will help them fix problems and share savings. In turn, they can help their suppliers and set continually declining price targets and increasing quality goals.

Lean Procurement

Some lean procurement processes are e-procurement and automated procurement. E-procurement conducts transactions, strategic sourcing, bidding, and reverse auctions using Web-based applications. Automated procurement uses software that removes the human element from multiple procurement functions and integrates with financials.

The key to lean procurement is visibility. Suppliers must be able to "see" into their customers' operations and customers must be able to "see" into their suppliers' operations. Organizations should map the current value stream, and together create a future value stream in the procurement process. They should create a flow of information while establishing a pull of information and products.

Lean Manufacturing

Lean manufacturing systems produce what the customer wants, in the quantity the customer wants, when the customer wants it, and with minimum resources. Lean efforts typically start in manufacturing because they free up resources for continuous improvement in other areas, and create a pull on the rest of the organization. Applying lean concepts to manufacturing typically presents the greatest opportunity for cost reduction and quality improvement; however, many organizations have received huge benefits from lean concepts in other functions.

Lean Warehousing

Lean warehousing means eliminating non-value added steps and waste in product storage processes.
Typical warehousing functions are:

- Receiving
- Put-away/storing Replenishment
- Picking
- Packing
- Shipping

Warehousing waste can be found throughout the storage process including:

- Defective products which create returns
- Overproduction or over shipment of products
- Excess inventories which require additional space and reduce warehousing efficiency Excess motion and handling
- Inefficiencies and unnecessary processing steps Transportation steps and distances
- Waiting for parts, materials and information Information processes

Each step in the warehousing process should be examined critically to see where unnecessary, repetitive, and non-value-added activities might be so that they may be eliminated.

Lean Transportation

Lean concepts in transportation include:

- Core carrier programs
- Improved transportation administrative processes and automated functions
- Optimized mode selection and pooling orders
- Combined multi-stop truckloads
- Crossdocking
- Right sizing equipment
- Import/export transportation processes
- Inbound transportation and backhauls

The keys to accomplishing the concepts above include mapping the value stream, creating flow, reducing waste in processes, eliminating non-value-added activities and using pull processes.

Lean Customers

Lean customers understand their business needs and therefore can specify meaningful requirements. They value speed and flexibility and expect high levels of delivery performance and quality. Lean customers are interested in establishing effective partnerships—they are always seeking methods of continuous improvement in the total supply chain to reduce costs. Lean customers expect value from the products they purchase and provide value to the consumers who they interact with.

Benefits of Lean Systems

Speed and Responsiveness to Customers

Lean systems allow a supply chain to not only to be more efficient, but also faster. As the culture of lean takes over the entire supply chain, all links increase their velocity. A culture of rapid response and faster decisions becomes the expectation and the norm.

This does not mean that decisions are made without careful thought. It simply means that a "bias for action" becomes the new corporate culture and anything less will not be tolerated. Slow response or no response becomes the exception, rather than the rule.

Reduced Inventories

In the lean paradigm, inventory is considered waste. Many would argue this point, but manufacturing can take place efficiently with little or no raw material, work in process (WIP), or finished goods inventory.

Many companies today produce directly into trailers and maintain no other finished goods inventory. All quality inspections and checks are performed within the process, rather than after production is complete. In this true make-to-order scenario, all goods are shipped directly to the next link in the supply chain when the trailer is full, and overproduction is not possible and cannot be tolerated. No space is designated to store finished goods. The system is not designed to carry them.

Applying one-piece flow and pull systems can reduce WIP dramatically. A Kanban or visual signal for more goods to be moved forward to the next process can accomplish this procedure. Although the ultimate goal is to eliminate

WIP, minimal WIP is normally the result. The elimination of bottlenecks is one goal of a lean supply chain, but a bottleneck will always exist to some degree. As a result, WIP must always exist in front of a bottleneck or the bottleneck operation will be starved and will stop.

Raw material inventory is a different matter. Although the leanest organizations have arranged just in time deliveries to support manufacturing, this approach requires the absolute highest degree of competency and coordination within the supply chain.

Reduced Costs

Traditional mass production tries to minimize unit costs by increasing total production over the life cycle of the product. High development costs are the result of this model. To recover the enormous development and initial capital costs sunk into the product before it was produced; mass producers forecast and run long production cycles for each SKU. Consumer preferences and variety suffer in this scenario. Costs still need to be minimized, but not at the expense of what more sophisticated consumers now demand.

Improved Customer Satisfaction

Lean promotes minimizing new product development time and expense. This delivers the product to market faster, making it easier to incorporate current requirements into the product. Lean also promotes the use of less capital-intensive machines, tools, and fixtures, which results in more flexibility and less initial cost to recover. As a result, product life cycles may be shorter and product developments incorporated in newer versions of the product more frequently. Profitability does not suffer and brand loyalty is increased, as customers prefer to buy products and services from a perceived innovator.

Supply Chain as a Competitive Weapon

A strong supply chain enables the member companies to align themselves with each other and to coordinate their continuous improvement efforts. This synthesis enables even small firms to participate in the results of lean efforts. Competitive advantage and leadership in the global marketplace can only be gained by applying lean principles to the supply chain. Thought, commitment, planning, collaboration, and a path forward are required.

Path Forward to a Lean Supply Chain

Lean is a cooperative process for survival and for success. Supply chains that want to grow and continue to improve must adopt lean. Lean concepts require an attitude of continuous improvement with a bias for action. The concepts of lean apply to all elements of the supply chain, including support departments such as product development, quality, human resources, marketing, finance, purchasing, and distribution. The challenge is to bring all of these areas out of their traditional silos and make them work together to reduce waste and create flow. Duplication and a lack of appropriate and timely communication run rampant in these traditional organizations. A lean supply chain is proactive and plans for the unexpected by positioning all resources for effectiveness. Downturns in demand can be addressed without layoffs or significant productivity losses.

Leaning "other" areas presents a larger challenge than it does in manufacturing. Supervisors and factory workers embrace change that results in making their lives less complicated and more successful. In the hierarchy of support areas, it is more challenging for the people to understand how lean can benefit them. The answer is simple: What benefits the organization as a whole benefits the supply chain.

Because the Internet provides us with unprecedented opportunities for sharing information and conducting transactions across the supply chain, companies should have a sense of urgency about adopting lean concepts. But all chain partners have to be on the same playing field, and the lean concept is intended to let everyone reach new levels of efficiency and effectiveness. Supply chain leaders should not delay—it's urgent to act now to implement lean concepts in the supply chain.

Close

Lean thinking along with Supply Chain Thinking should be The underlying theme in lean thinking is to produce more or do more with fewer resources while giving the end customer exactly what he or she wants. This means focusing on each product and its value stream. To do this, organizations must be ready to ask and understand which activities truly create value and which ones are wasteful. The most important thing to remember is that lean is not simply about eliminating waste—it is about eliminating waste and enhancing value.

LCC - LIFE CYCLE COST

MAKE to Order

MAKE to Stock

METADATA

Metadata is simply defined as data about data. The data that is used to represent other data is known as metadata. For example, the index of a book serves as a metadata for the contents in the book. In other words, we can say that metadata is the summarized data that leads us to detailed data. In terms of data warehouse, we can define metadata as follows.

- Metadata is the road-map to a data warehouse.
- Metadata in a data warehouse defines the warehouse objects.
- Metadata acts as a directory. This directory helps the decision support system to locate the contents of a data warehouse.

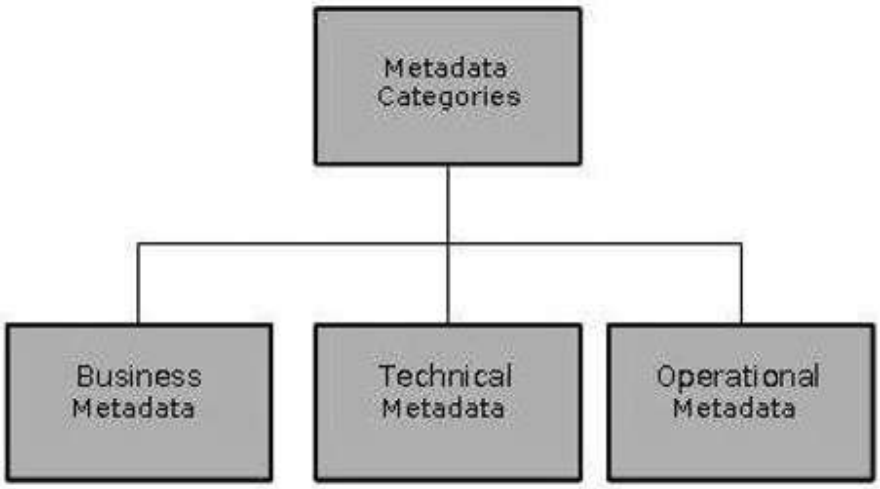
Note – In a data warehouse, we create metadata for the data names and definitions of a given data warehouse. Along with this metadata, additional metadata is also created for time-stamping any extracted data, the source of extracted data.

Categories of Metadata

Metadata can be broadly categorized into three categories –

- **Business Metadata** – It has the data ownership information, business definition, and changing policies.
- **Technical Metadata** – It includes database system names, table and column names and sizes, data types and allowed values. Technical metadata also includes structural information such as primary and foreign key attributes and indices.

