14th International Conference on Software Quality (14ICSQ)
23 March 2005, 1:30-2:30p, Session Q

Six Sigma Software

"The point isn't to build software without defects, but to build software solutions that can be kept from producing defectives in spite of their defects."

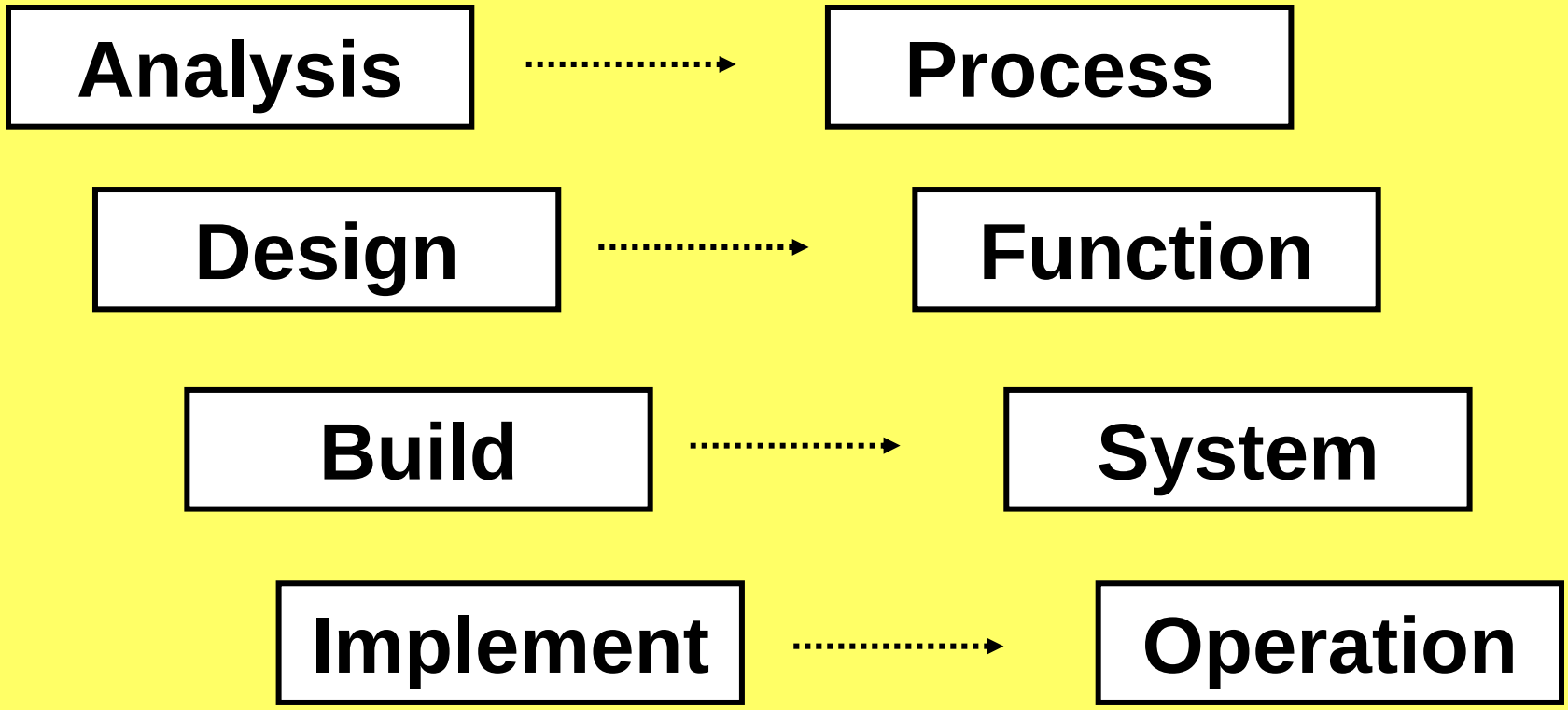
Richard E. Biehl, CSSBB, CSQE
Data-Oriented Quality Solutions

Key Question #1

- **What is the difference between using Six Sigma to improve our IT processes and using Six Sigma to engineer better systems?**

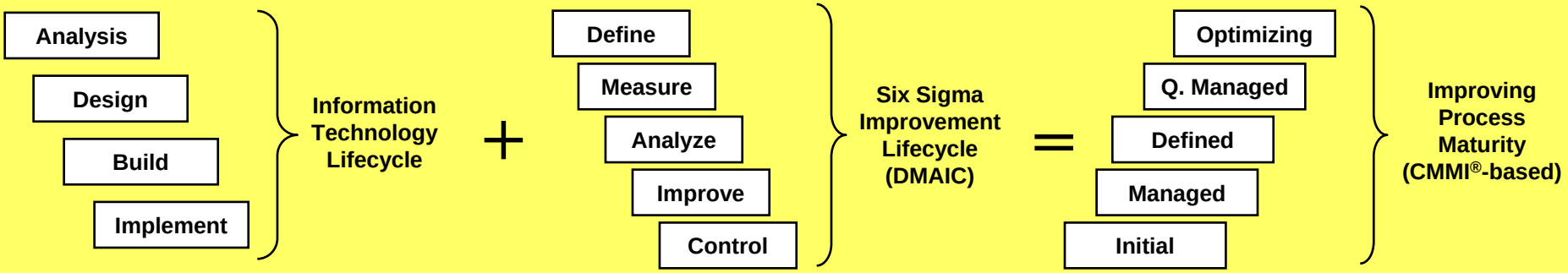
Underlying Lifecycle Rationale

IT Process & Product Relationships

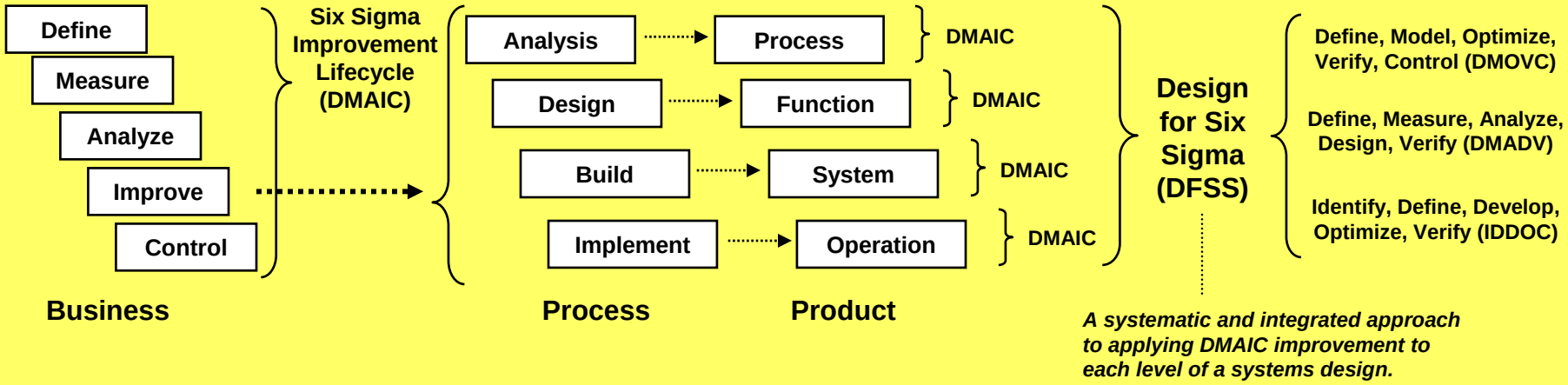


Six Sigma Lifecycle Perspectives

Improving our IT project processes…

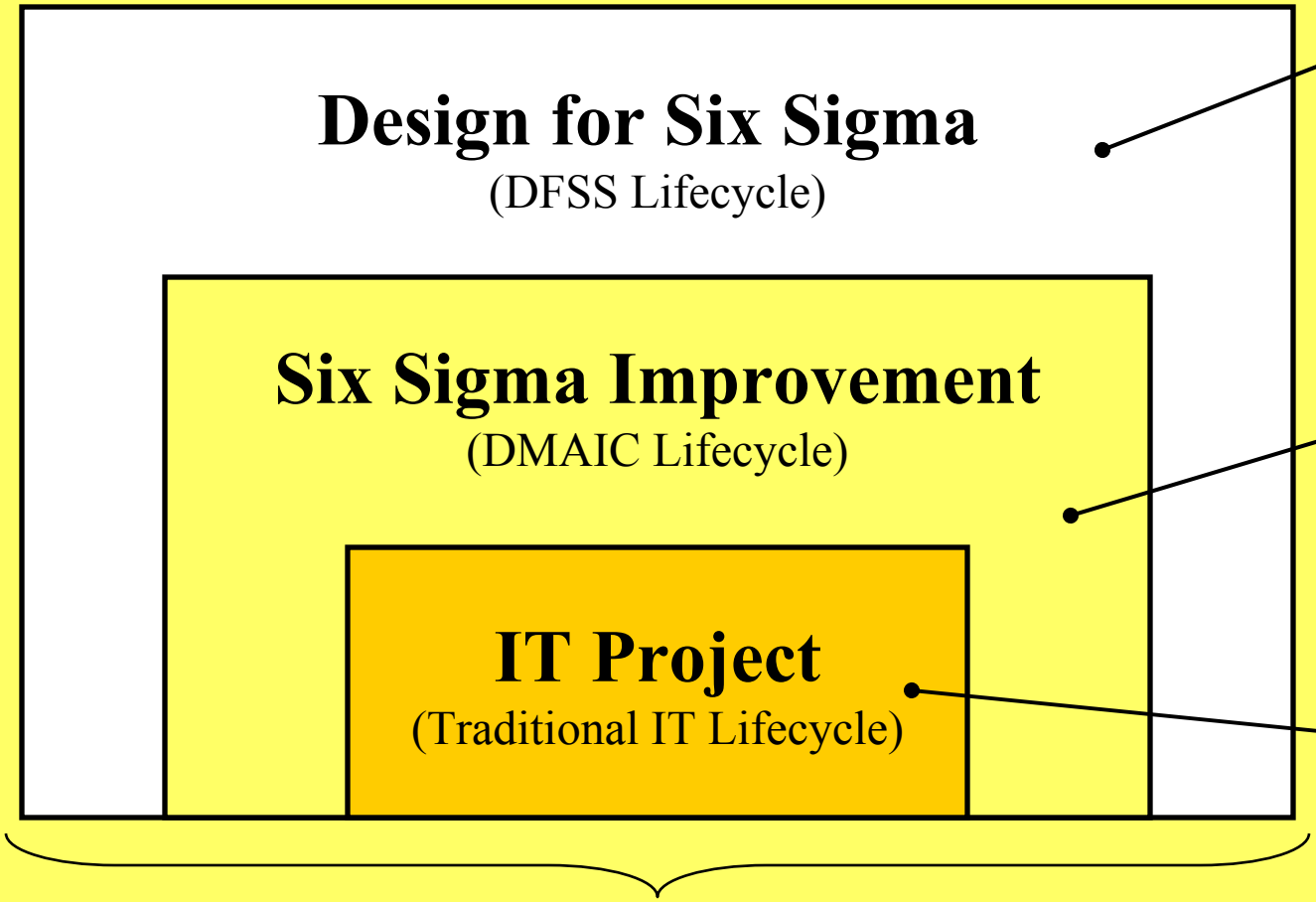


Improving our IT products and services…



A systematic and integrated approach to applying DMAIC improvement to each level of a systems design.

Six Sigma IT Project Perspectives



Radical process or system redesign in conjunction with business changes.
(Improve Cpk)

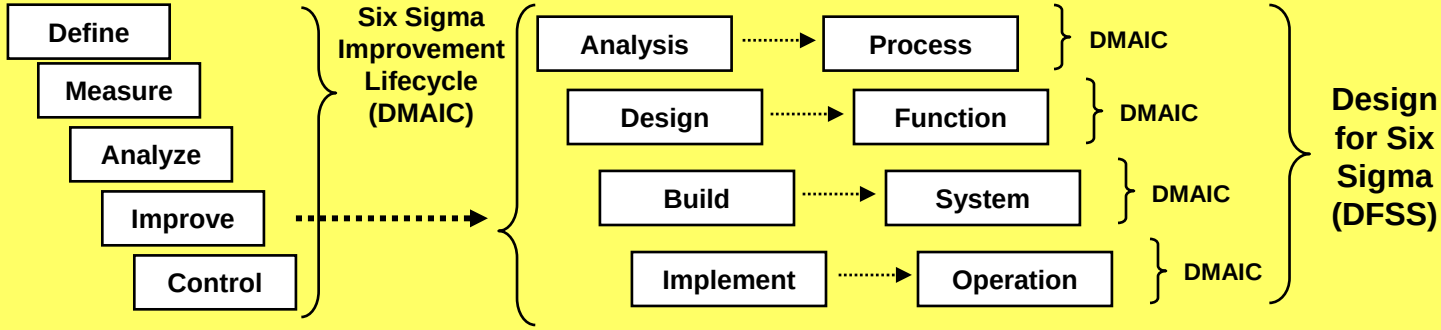
Process or system implementation in conjunction with business process improvement.
(Improve Cp)

Augment or automate portions of business process steps as an Improve phase activity within a business DMAIC initiative.