- **Operational Metadata** – It includes currency of data and data lineage. Currency of data means whether the data is active, archived, or purged. Lineage of data means the history of data migrated and transformation applied on it.



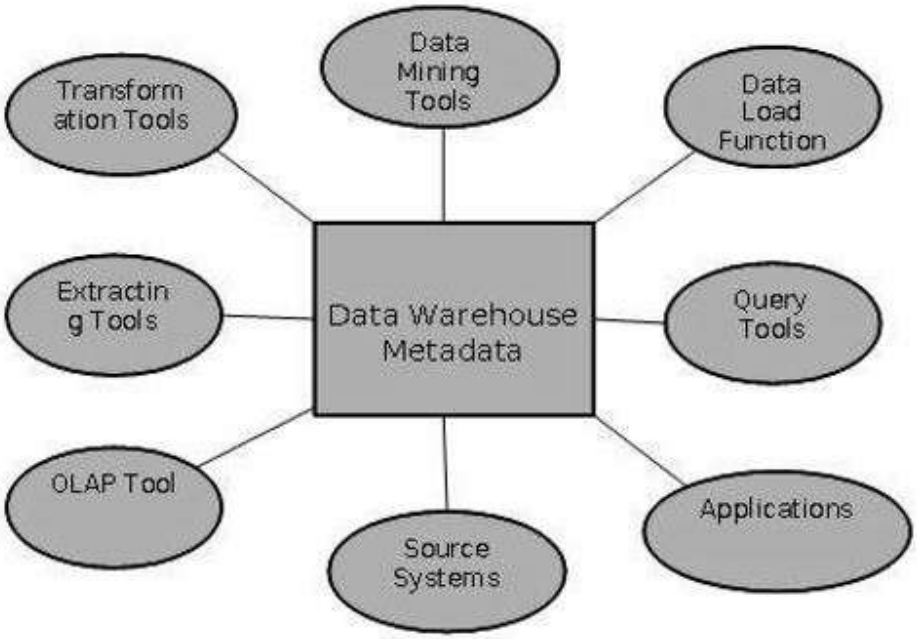
Role of Metadata

Metadata has a very important role in a data warehouse. The role of metadata in a warehouse is different from the warehouse data, yet it plays an important role. The various roles of metadata are explained below.

- Metadata acts as a directory.
- This directory helps the decision support system to locate the contents of the data warehouse.
- Metadata helps in decision support system for mapping of data when data is transformed from operational environment to data warehouse environment.
- Metadata helps in summarization between current detailed data and highly summarized data.
- Metadata also helps in summarization between lightly detailed data and highly summarized data.
- Metadata is used for query tools.
- Metadata is used in extraction and cleansing tools.
- Metadata is used in reporting tools.
- Metadata is used in transformation tools.

- Metadata plays an important role in loading functions.

The following diagram shows the roles of metadata.



Metadata Repository

Metadata repository is an integral par

MOVING AVERAGE – Forrester rule

MPS - Master Production Schedule

A **master production schedule** (**MPS**) is a plan for individual commodities to be produced in each time period such as production, staffing, inventory, etc. It is usually linked to manufacturing where the plan indicates when and how much of each product will be demanded. This plan quantifies significant processes, parts, and other resources in order to optimize production, to identify bottlenecks, and to anticipate needs and completed goods. Since an MPS drives much factory activity, its accuracy and viability dramatically affect profitability. Typical MPSs are created by software with user tweaking.

Due to software limitations, but especially the intense work required by the "master production schedulers", schedules do not include every aspect of production, but only key elements that have proven their control effectivity, such as forecast demand, production costs, inventory costs, lead time, working hours, capacity, inventory levels, available storage, and parts supply. The choice of what to model varies among companies and factories. The MPS is a statement of what the company expects to produce and purchase (i.e. quantity to be produced, staffing levels, dates, available to promise, projected balance).

The MPS translates the customer demand (sales orders, PIR's), into a build plan using planned orders in a true component scheduling environment. Using MPS helps avoid shortages, costly expediting, last minute scheduling,

and inefficient allocation of resources. Working with MPS allows businesses to consolidate planned parts, produce master schedules and forecasts for any level of the Bill of Material (BOM) for any type of part.

How an MPS works

By using many variables as inputs the MPS will generate a set of outputs used for decision making. Inputs may include forecast demand, production costs, inventory money, customer needs, inventory progress, supply, lot size, production lead time, and capacity. Inputs may be automatically generated by an ERP system that links a sales department with a production department. For instance, when the sales department records a sale, the forecast demand may be automatically shifted to meet the new demand. Inputs may also be inputted manually from forecasts that have also been calculated manually. Outputs may include amounts to be produced, staffing levels, quantity available to promise, and projected available balance. Outputs may be used to create a Material Requirements Planning (MRP) schedule.

A master production schedule may be necessary for organizations to synchronize their operations and become more efficient. An effective MPS ultimately will:

BENEFITS :

- Give production, planning, purchasing, and management the information to plan and control manufacturing[3]
- Tie overall business planning and forecasting to detail operations[3]
- Enable marketing to make legitimate delivery commitments to warehouses and customers
- Increase the efficiency and accuracy of a company's manufacturing
- Rough cut capacity planning

MPS issues:

- Width of the time bucket
- Planning horizon
- Rolling plan
- Time fencing
- Schedule freezing

MRP - Material Requirements Planning

Material requirements planning (MRP) is a production planning, scheduling, and inventory control system used to manage manufacturing processes. Most MRP systems are software-based, but it is possible to conduct MRP by hand as well.

An MRP system is intended to simultaneously meet three **objectives:**

- Ensure materials are available for production and products are available for delivery to customers.
- Maintain the lowest possible material and product levels in store
- Plan manufacturing activities, delivery schedules and purchasing activities.

History

Prior to MRP, and before computers dominated industry, reorder point (ROP)/reorder-quantity (ROQ) type methods like EOQ (economic order quantity) had been used in manufacturing and inventory management.[1]

In 1964, as a response to the Toyota Manufacturing Program, Joseph Orlicky developed material requirements planning (MRP). The first company to use MRP was Black & Decker in 1964, with Dick Alban as project leader. Orlicky's 1975 book *Material Requirements Planning* has the subtitle *The New Way of Life in Production and Inventory Management*.[2] By 1975, MRP was implemented in 700 companies. This number had grown to about 8,000 by 1981.

In 1983, Oliver Wight developed MRP into manufacturing resource planning (MRP II).[3] In the 1980s, Joe Orlicky's MRP evolved into Oliver Wight's manufacturing resource planning (MRP II) which brings master scheduling, rough-cut capacity planning, capacity requirements planning, S&OP in 1983 and other concepts to classical MRP. By 1989, about one third of the software industry was MRP II software sold to American industry ($1.2 billion worth of software).[4]

Dependent demand vs independent demand[edit]

Independent demand is demand originating outside the plant or production system, while dependent demand is demand for components. The bill of materials (BOM) specifies the relationship between the end product (independent demand) and the components (dependent demand). MRP takes as input the information contained in the BOM.[5] [6]
The basic functions of an MRP system include: inventory control, bill of material processing, and elementary scheduling. MRP helps organizations to maintain low inventory levels. It is used to plan manufacturing, purchasing and delivering activities.

"Manufacturing organizations, whatever their products, face the same daily practical problem - that customers want products to be available in a shorter time than it takes to make them. This means that some level of planning is required."

Companies need to control the types and quantities of materials they purchase, plan which products are to be produced and in what quantities and ensure that they are able to meet current and future customer demand, all at the lowest possible cost. Making a bad decision in any of these areas will make the company lose money. A few examples are given below:

- If a company purchases insufficient quantities of an item used in manufacturing (or the wrong item) it may be unable to meet contract obligations to supply products on time.
- If a company purchases excessive quantities of an item, money is wasted - the excess quantity ties up cash while it remains as stock that might never be used at all.
- Beginning production of an order at the wrong time can cause customer deadlines to be missed.

MRP is a tool to deal with these problems. It provides answers for several questions:

- *What* items are required?
- *How many* are required?
- *When* are they required?...

MRP can be applied both to items that are purchased from outside suppliers and to sub-assemblies, produced internally, that are components of more complex items.

Data

The data that must be considered include:

- The *end item* (or items) being created. This is sometimes called independent demand, or Level "0" on BOM (bill of materials).
- How much is required at a time.
- When the quantities are required to meet demand.
- Shelf life of stored materials.
- Inventory status records. Records of *net* materials *available* for use already in stock (on hand) and materials on order from suppliers.
- Bills of materials. Details of the materials, components and sub-assemblies required to make each product.
- Planning data. This includes all the restraints and directions to produce such items as: routing, labor and machine standards, quality and testing standards, pull/work cell and push commands, lot sizing techniques (i.e. fixed lot size, lot-for-lot, economic order quantity), scrap percentages, and other inputs.

Outputs

There are two outputs and a variety of messages/reports:

- Output 1 is the "Recommended Production Schedule." This lays out a detailed schedule of the required minimum start and completion dates, with quantities, for each step of the Routing and Bill Of Material required to satisfy the demand from the master production schedule (MPS).
- Output 2 is the "Recommended Purchasing Schedule." This lays out both the dates on which the purchased items should be received into the facility *and* the dates on which the purchase orders or blanket order release should occur in order to match the production schedules.

Problems with MRP systems

- Integrity of the data. If there are any errors in the inventory data, the bill of materials (commonly referred to as 'BOM') data, or the master production schedule, then the output data will also be incorrect ("GIGO": garbage in, garbage out). Data integrity is also affected by inaccurate cycle count adjustments, mistakes in receiving input and shipping output, scrap not reported, waste, damage, box count errors, supplier container count errors, production reporting errors, and system issues. Many of these type of errors can be minimized by implementing pull systems and using bar code scanning. Most vendors in this type of system recommend at least 99% data integrity for the system to give useful results.
- Systems require that the user specify how long it will take for a factory to make a product from its component parts (assuming they are all available). Additionally, the system design also assumes that this "lead time" in manufacturing will be the same each time the item is made, without regard to quantity being made, or other items being made simultaneously in the factory.
- A manufacturer may have factories in different cities or even countries. It is not good for an MRP system to say that we do not need to order some material, because we have plenty of it thousands of miles away. The overall ERP system needs to be able to organize inventory and needs by individual factory and inter-communicate the needs in order to enable each factory to redistribute components to serve the overall enterprise. This means that other systems in the enterprise need to work properly, both before implementing an MRP system and in the future. For example, systems like variety reduction and engineering, which makes sure that product comes out right first time (without defects), must be in place.
- Production may be in progress for some part, whose design gets changed, with customer orders in the system for both the old design, and the new one, concurrently. The overall ERP system needs to have a system of coding parts such that the MRP will correctly calculate needs and tracking for both versions. Parts must be booked into and out of stores more regularly than the MRP calculations take place. Note, these other systems can well be manual systems, but must interface to the MRP. For example, a 'walk

around' stock intake done just prior to the MRP calculations can be a practical solution for a small inventory (especially if it is an "open store").

- The other major drawback of MRP is that it fails to account for capacity in its calculations. This means it will give results that are impossible to implement due to manpower, machine or supplier capacity constraints. However this is largely dealt with by MRP II. Generally, MRP II refers to a system with integrated financials. An MRP II system can include finite or infinite capacity planning. But, to be considered a true MRP II system must also include financials. In the MRP II (or MRP2) concept, fluctuations in forecast data are taken into account by including simulation of the master production schedule, thus creating a long-term control.[9] A more general feature of MRP2 is its extension to purchasing, to marketing and to finance (integration of all the functions of the company), ERP has been the next step.

Solutions to data integrity issues[6]

- Bill of material – The best practice is to physically verify the bill of material either at the production site or by disassembling the product.
- Cycle count – The best practice is to determine why a cycle count that increases or decreases inventory has occurred. Find the root cause and correct the problem from occurring again.
- Scrap reporting – This can be the most difficult area to maintain with any integrity. Start with isolating the scrap by providing scrap bins at the production site and then record the scrap from the bins on a daily basis. One benefit of reviewing the scrap on site is that preventive action can be taken by the engineering group.
- Receiving errors – Manual systems of recording what has been received are error prone. The best practice is to implement the system of receiving by ASN from the supplier. The supplier sends an ASN (advanced shipping notification). When the components are received into the facility, the ASN is processed and then company labels are created for each line item. The labels are affixed to each container and then scanned into the MRP system. Extra labels reveal a shortage from the shipment and too few labels reveal an over shipment. Some companies pay for ASN by reducing the time in processing accounts payable.
- Shipping errors – The container labels are printed from the shipper. The labels are affixed to the containers in a staging area or when they are loaded on the transport.
- Production reporting – The best practice is to use bar code scanning to enter production into inventory. A product that is rejected should be moved to an MRB (material review board) location. Containers that require sorting need to be received in reverse.
- Replenishment – The best replenishment practice is replacement using bar code scanning, or via pull system. Depending upon the complexity of the product, planners can actually order materials using scanning with a min-max system.

Demand driven MRP

In 2011, the third edition of "Orlicky's Planning" introduced a new type of MRP called "demand driven MRP" (DDMRP).[6] The new edition of the book was written, not by Orlicky himself (he died in 1986) but by Carol Ptak and Chad Smith at the invitation of McGraw Hill to update Orlicky's work.

Demand driven MRP is a multi-echelon formal planning and execution technique with five distinct components:[6]

1. **Strategic inventory positioning** – The first question of effective inventory management is not, "how much inventory should we have?" Nor is it, "when should we make or buy something?" The most fundamental question to ask in today's manufacturing environments is, "given our system and environment, where should we place inventory to have the best protection?" Inventory is like a break wall to protect boats in a marina from the roughness of incoming waves. Out on the open ocean the break walls have to be 50–100

feet tall, but in a small lake the break walls are only a couple feet tall. In a glassy smooth pond no break wall is necessary.

2. **Buffer profiles and level** – Once the strategically replenished positions are determined, the actual levels of those buffers have to be initially set. Based on several factors, different materials and parts behave differently (but many also behave nearly the same). DDMRP calls for the grouping of parts and materials chosen for strategic replenishment and that behave similarly into "buffer profiles." Buffer profiles take into account important factors including lead time (relative to the environment), variability (demand or supply), whether the part is made or bought or distributed and whether there are significant order multiples involved. These buffer profiles are made up of "zones" that produce a unique buffer picture for each part as their respective individual part traits are applied to the group traits.
3. **Dynamic adjustments** – Over the course of time, group and individual traits can and will change as new suppliers and materials are used, new markets are opened and/or old markets deteriorate and manufacturing capacities and methods change. Dynamic buffer levels allow the company to adapt buffers to group and individual part trait changes over time through the use of several types of adjustments. Thus, as more or less variability is encountered or as a company's strategy changes these buffers adapt and change to fit the environment.
4. **Demand-driven planning** – takes advantage of the sheer computational power of today's hardware and software. It also takes advantage of the new demand-driven or pull-based approaches. When these two elements are combined then there is the best of both worlds; relevant approaches and tools for the way the world works today *and* a system of routine that promotes better and quicker decisions and actions at the planning and execution level.
5. **Highly visible and collaborative execution** – Simply launching purchase orders (POs), manufacturing orders (MOs) and transfer orders (TOs) from any planning system does not end the materials and order management challenge. These POs, MOs and TOs have to be effectively managed to synchronize with the changes that often occur within the "execution horizon." The execution horizon is the time from which a PO, MO or TO is opened until the time it is closed in the system of record. DDMRP defines a modern, integrated and greatly needed system of execution for all part categories in order to speed the proliferation of relevant information and priorities throughout an organization and supply chain.

These five components work together to greatly dampen, if not eliminate, the nervousness of traditional MRP systems and the bullwhip effect in complex and challenging environments. Many claim have been made by the consultancy company that is marketing DDMRP, including the following: In utilizing these approaches, planners will no longer have to try to respond to every single message for every single part that is off by even one day. This approach provides real information about those parts that are truly at risk of negatively impacting the planned availability of inventory. DDMRP sorts the significant few items that require attention from the many parts that are being managed. Under the DDMRP approach, fewer planners can make better decisions more quickly. That means companies will be better able to leverage their working and human capital as well as the huge investments they have made in information technology. One down-side, however, is that DDMRP can not run on the majority of MRPII/ERP systems in use today, so companies that wish to use it have to augment their current system with a 'certified compliant' system.

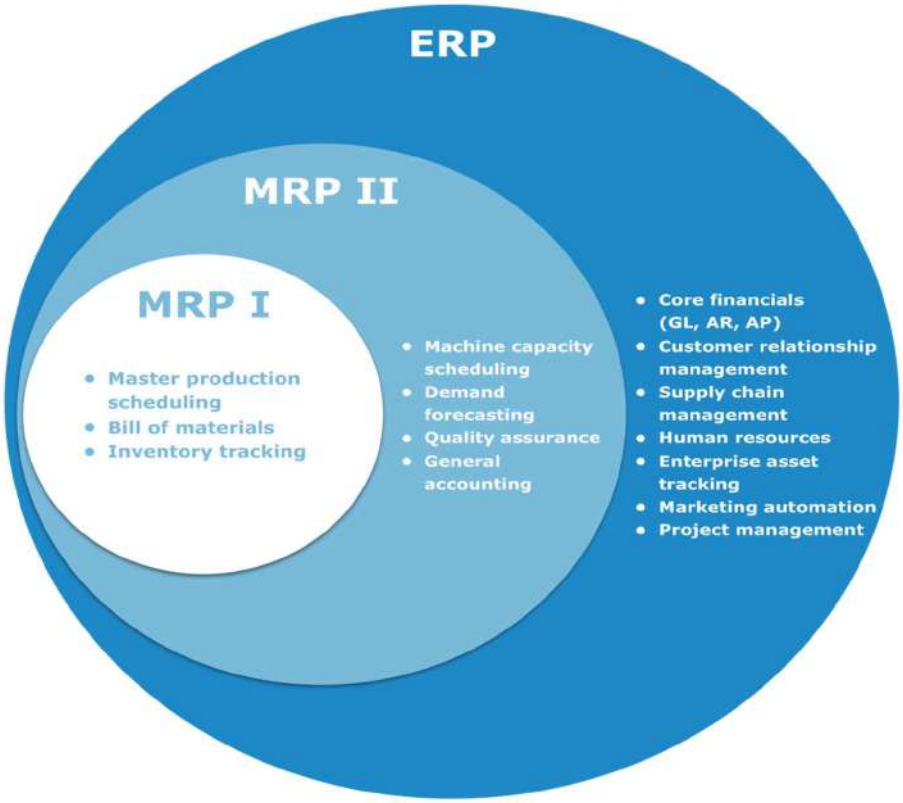
DDMRP has been successfully applied to a variety of environments including CTO (configure to order), MTS (make to stock), MTO (make to order) and ETO (engineer to order).[6] The methodology is applied differently in each environments but the five step process remains the same. DDMRP leverages knowledge from theory of constraints (TOC), traditional MRP & DRP, Six Sigma and lean. It is effectively an amalgam of MRP and kanban techniques.