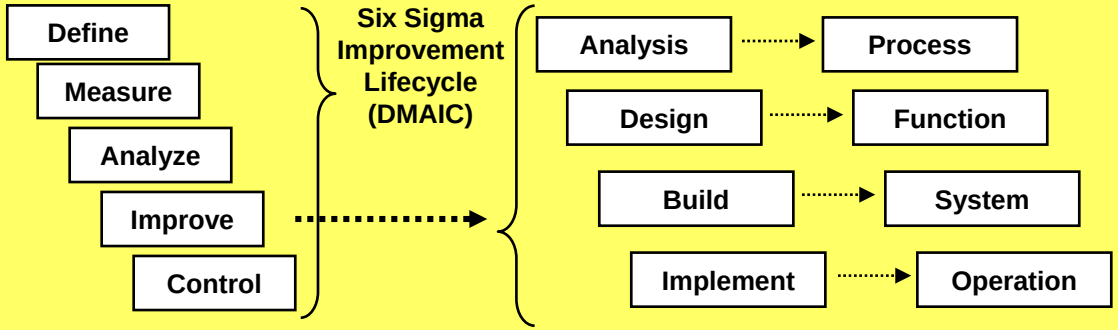
Project tailoring guidelines assist project managers in selecting and documenting their organizational standard process selection and project process definition choices and rationale.

Six Sigma IT Project Tailoring

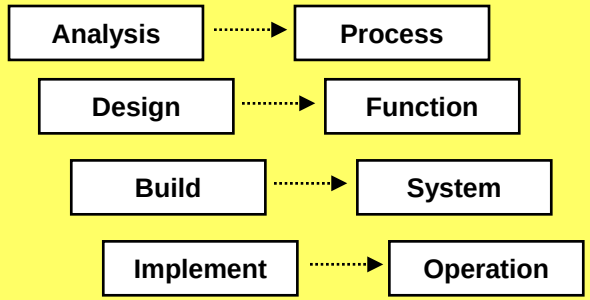
Design & Implementation Risk
(DFSS Project)



Implementation Risk Only
(DMAIC Project)



Little Risk
(IT Project)



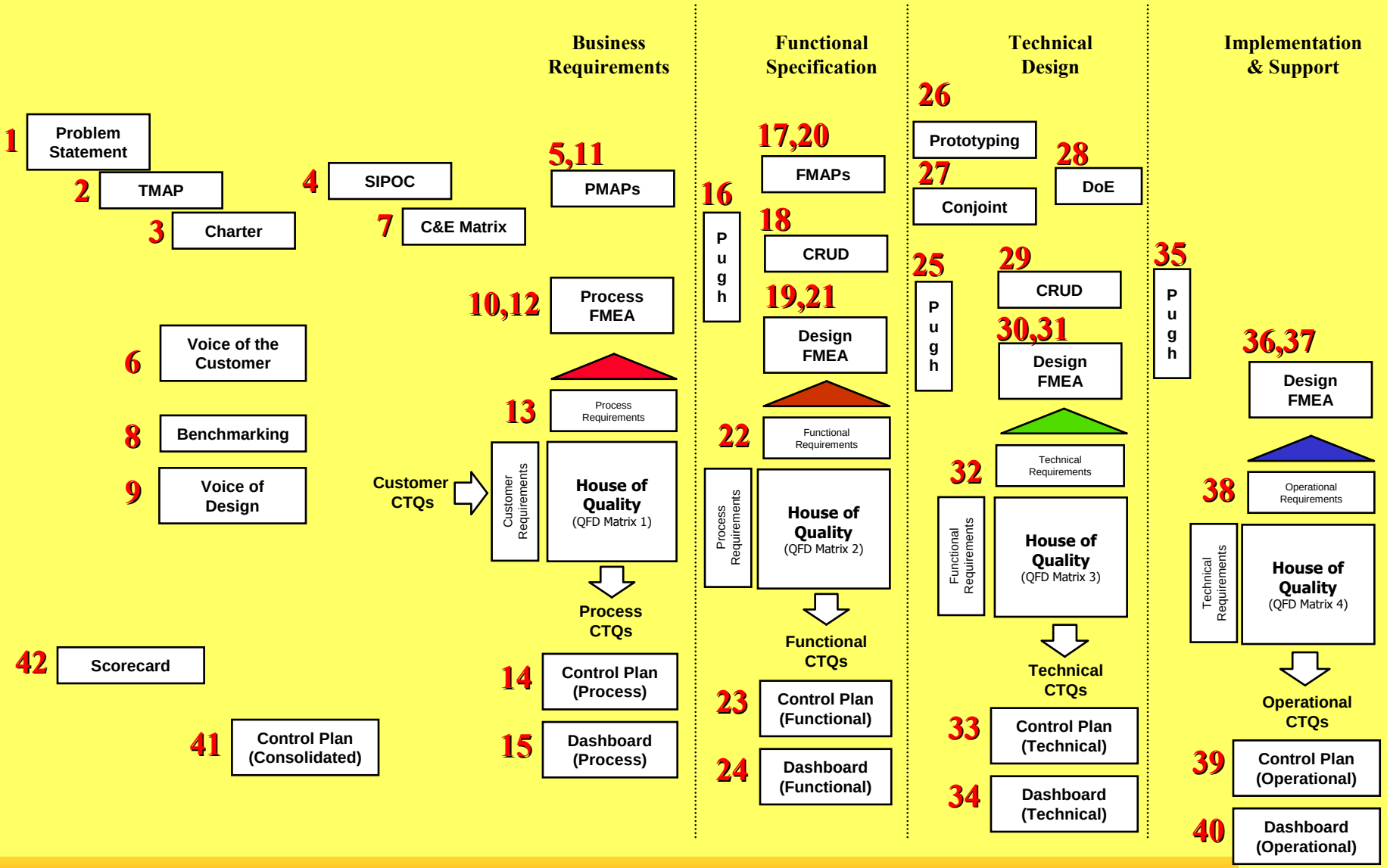
Key Question #2

- **How do the levels of DFSS, particularly QFD, correspond to the levels of systems definition and design that are typically encountered on IT projects?**