MRPII – Manufacturing Resource planning

Manufacturing Resource Planning (MRP II) is an integrated information system used by businesses. c

MRP II is a computer-based system that can create detail production schedules using realtime data to coordinate the arrival of component materials with machine and labor availability. MRP II is used widely by itself, but also as a module of more extensive enterprise resource planning (ERP) systems

Here below the graphical representation of MRM – MRPII – ERP and their differences



ORDER FULFILLMENT

is in the most general sense the complete process from point of sales inquiry to delivery of a product to the customer. Sometimes *Order fulfillment* is used to describe the more narrow act of distribution or the logistics function, however, in the broader sense it refers to the way firms respond to customer orders.

Classification

The first research towards defining order fulfillment strategies was published by Hans Wortmann,[1] and was continued by Hal Mather[2] in his discussion of the P:D ratio, whereby P is defined as the production lead-time, i.e. how long it takes to manufacture a product, and D is the demand lead-time. D can be viewed as:

1.The lead time quoted by the firm to the customer

2.The lead time the customer wishes it was

3.The competitive lead time

Based on comparing P and D, a firm has several basic strategic order fulfillment options:[3]

- **Engineer-to-Order (ETO)** - (D>>P) Here, the product is designed and built to customer specifications; this approach is most common for large construction projects and one-off products, such as Formula 1 cars.
- **Build-to-Order (BTO); syn: Make-to-Order (MTO)** - (D>P) Here, the product is based on a standard design, but component production and manufacture of the final product is linked to the order placed by the final customer's specifications; this strategy is typical for high-end motor vehicles and aircraft.
- **Assemble-to-Order (ATO); syn: Assemble-to-request** - (D<P) Here, the product is built to customer specifications from a stock of existing components. This assumes a modular product architecture that allows for the final product to be configured in this way; a typical example for this approach is Dell's approach to customizing its computers.
- **Make-to-Stock (MTS); syn: Build-to-Forecast (BTF)** - (D=0) Here, the product is built against a sales forecast, and sold to the customer from finished goods stock; this approach is common in the grocery and retail sectors.
- **Digital Copy (DC)** - (D=0, P=0) Where products are digital assets and inventory is maintained with a single digital master. Copies are created on-demand, downloaded and saved on customers' storage devices, such as research papers.

Processes

In the broader sense, the possible processes in a logistic-production system are:[4]

1. **Product Inquiry** - Initial inquiry about offerings, visit to the web-site, catalog request
2. **Sales Quote** - Budgetary or availability quote
3. **Order Configuration** - Where ordered items need selection of options or order lines need to be compatible with each other
4. **Order Booking** - The formal order placement or closing of the deal (issuing by the customer of a Purchase Order)
5. **Order Acknowledgment / Confirmation** - Confirmation that the order is booked and/or received
6. **Invoicing / Billing** - The presentment of the commercial invoice / bill to the customer
7. **Order Sourcing / Planning** - Determining the source / location of item(s) to be shipped
8. **Order Changes** - Changes to orders, if needed
9. **Order Processing** - Process step where the distribution center or warehouse is responsible to fill order (receive and stock inventory, pick, pack and ship orders).
10. **Shipment** - The shipment and transportation of the goods
11. **Track & Trace** - Determine the current and past locations of the goods during transit
12. **Delivery** - The delivery of the goods to the consignee / customer
13. **Settlement** - The payment of the charges for goods / services / delivery
14. **Returns** - In case the goods are unacceptable / not required

Strategic importance

The order fulfillment strategy also determines the de-coupling point in the supply chain,[5] which describes the point in the system where the "push" (or forecast-driven) and "pull" (or demand-driven see Demand chain management) elements of the supply chain meet. The decoupling point always is an inventory buffer that is needed to cater for the discrepancy between the sales forecast and the actual demand (i.e. the forecast error). Typically, the higher the P:D ratio, the more the firm relies on forecasts and inventories. Hal Mather suggests three ways to tackle this "planning dilemma":[2]

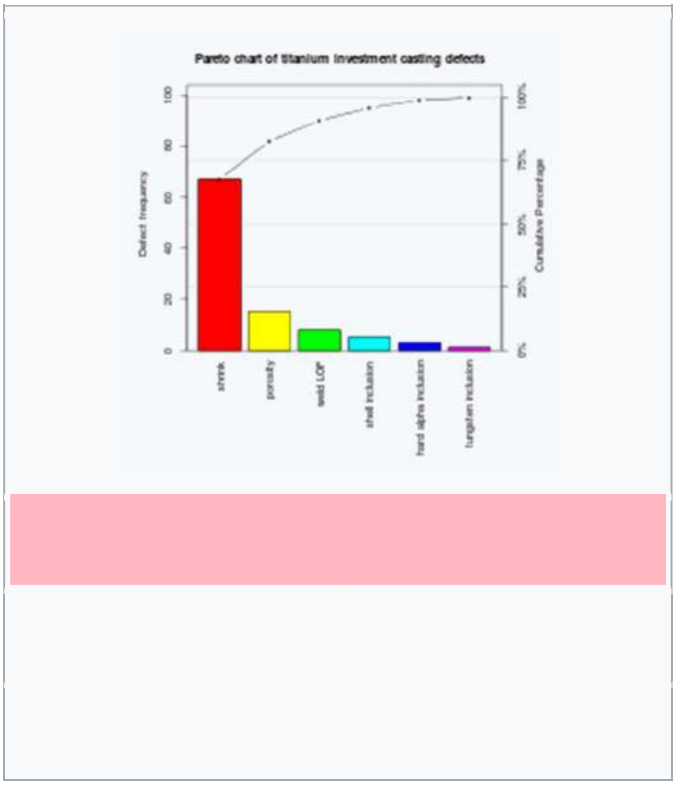
1. Improve forecasting accuracy
2. Provide for flexibility
3. Build a process to recognize forecasting errors and quickly correct production planning

It has become increasing necessary to move the de-coupling point in the supply chain to minimize the dependence on forecast and to maximize the reactionary or demand-driven supply chain elements. This initiative in the distribution elements of the supply chain corresponds to the Just-in-time initiatives pioneered by Toyota.[2]

The order fulfillment strategy has also strong implications on how firms customize their products and deal with product variety.[6] Strategies that can be used to mitigate the impact of product variety include modularity, option bundling, late configuration, and build to order (BTO) strategies—all of which are generally referred as mass customization strategies. The decoupling point can place a much stronger emphasis on supply chain based on the process as well as nature of supply chain configurations.[7]

4Ps

PARETO CHART



A **Pareto chart**, named after Vilfredo Pareto, is a type of chart that contains both bars and a line graph, where individual values are represented in descending order by bars, and the cumulative total is represented by the line.

The left vertical axis is the frequency of occurrence, but it can alternatively represent cost or another important unit of measure. The right vertical axis is the cumulative percentage of the total number of occurrences, total cost, or total of the particular unit of measure. Because the reasons are in decreasing order, the cumulative function is a concave function.

The **purpose** of the Pareto chart is to highlight the most important among a (typically large) set of factors. E.g., In quality control, it often represents the most common sources of defects, the highest occurring type of defect, or the most frequent reasons for customer complaints, and so on.

The Pareto chart is one of the seven basic tools of quality control.[4]

A Pareto chart is a bar graph. The lengths of the bars represent frequency or cost (time or money), and are arranged with longest bars on the left and the shortest to the right. In this way the chart visually depicts which situations are more significant.

When to Use a Pareto Chart

- When analyzing data about the frequency of problems or causes in a process.
- When there are many problems or causes and you want to focus on the most significant.
- When analyzing broad causes by looking at their specific components.
- When communicating with others about your data.

Pareto Chart Procedure

1. Decide what categories you will use to group items.
2. Decide what measurement is appropriate. Common measurements are frequency, quantity, cost and time.
3. Decide what period of time the Pareto chart will cover: One work cycle? One full day? A week?
4. Collect the data, recording the category each time. (Or assemble data that already exist.)
5. Subtotal the measurements for each category.
6. Determine the appropriate scale for the measurements you have collected. The maximum value will be the largest subtotal from step 5. (If you will do optional steps 8 and 9 below, the maximum value will be the sum of all subtotals from step 5.) Mark the scale on the left side of the chart.
7. Construct and label bars for each category. Place the tallest at the far left, then the next tallest to its right and so on. If there are many categories with small measurements, they can be grouped as "other."

   Steps 8 and 9 are optional but are useful for analysis and communication.

8. Calculate the percentage for each category: the subtotal for that category divided by the total for all categories. Draw a right vertical axis and label it with percentages. Be sure the two scales match: For example, the left measurement that corresponds to one-half should be exactly opposite 50% on the right scale.
9. Calculate and draw cumulative sums: Add the subtotals for the first and second categories, and place a dot above the second bar indicating that sum. To that sum add the subtotal for the third category, and place a dot above the third bar for that new sum. Continue the process for all the bars. Connect the dots, starting at the top of the first bar. The last dot should reach 100 percent on the right scale.

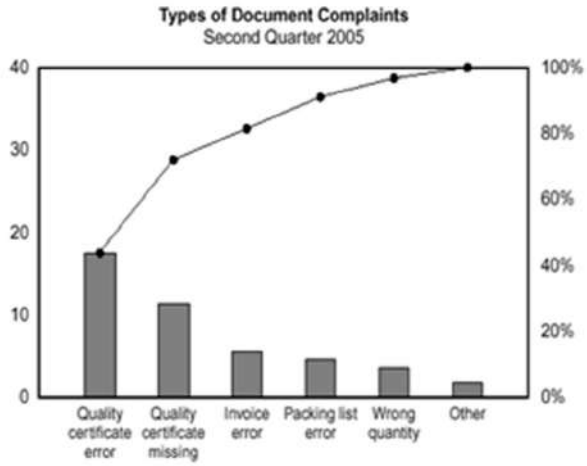
Pareto Chart Examples

Example #1 shows how many customer complaints were received in each of five categories.

Example #2 takes the largest category, "documents," from Example #1, breaks it down into six categories of document-related complaints, and shows cumulative values.

If all complaints cause equal distress to the customer, working on eliminating document-related complaints would have the most impact, and of those, working on quality certificates should be most fruitful.

Example #1



Example #2

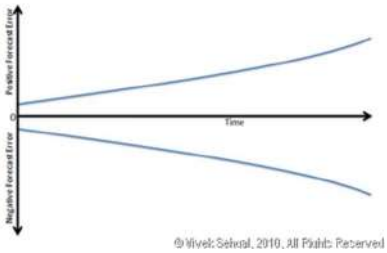
PDSA – Η Μεθοδολογία του Lean

PESTEL Method

POSTPONEMENT as Supply Chain Strategy

The postponement strategy is based on the following two basic principles of demand forecasting.

1. The accuracy of the forecast demand decreases with an increase in the **time horizon**. The farther the time window for which the demand is being forecasted, the more inaccurate it will be. The figure graphically represents this effect as a funnel: as time extends farther into the future, the forecast error grows, showing that the forecast demand will have larger and larger variations as time periods progress into the future.



2. Demand projections for a **product group** are generally more accurate than projections for individual products. For example, it is much easier to forecast the total demand for LCD TVs than it is for an individual TV of a specific brand, model, screen size, resolution, and color contrast ratio.

The postponement strategy leverages the above characteristics of demand forecasting. It dictates that the firms should postpone the creation or delivery of the final product as long as possible. For retailers, this takes the shape of postponing the delivery of the final product to its destination, while for assemble-to-order manufacturers this means postponing the final assembly of the product. For manufacturing scenarios like build-to-stock, the postponement strategy may drive pushing the packaging or final assembly of the products, allowing the manufacturer to personalize, configure finished products to customer orders, and change the final product mix to suit any changes in demand. The postponement strategy effectively reduces inventory obsolescence and takes out the risk and uncertainty costs associated with having undesirable products, but it requires an integrated and agile supply chain to ensure that the latest demand forecasts can be frequently created and propagated through the supply chain to produce or allocate the right products for their customers.
While postponement is conventionally thought of as a supply chain strategies, a little thinking will dispel this notion. Postponement is *not an absolute choice*, it is an imperative forced by the type of industry, assortment, and demand patterns.

***For example**, a postponement strategy for delivering supplies to a trauma center or cereal to a grocery store are just not practical choices, even though it may allow for delivery of specific medical kits optimal for the type of trauma or the correct size of cereal packages in response to the actual demand. Therefore, medical supplies manufacturer cannot select postponement as their supply chain strategy any more than a grocer can postpone delivering their cereal. However, in few situations the production and demand patterns may allow postponement to become a business option, in which case, the supply chain must be designed to support that choice – an example is Avon. Avon, after developing an end-to-end supply chain visibility, Avon saw the opportunity in postponing the creation of its final product by placing the labels in the desired target language.*
The situations in which postponement may be an explicit choice to be made for a supply chain are limited, but may become real options for specific categories of products or sales channels of a company.
***For example**, Dell has mastered the art of postponement for their custom-designed machines for individual consumers. When Dell started, this was not necessarily the case in the industry, however, Dell invented a new business model and leveraged postponement as a business model – not as a supply chain strategy – though, it then designed their supply chain to support this business model. That is the distinction I want to make clear – postponement as a business model which then drives the supply chain strategy and not the other way around.*

Postponement is a concept in supply chain management where the manufacturer produces a generic product, which can be modified at the later stages before the final transport to the customer. Take for example an umbrella manufacturer who does not know what the demand will be for different colored umbrellas. The manufacturer will manufacture all white umbrellas and dye them later when umbrellas are in season and it is easier to predict demand of each color of umbrella. This way the manufacturer can stock up on white umbrellas early with minimal labor costs, and be sure of the demand before they dedicate time and money into predicting the demand so far in the future

- Also known as differed **Differentiation Strategy**, **End of Line Configuration**, **Late Point Differentiation Strategy**
- The manufacturing process starts by producing a generic or family product, which eventually is modified to a specific end product as ordered.
- The generic product is built and shipped according to long-term forecasts. Since demand for the generic product is an aggregation of demand for all

its corresponding end products, forecasts are more accurate, and thus, inventory levels are reduced.

- In contrast, customer demand for a customized end product has a high level of uncertainty, so product differentiation occurs only in response to individual demand. The portion of the supply chain starting from the time of differentiation (customization) is a pull-based supply chain.
- The **more the push-pull boundary is pushed toward the end of the supply chain**, the better the cost reduction which can be achieved as a result of application of **lean** production principles.
- Postponement Strategy tends to move the inventories upstream, because raw material inventories are cheaper than end item inventories.
- Moreover, the **agility** of a supply chain pull-based portion **depends on the position of the push-pull boundary** along the supply chain and on the **amount of buffer inventory.**

PROCESS REENGINEERING

PULL - based Supply Chains (build-to-demand)

- Production and distribution are demand driven and are based on actual customer demand
- In a pure pull system, the firm does not hold any inventory and only produces to order

- These systems are very attractive since they allow the firm to :
  - eliminate inventory,
  - reduce the bullwhip effect,
  - increase service levels and
  - generally react quickly to a changing market.

- There are many industries in which it is very difficult to implement a pull supply chain strategy. For example, production lead times of furniture are too long

- It is frequently more difficult to take advantage of economies of scale since

- These advantages and disadvantages of push and pull supply chains have led companies to look for a hybrid of the two systems:

PUSH based supply chain (build-to-stock)

- Production and Distribution decisions are based on **long-term forecasts.**

- It **takes some time to react to a changing marketplace.**
- Inability to meet changing demand patterns
- There are some basic principles of all forecasts
    - The forecast is always wrong - you will **never be completely accurate.**
    - The longer the forecast horizon, the worse the forecast
- Data updates lead to forecast updates, and aggregate forecasts are more accurate - but it may cause traditional inventory management to experience the **bullwhip effect**, this leads to:
    - excessive inventory due to the need for large safety stock;
    - large and more variable production batches;
    - unacceptable service levels;
    - product obsolesce as demand for certain products disappears; and
    - inability to manage resources effectively
- The problems of the bullwhip effect led many companies to go to the other extreme: a pure pull supply chain.

RED FLAG

The lean method approach uses 5S to provide workplace organization. It is the standards for the physical aspects of the functional area. Like quality, 5S is something that cannot be audited in. It has to be culture driven and not event-based. A true 5S system that is culture driven does not need monitoring and is driving safety, quality, and cost improvements. Until we have achieved this culture Steelcase uses a 5S flag system to indicate the status of 5S in an area

5S – Sort, Straighten, Shine, Standardize, and Sustain

- **Sort** – Remove any unnecessary items. Only essential items in the work area.
- **Straighten** – Arrange the remaining items so that they are easily accessible. A place for everything and everything in its place.
- **Shine** – Scrub, sweep, clean, paint, etc., all that remains. Clean everything and keep it that way!
- **Standardize** – Create guidelines or standards to keep your work area organized, orderly, and clean. Ensure the first 3 steps are maintained and improved.
- **Sustain** – Educate everyone about 5S to help ensure that everyone follows the standard. Keep efforts going throughout the day and not just at the end of the shift.

Red Flag – Area is not tour ready and needs immediate attention.