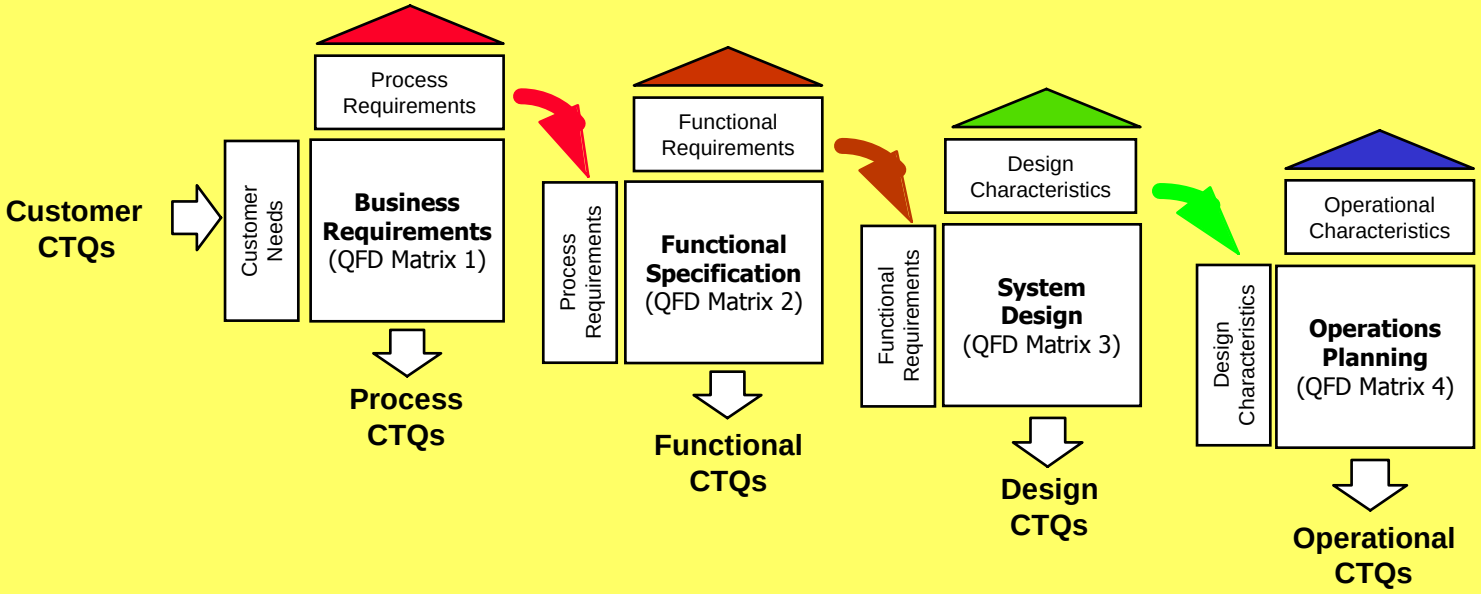
DFSS = Design for Six Sigma
QFD = Quality Function Deployment