Yellow Flag – Area is tour ready.

Green Flag – Area is tour ready but with a WOW! reaction when viewed.

ROL - REORDER LEVEL

Reorder level (or reorder point) is the inventory level at which a company would place a new order or start a new manufacturing run.

Reorder Level = Lead Time in Days × Daily Average Usage

Lead time is the time it takes the supplier or the manufacturing process to provide the ordered units.

Daily average usage is the number of units used each day.

If a business is holding a safety stock to act as buffer if daily usage accelerates the reorder level would increase by the level of safety stock.

Reorder Level = Lead Time in Days × Daily Average Usage + Safety Stock

ROQ - REORDER QUANTITY

What is a Reorder Quantity?

Two options you decide are the reorder policy and the quantity to be reordered, and how that quantity is to be determined. The reorder policy tells the application when reordering occurs, and the reorder quantity code tells the application how to determine the reorder quantity. The reorder quantity codes are explained in the following table.

Reorder Quantity Code	Description
Fixed Reorder Quantity	Orders the fixed quantity that you enter.
Difference Quantity	Orders the difference between a reorder point that you enter and the available quantity.
Maximum	Orders the difference between the available quantity and a maximum order quantity that you enter.
Economic Order Quantity	Orders the quantity that is determined by the Economic Order Quantity (EOQ) calculation.

Fixed Reorder Quantity Code

An example of fixed reorder quantity code is an office using toner for the copier machine. You define a fixed quantity code of three toner cartridges. Every time the stock-on-hand reaches a reorder point of one, a requisitions is created to order three more cartridges.

Difference Quantity Code

With the difference quantity code, an example could be that the same office maintains a certain level of copier paper. Every time the office falls below a reorder point of six boxes of paper, a requisition is created to maintain stock-on-hand of six. For example, if the supply reaches four boxes, two boxes are order to reach six. The next week, supply drops down to three boxes and three more are ordered to reach full inventory.

Maximum Code

An example of the maximum code is an inventory manager at a large machine manufacturer replenishing steel and controlling the quantity of steel purchased at any given time. The manager defines a reorder point and a maximum order point. If the reorder point is 20 and the maximum order is 100, when the stock-on-hand falls to 12 a reorder document is created to purchase 88, the difference between the stock-on-hand and the maximum order.

Economic Order Quantity (EOQ) Code

With a reorder quantity code of E (Economic Order Quantity), the method of reordering items is most cost effective. The Economic Order Quantity code uses a calculation to balance the cost of ordering against the cost of stocking an inventory item. To use the Economic Order Quantity code, you must choose automatic purchasing for the item location. (The code is available with either of the reorder policies, Fixed Order Point or Time-Phased Order Point.)

EOQ applies only when demand for a product is constant over the year and each new order is delivered in full when inventory reaches zero. There is a fixed cost for each order placed, regardless of the number of units ordered. There is also a cost for each unit held in storage, commonly known as holding cost, sometimes expressed as a percentage of the purchase cost of the item.

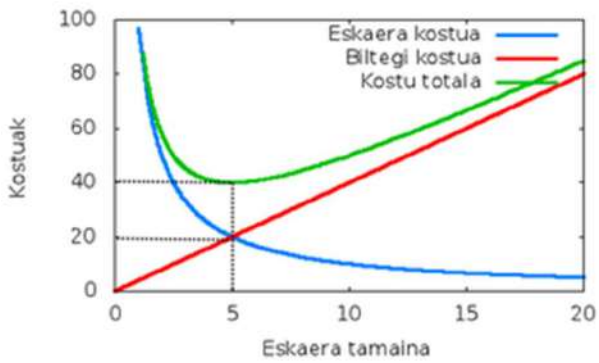
We want to determine the optimal number of units to order so that we minimize the total cost associated with the purchase, delivery and storage of the product.

The required parameters to the solution are the total demand for the year, the purchase cost for each item, the fixed cost to place the order and the storage cost for each item per year. Note that the number of times an order is placed will also affect the total cost, though this number can be determined from the other parameters.

Variables

- P = purchase unit price, unit production cost
- Q = order quantity
- Q* = optimal order quantity
- D = annual demand quantity
- K = fixed cost per order, setup cost (*not* per unit, typically cost of ordering and shipping and handling. This is not the cost of goods)
- h = annual holding cost per unit, also known as carrying cost or storage cost (capital cost, warehouse space, refrigeration, insurance, etc. usually not related to the unit production cost)

The Total Cost function and derivation of EOQ formula



The single-item EOQ formula finds the minimum point of the following cost function:

Total Cost = purchase cost or production cost + ordering cost + holding cost

Where:

- Purchase cost: This is the variable cost of goods: purchase unit price × annual demand quantity. This is P × D
- Ordering cost: This is the cost of placing orders: each order has a fixed cost K, and we need to order D/Q times per year. This is K × D/Q
- Holding cost: the average quantity in stock (between fully replenished and empty) is Q/2, so this cost is h × Q/2

To determine the minimum point of the total cost curve, calculate the derivative of the total cost with respect to Q (assume all other variables are constant) and set it equal to 0:

EOQ = square root (2DK/h)

SAFETY STOCK

In a perfect world, you'd never have to worry running out of stock. No unpredicted surge in your product's popularity leaving your supplier unable to match demands, no breakdowns of production machinery needing days of repair, no snowstorms or typhoons (or other weather related troubles affecting your stock)… basically, nothing unexpected happening. Now, if only that was possible…

Well, we live in the real world, and supply chain problems happen.

As a retailer, how do you handle these incidents? Stop selling until everything goes back to normal? Of course not. Backordering works, but if you're in a business where everything's about instant gratification, you risk losing out on sales and customer loyalty. So what can you do to guard against unexpected incidents and keep your customers happy?

The answer lies in safety stock. Safety stock is like a small emergency warchest you can break out when the going gets tough and it looks like you're on the verge of selling out. You'd want to have enough in it to help you weather the storms when they roll around, but not so much that the carrying costs end up straining your finances. While this sounds like common sense, the trick is to decide on how much safety stock to carry.

There's the temptation to stock enough to last you until a fresh shipment (or two) comes through, but always remember that the more you stock, the higher your carrying costs become. Just think about it; whatever you sell doesn't just have to cover its own carrying costs - it has to cover the carrying costs of the safety stock as well.

Calculating your safety stock - Getting the math right

Calculating your safety stock levels is easy. All you need are your purchase and sales orders history, and this simple formula:

Let's say there's a business based in the United States (N's Handmade Shawls) selling sustainably produced handwoven cashmere shawls by craftsmen in Mongolia. On an average, it takes about 55 (average lead time in days) days to get the shawls from Mongolia to the United States. N's Handmade Shawls sells about 10 shawls a day (average daily usage), and on weekends and bank holidays, they can sell as many as 14 (maximum daily usage). Unfortunately, in Mongolia they have dust storms, which results in longer lead times, up to 60 days (maximum lead time in days).

So for N's Handmade Shawls, their safety stock levels would be:

(14 x 60) - (10 x 55) = 290

This means N's Handmade Shawls would need to have about 290 units of safety stock on hand at any time (especially during spring when dust storms are rife). With 290 units in their safety stock warchest, selling about 78 shawls a week (10 per day on weekdays and 14 per day on weekends), N's Handmade Shawls will have enough stock to last just over three and half weeks.

Your safety stock's there to protect you against all the fluctuations in demand and lead time, buffering you against all unexpected occurrences - from a surprise boom in popularity to broken looms and subsequent delays.

Depending on what you're selling, you may need to pay attention to seasons. For example, if you're like N's Handmade Shawls, you may see a spike in demand around Christmas. Maybe N's Handmade Shawls tend to fly off the shelves come December as they make great Christmas presents, tripling demand. So for December, N's Handmade Shawls would need to ensure that they've got enough safety stock to cater to this expected tripling of demand.

However, once the peak season's over, it's time to start reducing your safety stock levels. Always remember: more safety stock = higher carrying costs. After the holiday season has passed, there's going to be a lot less people shopping for sustainably sourced handmade cashmere shawls.

Safety Stock levels and Reorder Point

So now you've know exactly how much safety stock you need to keep on hand. When it's time to decide your reordering quantity, you shouldn't keep your safety stock behind a glass case that reads "Break in case of emergency".

Inventory management is a **financial trade-off between inventory costs and stock-out costs**. The more stock, the more working capital is needed and the more stock depreciation you get. On the other hand if you do not have enough stock, you get inventory stock-outs, missing potential sales, possibility interrupting the whole production process.

Inventory stock depends essentially of two factors

- demand: the amount of items that will be consumed or bought.
- lead time: the delay between reorder decision and renewed availability.

Yet those two factors are subject to uncertainties

- demand variations: customer behaviors can evolve in rather unpredictable ways.
- lead time variations: suppliers or transporters may be faced with unplanned difficulties.

Deciding the level of safety stock is implicitly equivalent to making a trade-off between those costs considering the uncertainties.

The balance inventory costs vs. stock-outs costs is very business dependent. Thus, instead of considering those costs directly, we will now introduce the classical notion of *service level*.

The **service level expresses the probability that a certain level of safety stock will not lead to stock-out**. Naturally, when safety stocks are increased, the service level increases as well. When safety stocks get very large, the service level tends toward 100% (i.e. zero probability of encountering stock-out).

SCOR - Supply Chain Operations Reference model

The Supply Chain Operations Reference model (SCOR) is the world's leading supply chain framework, linking business processes, performance metrics, practices and people skills into a unified structure.

Level 1 Processes included in SCOR:

- Plan
- Source
- Make
- Deliver
- Return
- Enable

Level 1 Metrics included in SCOR:

- Perfect order fulfillment
- Order fulfillment cycle time
- Upside supply chain flexibility
- Upside supply chain adaptability
- Downside supply chain adaptability
- Overall value at risk
- Total cost to serve
- Cash-to-cash cycle time
- Return on supply chain fixed assets
- Return on working capital

The supply chain operations reference model (SCOR) is a management tool used to address, improve, and communicate supply chain management decisions within a company and with suppliers and customers of a company (1). The model describes the business processes required to satisfy a customer's demands. It also helps to explain the processes along the entire supply chain and provides a basis for how to improve those processes.

Plan : Demand and supply planning and management are included in this first step. Elements include balancing resources with requirements and determining communication along the entire chain. The plan also includes determining business rules to improve and measure supply chain efficiency. These business rules span inventory, transportation, assets, and regulatory compliance, among others. The plan also aligns the supply chain plan with the financial plan of the company

Source : This step describes sourcing infrastructure and material acquisition. It describes how to manage inventory, the supplier network, supplier agreements, and supplier performance. It discusses how to handle supplier payments and when to receive, verify, and transfer product

Make : Manufacturing and production are the emphasis of this step. Is the manufacturing process make-to-order, make-to-stock, or engineer-to-order? The make step includes, production activities, packaging, staging product, and releasing. It also includes managing the production network, equipment and facilities, and transportation

Deliver : Delivery includes order management, warehousing, and transportation. It also includes receiving orders from customers and invoicing them once product has been received. This step involves management of finished inventories, assets, transportation, product life cycles, and importing and exporting requirements.

Return : Companies must be prepared to handle the return of containers, packaging, or defective product. The return involves the management of business rules, return inventory, assets, transportation, and regulatory requirements

Benefits of Using the SCOR Model

Employ the SCOR framework at your organization and:

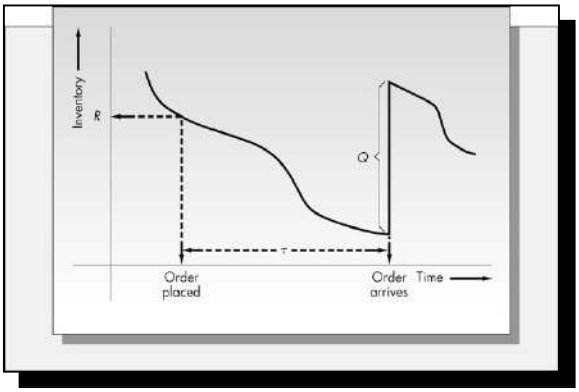
- Increase the speed of system implementations
- Support organizational learning goals
- Improve inventory turns

The SCOR process can go into many levels of process detail to help a company analyze its supply chain. It gives companies an idea of how advanced its supply chain is. The process helps companies understand how the 5 steps repeat over and over again between suppliers, the company, and customers. Each step is a link in the supply chain that is critical in getting a product successfully along each level. The SCOR model has proven to benefit companies

that use it to identify supply chain problems. The model enables full leverage of capital investment, creation of a supply chain road map, alignment of business functions, and an average of two to six times return on investment

SIC - STOCHASTIC INVENTORY SYSTEMS

For most order quantity/reorder point inventory systems, the stochastic model, which specifies the demands as stochastic processes, is often more accurate than its deterministic counterpart—the EOQ model. However, the application of the stochastic model has been limited because of the absence of insightful analytical results on the model.



SIC - Standard Industrial Classification

is a system for classifying industries by a four-digit code. Established in the United States in 1937, it is used by government agencies to classify industry areas

SIX SIGMA

SLOW MOVING

S&OP - Sales and Operations Planning

Sales and operations planning (**S&OP**) is an integrated business management process through which the executive/leadership team continually achieves focus, alignment and synchronization among all functions of the organization. The S&OP includes an updated forecast that leads to a sales plan, production plan, inventory plan, customer lead time (backlog) plan, new product development plan, strategic initiative plan and resulting financial plan. Plan frequency and planning horizon depend on the specifics of the industry. Short product life cycles and high demand volatility require a tighter S&OP than steadily consumed products. Done well, the S&OP process also enables effective supply chain management.

A properly implemented S&OP process routinely reviews customer demand and supply resources and "re-plans" quantitatively across an agreed rolling horizon. The re-planning process focuses on changes from the previously agreed sales and operations plan, while it helps the management team to understand how the company achieved its current level of performance, its primary focus is on future actions and anticipated results.

Definitions

APICS defines S&OP as the "function of setting the overall level of manufacturing output (production plan) and other activities to best satisfy the current planned levels of sales (sales plan and/or forecasts), while meeting general business objectives of profitability, productivity, competitive customer lead times, etc., as expressed in the overall business plan. One of its primary purposes is to establish production rates that will achieve management's objective of maintaining, raising, or lowering inventories or backlogs, while usually attempting to keep the workforce relatively stable. It must extend through a planning horizon sufficient to plan the labor, equipment, facilities, material, and finances required to accomplish the production plan. As this plan affects many company functions, it is normally prepared with information from marketing, manufacturing, engineering, finance, materials, etc."[

Sales and operations planning has evolved into a major business process adopted to manage the balance and trade-off between the conflicting preferences of the supply and demand side of the supply chain and offers many value creation opportunities. It is one of the most critical business processes used to achieve best in class performance to consistently outperform competitors. It is increasingly being viewed as essential to synchronise the entire supply chain in order to improve its efficiency.[1] It has also been described as "a set of decision-making processes to balance demand and supply, to integrate financial planning and operational planning, and to link high-level strategic plans with day-to-day operations."

The planning process

S&OP is the result of monthly planning activities. It is usually based on an Annual Operations Plan (AOP) that acts as the company's annual target in terms of sales and supply. Therefore, the sales and operations plans are a means to gradually accomplish the AOP targets – by linking monthly sales and marketing planning directly to the operations side of a business.

The planning horizon for a typical S&OP process is long term and extends over 18–36 months. The selection of a time horizon is an important decision and there are different factors that influence this decision including type of industry, product characteristics, and the time of the year when S&OP planning takes place. Additionally, the S&OP process is conducted at an aggregate level. The focus is on commonly on product families and not every single product.

Best practices

S&OP best practices share a **common set of approaches:**

- Rely on a phased approach: S&OP is much more an integrated set of business processes and technologies than a single, all-encompassing process or technology. If you just focus on the implementation of a new technology and think that S&OP will miraculously take shape, you're wrong.
- Develop an "outside-in" sequence of S&OP initiatives: typically, the events that will have the most profound and negative impact on your sales and operations planning are those outside of your control. For the most part, these are due to the decisions and actions of your customers, partners, and competitors, which have a direct impact on your revenue and your competitor's strategy.
- Focus on more information, less data: another key to successful S&OP is clean, current, and accurate data. Plans are often slowed down by the effort of gathering data that has minimal importance to the overall project. It is important to ensure that you know exactly what business problem you are trying to resolve and understand the minimum data necessary for the project.
- Provide effective leadership for the process. S&OP crosses organizational boundaries – that is its strength but also its vulnerability. Many businesses find that their attempts to implement S&OP are frustrated by internal tensions between departments. Classic best practice suggests that S&OP must be owned to the

Chief Executive Officer. If that is not possible then a strong united coalition of department heads may be able to lead the process if they set clear ground rules and boundaries for working together.

TQM – Total Quality Management

Total quality management (**TQM**) consists of organization-wide efforts to "install and make permanent climate where employees continuously improve their ability to provide on demand products and services that customers will find of particular value. -"Total" emphasizes that departments in addition to production (for example sales and marketing, accounting and finance, engineering and design) are obligated to improve their operations; - "management" emphasizes that executives are obligated to actively manage quality through funding, training, staffing, and goal setting.

While there is no widely agreed-upon approach, TQM efforts typically draw heavily on the previously developed tools and techniques of quality control. TQM enjoyed widespread attention during the late 1980s and early 1990s before being overshadowed by ISO 9000, Lean manufacturing, and Six Sigma.

Trade-offs

Value Chain

A **value chain** is a set of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market. The concept comes through business management and was first described by Michael Porter in his 1985 best-seller, *Competitive Advantage: Creating and Sustaining Superior Performance*.[1]

The idea of the value chain is based on the process view of organizations, the idea of seeing a manufacturing (or service) organization as a system, made up of subsystems each with inputs, transformation processes and outputs. Inputs, transformation processes, and outputs involve the acquisition and consumption of resources – money, labour, materials, equipment, buildings, land, administration and management. How value chain activities are carried out determines costs and affects profits.