DOQS
Six Sigma
Software

Six Sigma Conceptual Tool Map

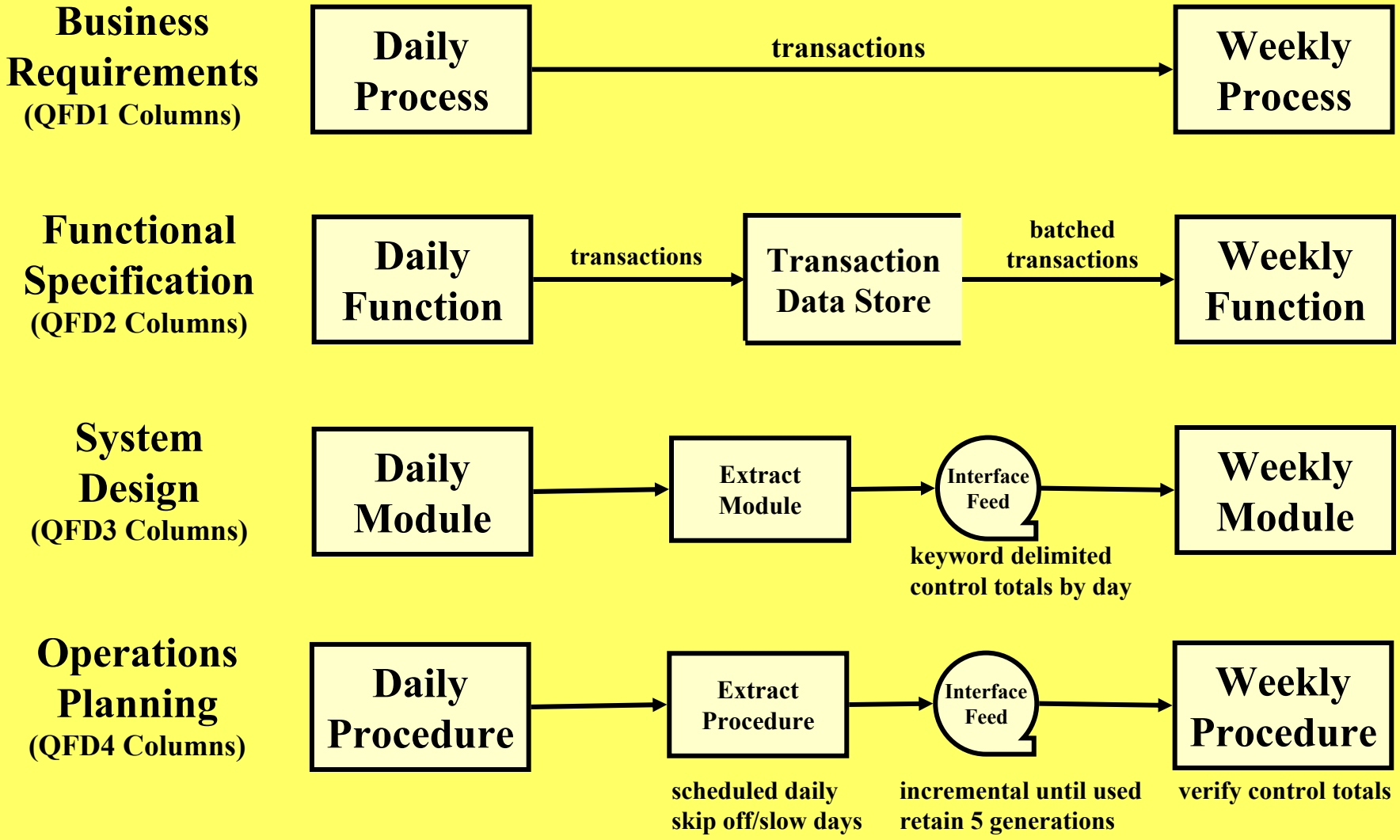


DFSS: QFD Backbone



QFD = Quality Function Deployment
CTQ = Critical to Quality

4 QFD Levels in IT

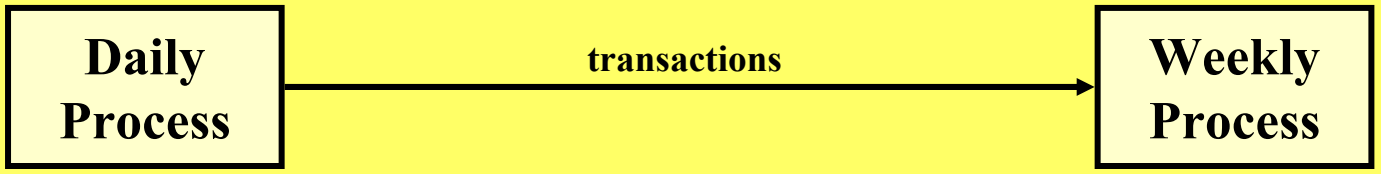


QFD1 – Business Requirements

Customer Needs
Lower Costs
Better Service
More Functionality
Higher Quality
Reduced Cycle Time
Increased Reliability

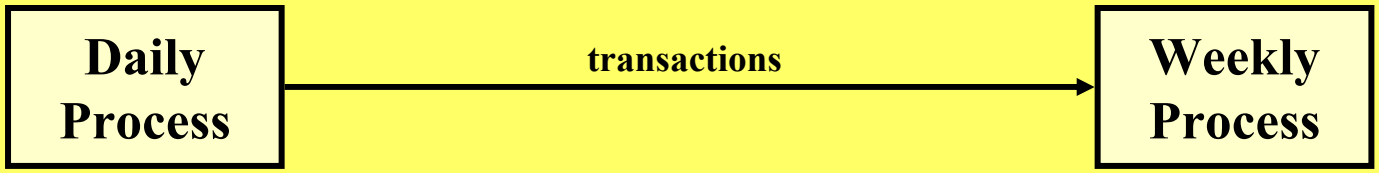
QFD1		Bus. Req'ts		
Customer Needs	Importance	Daily Process	transactions	Weekly Process
Lower Costs	10	9	9	9
Better Service	10	9	9	9
More Functionality	10	9	9	9
Higher Quality	10	9	9	9
Reduced Cycle Time	10	9	9	9
Increased Reliability	10	9	9	9
Relative Importance		540	540	540

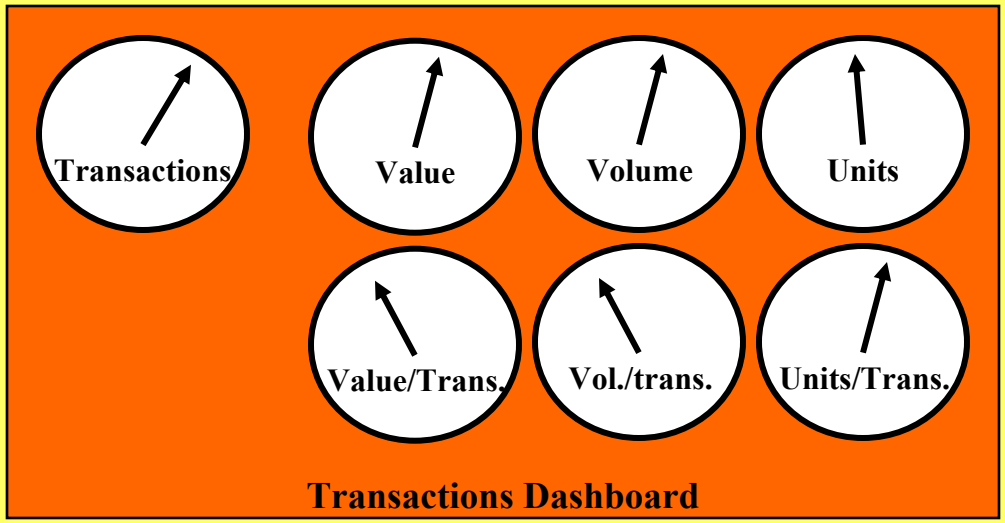
Business Requirements (QFD1 Columns)



QFD1 – Business Requirements

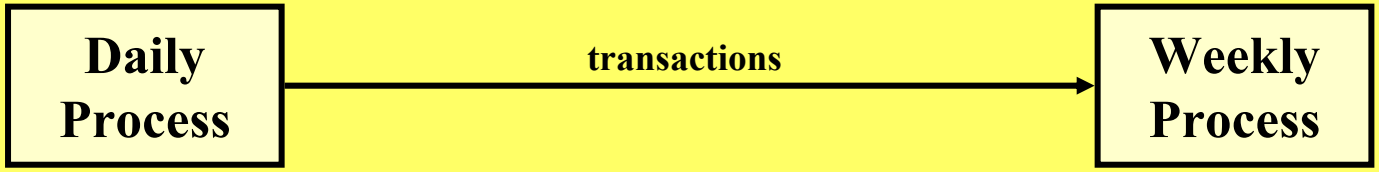
Business Requirements
(QFD1 Columns)





QFD2 – Functional Specification

Business Requirements
(QFD2 Rows)

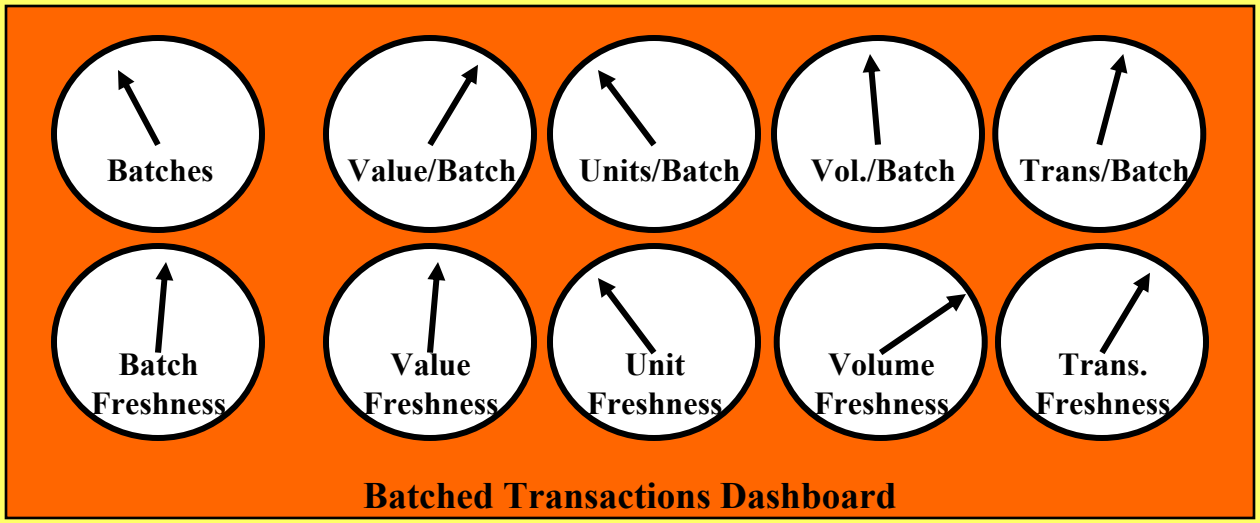


QFD2		Functional Specs				
Business Req'ts	Importance	Daily Function	transactions	Transaction Data Store	batched transactions	Weekly Function
Daily Process	10	9	9	9	9	9
transactions	10	9	9	9	9	9
Weekly Process	10	9	9	9	9	9
Relative Importance		270	270	270	270	270

Functional Specification
(QFD2 Columns)

QFD2 – Functional Specification

Functional Specification
(QFD2 Columns)

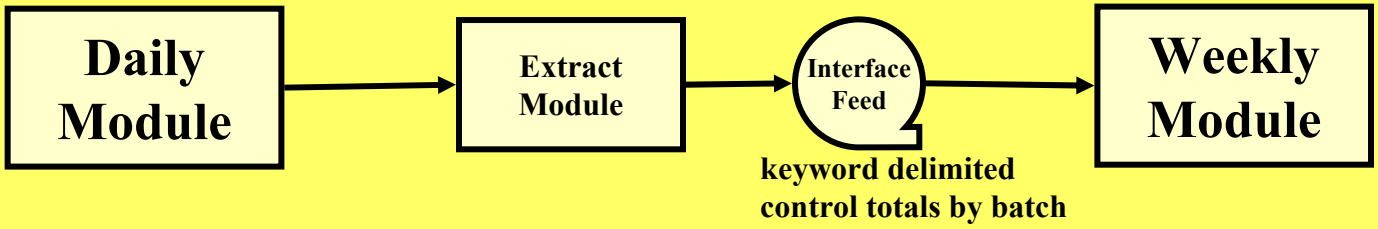


QFD3 – System Design

Functional Specification
(QFD3 Rows)

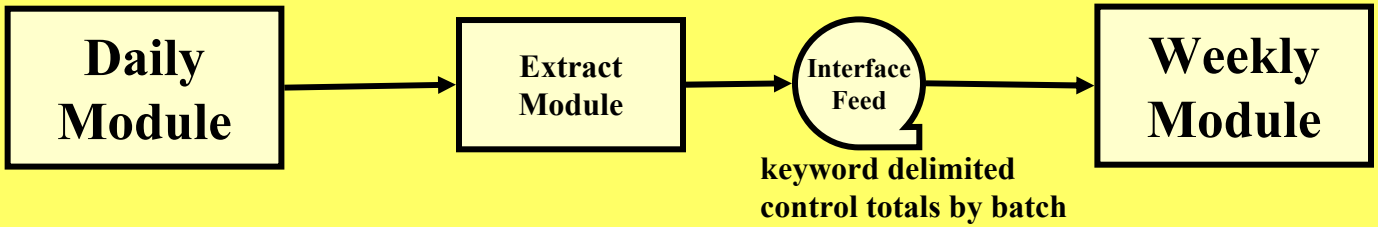
QFD3		Design Specifications					
Functional Specifications	Importance	Daily Module	Extract Module	Interface Feed	Keword delimitation	Control totals by day	Weekly Module
Daily Function	10	9	9	9	9	9	9
transactions	10	9	9	9	9	9	9
Transaction Data Store	10	9	9	9	9	9	9
batched transactions	10	9	9	9	9	9	9
Weekly Function	10	9	9	9	9	9	9
Relative Importance		450	450	450	450	450	450

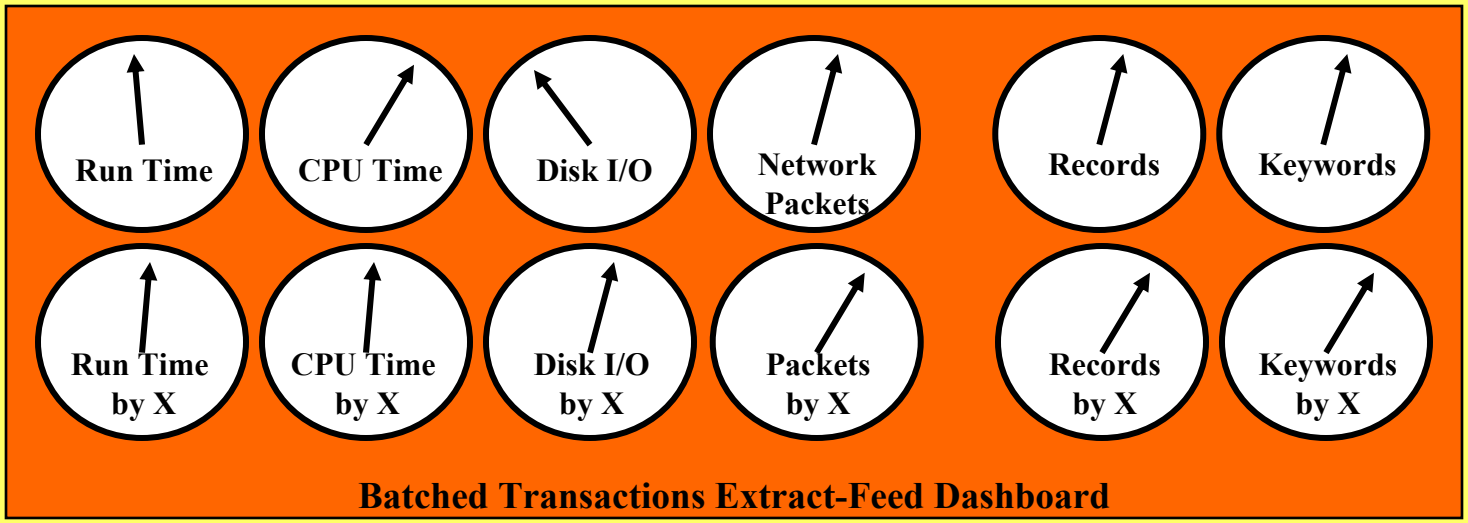
System Design
(QFD3 Columns)