VMI MODEL

Vendor-managed inventory (**VMI**) is a family of business models in which the buyer of a product provides certain information to a supplier (vendor) of that product and the supplier takes full responsibility for maintaining an agreed inventory of the material, usually at the buyer's consumption location (usually a store)

BENEFITS

1. As a symbiotic relationship, VMI makes it less likely that a business will unintentionally become out of stock of a good and reduces inventory in the supply chain. Furthermore, vendor (supplier) representatives in a store benefit the vendor by ensuring the product is properly displayed and store staff are familiar with the features of the

product line, all the while helping to clean and organize their product lines for the store. VMI can also decrease the magnitude of the bullwhip effect.

2. One of the keys to making VMI work is shared risk. In some cases, if the inventory does not sell, the vendor (supplier) will repurchase the product from the buyer (retailer). In other cases, the product may be in the possession of the retailer but is not owned by the retailer until the sale takes place, meaning that the retailer simply houses (and assists with the sale of) the product in exchange for a predetermined commission or profit (sometimes referred to as consignment stock).

3. Vendors benefit from more control of displays and more customer contact for their employees; retailers benefit from reduced risk, better store staff knowledge (which builds brand loyalty for both the vendor and the retailer), and reduced display maintenance outlays.

4. Consumers benefit from knowledgeable store staff who are in frequent and familiar contact with manufacturer (vendor) representatives when parts or service are required. Store staff have good knowledge of most product lines offered by the entire range of vendors. They can help the consumer choose from competing products for items most suited to them and offer service support being offered by the store.

5. At the goods' manufacturing level, VMI helps prevent overflowing warehouses or shortages,

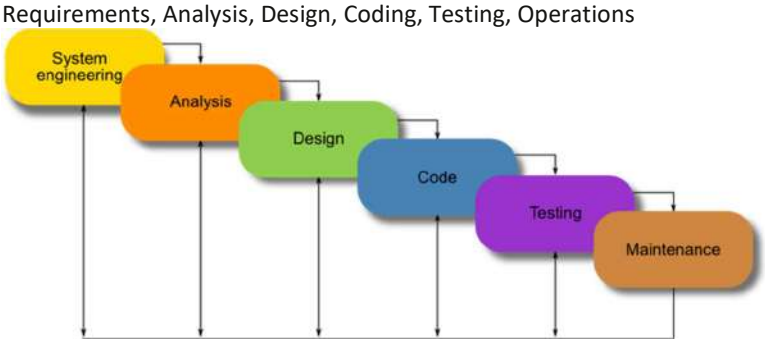
6. VMI helps also preventing costly labor, purchasing and accounting. With VMI, businesses maintain a proper inventory, and optimized inventory leads to easy access and fast processing with reduced labor costs.

WASTES 7 η 8 :

TIMWOOD : 1. Transport, 2. **I**nventory, 3. **M**otion, 4. **W**aiting, 5. **O**ver Processing, 6. **O**ver Production, 7. Defects, also 8. Non-utilised Talents

WATERFALL METHOD :

Similar to phase -gate process. The waterfall model emphasizes that a logical progression of steps be taken throughout the life cycle (SDLC), much like the cascading steps down an incremental waterfall. § 6 phases : Requirements, Analysis, Design, Coding, Testing, Operations



First introduced by Dr. Winston W. Royce in a paper published in 1970, the waterfall model is a software development process. The waterfall model emphasizes that a logical progression of steps be taken throughout the software development life cycle (SDLC), much like the cascading steps down an incremental waterfall. While the popularity of the waterfall model has waned over recent years in favor of more agile methodologies, the logical nature of the sequential process used in the waterfall method cannot be denied, and it remains a common design process in the industry.

Throughout this article we'll examine what specific stages make up the core of the waterfall model, when and where it is best implemented, and scenarios where it might be avoided in favor of other design philosophies.

Some more specific takes on SDLC include:

Rapid Application Development	Test-Driven Development	Software Development Life Cycle
Iterative Model	Extreme Programming	Scaled Agile Framework
Agile Model	Scrum	Rational Unified Process
Big Bang Model	V-Model	Conceptual Model
Kaizen Model	Kanban Model	Spiral Model

The Six Stages of Falling Water

Actually implementing a waterfall model within a new software project is a rather straightforward process, thanks in large part due to the step-by-step nature of the method itself. There are minor differences in the numbers and descriptions of the steps involved in a waterfall method, depending on the developer you ask (and even the year during which you ask him or her). Regardless, the concepts are all the same and encompass the broad scope of what it takes to start with an idea and develop a full-scale, live application.

- **Requirements**: During this initial phase, the potential requirements of the application are methodically analyzed and written down in a specification document that serves as the basis for all future development. The result is typically a requirements document that defines *what* the application should do, but not *how* it should do it.
- **Analysis**: During this second stage, the system is analyzed in order to properly generate the models and business logic that will be used in the application.
- **Design**: This stage largely covers technical design requirements, such as programming language, data layers, services, etc. A design specification will typically be created that outlines how exactly the business logic covered in analysis will be technically implemented.
- **Coding**: The actual source code is finally written in this fourth stage, implementing all models, business logic, and service integrations that were specified in the prior stages.
- **Testing**: During this stage, QA, beta testers, and all other testers systematically discover and report issues within the application that need to be resolved. It is not uncommon for this phase to cause a "necessary repeat" of the previous coding phase, in order for revealed bugs to be properly squashed.

- **Operations**: Finally, the application is ready for deployment to a live environment. The operations stage entails not just the deployment of the application, but also subsequent support and maintenance that may be required to keep it functional and up-to-date.

The Advantages of the Waterfall Model

While the waterfall model has seen a slow phasing out in recent years in favor of more agile methods, it can still provide a number of benefits, particularly for larger projects and organizations that require the stringent stages and deadlines available within these cool, cascading waters.

- **Adapts to Shifting Teams**: While not necessarily specific to the waterfall model only, using a waterfall method does allow the project as a whole to maintain a more detailed, robust scope and design structure due to all the upfront planning and documentation stages. This is particularly well suited to large teams that may see members come and go throughout the life cycle of the project, allowing the burden of design to be placed on the core documentation and less on any individual team member.
- **Forces Structured Organization**: While some may argue this is a burden rather than a benefit, the fact remains that the waterfall model *forces* the project, and even the organization building said project, to be extraordinarily disciplined in its design and structure. Most sizable projects will, by necessity, include detailed procedures to manage every aspect of the project, from design and development to testing and implementation.
- **Allows for Early Design Changes**: While it can be difficult to make design changes later in the process, the waterfall approach lends itself well to alterations early in the life cycle. This is great when fleshing out the specification documents in the first couple stages with the development team and clients, as alterations can be made immediately and with minimal effort, since no coding or implementation has actually taken place up to that point.
- **Suited for Milestone-Focused Development**: Due to the inherent linear structure of a waterfall project, such applications are always well-suited for organizations or teams that work well under a milestone- and date-focused paradigm. With clear, concrete, and well understood stages that everyone on the team can understand and prepare for, it is relatively simple to develop a time line for the entire process and assign particular markers and milestones for each stage and even completion. This isn't to suggest software development isn't often rife with delays (since it is), but waterfall is befitting the kind of project that needs deadlines.

The Disadvantages of the Waterfall Model

While some things in software development never really change, many others often fall by the wayside. While Dr. Royce's initial proposal of what is now known as the waterfall model was groundbreaking when first published back in 1970, over four decades later, a number of cracks are showing in the armor of this once heralded model.

- **Nonadaptive Design Constraints**: While arguably a whole book could be written on this topic alone, the most damning aspect of the waterfall model is its inherent lack of adaptability across all stages of the development life cycle. When a test in stage five reveals a fundamental flaw in the design of the system, it not only requires a dramatic leap backward in stages of the process, but in some cases, can be often lead to a devastating realization regarding the legitimacy of the entire system. While most experienced teams and developers would (rightfully) argue that such revelations shouldn't occur if the system was properly designed in the first place, not every possibility can be accounted for, especially when stages are so often delayed until the end of the process.
- **Ignores Mid-Process User/Client Feedback**: Due to the strict step-by-step process that the waterfall model enforces, another particularly difficult issue to get around is that user or client feedback that is provided late into the development cycle can often be too little, too late. While project managers can obviously enforce a process to step back to a previous stage due to an unforeseen requirement or change coming from a client, it will be both costly and time-consuming, for both the development team and the client.

- **Delayed Testing Period**: While most of the more modern SDLC models attempt to integrate testing as a fundamental and always-present process throughout development, the waterfall model largely shies away from testing until quite late into the life cycle. This not only means that most bugs or even design issues won't be discovered until very late into the process, but it also encourages lackadaisical coding practices since testing is only an afterthought.

  In spite of going through an explicit testing phase during implementation of a waterfall model project, as discussed above, this testing is often too little, too late. *In addition to* the normal testing phase, you and your team should strongly consider introducing an effective error management tool into the development life cycle of your project. Airbrake's error monitoring software provides real-time error monitoring and automatic exception reporting for all your development projects. Airbrake's state of the art web dashboard ensures you receive round-the-clock status updates on your application's health and error rates. No matter what you're working on, Airbrake easily integrates with all the most popular languages and frameworks. Plus, Airbrake makes it easy to customize exception parameters, while giving you complete control of the active error filter system, so you only gather the errors that matter most.

WIP - Work in progress