QFD3 – System Design

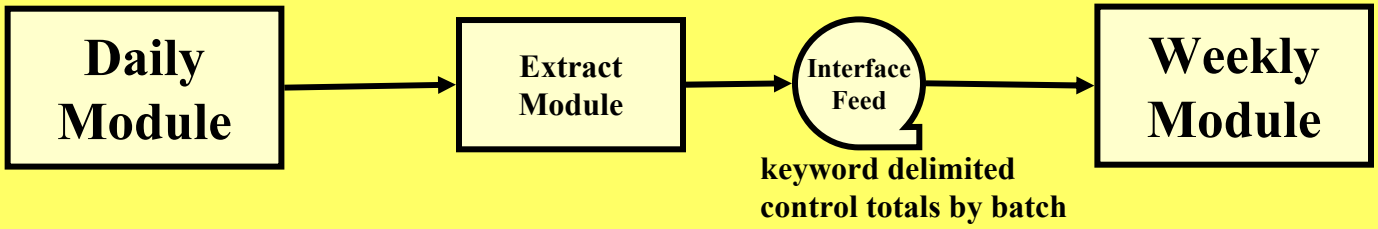
System Design
(QFD3 Columns)





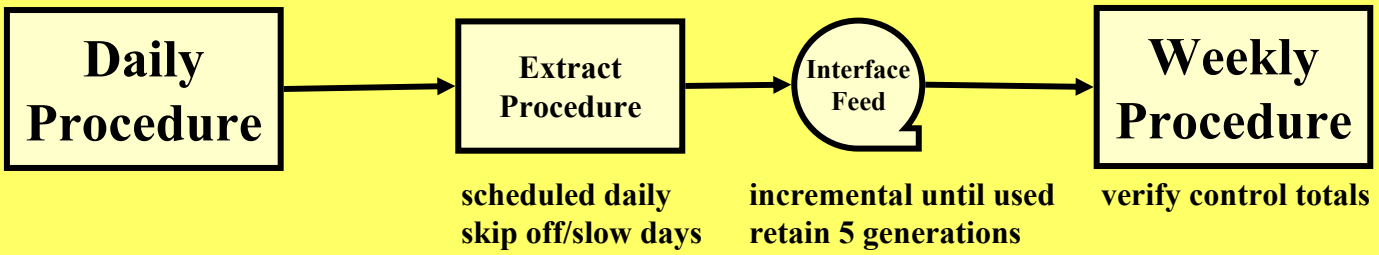
QFD4 – Operations Planning

System Design
(QFD4 Rows)



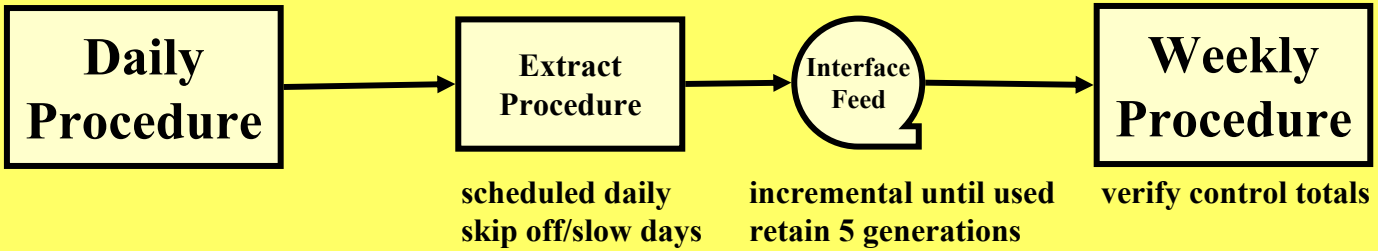
QFD4		Operations								
Design Specifications	Importance	Daily Procedure	Extract Procedure	daily schedule	skip off/slow days	Interface Feed	increment until used	5 generation retention	Weekly Procedure	control total verification
Daily Module	10	9	9	9	9	9	9	9	9	9
Extract Module	10	9	9	9	9	9	9	9	9	9
Interface Feed	10	9	9	9	9	9	9	9	9	9
Keyword delimitation	10	9	9	9	9	9	9	9	9	9
Control totals by day	10	9	9	9	9	9	9	9	9	9
Weekly Module	10	9	9	9	9	9	9	9	9	9
Relative Importance		540	540	540	540	540	540	540	540	540

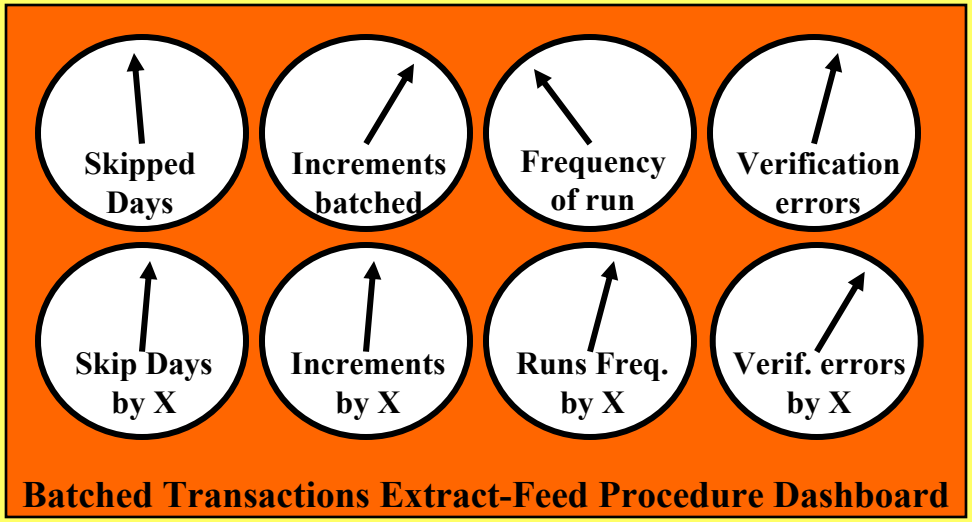
Operations Planning
(QFD4 Columns)



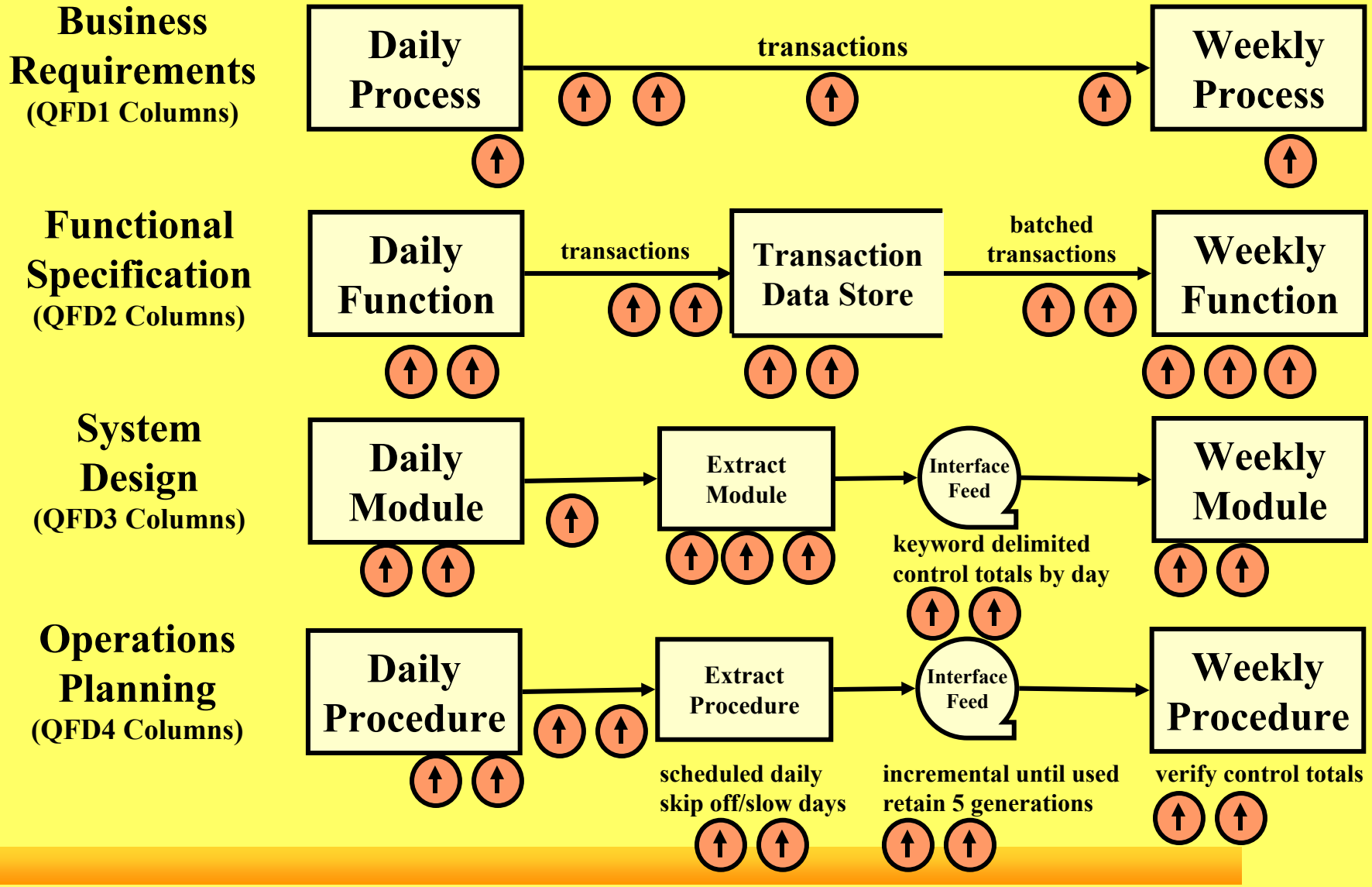
QFD4 – Operations Planning

Operations Planning
(QFD4 Columns)





4 QFD Levels in IT



SIPOC to QFD Traceability

SIPOC

Outputs	Requirements
Financial reports	Timely Available on time

Be careful not to "hard code" target values in the SIPOC that might be subject to negotiation or revision during DFSS Optimization.

QFD1

Customer Needs	Target Value(s)
Timely financial reports	Prior day close-of-business
Available financial reports	By 8:00am on work days

Separating the characteristic from the value of the characteristic supports clearer understanding during the deployment of requirements through the QFD backbone, and greater experimentation during design optimization.

QFD Optimization of SIPOC Requirements

SIPOC

Outputs	Requirements
Financial reports	Timely Available on time

QFD1

Customer Needs	Target Value(s)
Timely financial reports	Prior day close-of-business
Available financial reports	By 8:00am on work days

Design Target A
USL = 8:00am
TGT = 7:30am, LTB
σ = 10 minutes
Sigma Score = 3σ

Design Target B
USL = 8:00am
TGT = 7:00am, LTB
σ = 20 minutes
Sigma Score = 3σ

Design Target C
USL = 8:00am
TGT = 7:00am, LTB
σ = 15 minutes
Sigma Score = 4σ

DFSS Optimization

Design Target D
USL = 8:00am
TGT = 7:00am, LTB
σ = 10 minutes
Sigma Score = 6σ

Design Target E
USL = 8:00am
TGT = 7:30am, LTB
σ = 5 minutes
Sigma Score = 6σ

The customer needs will drive the definition and setting of design targets across the DFSS lifecycle.

Target delivery time (TGT) will be an optimized function of anticipated delivery variation (σ) and desired quality level (Sigma Score) against the available windows for report production (i.e. overnight batch window, production job schedule, database availability, etc.)

Key Question #3

- **What are the three types of Six Sigma IT projects, and how do they interact and support each other?**

3 Perspectives on IT

Automation

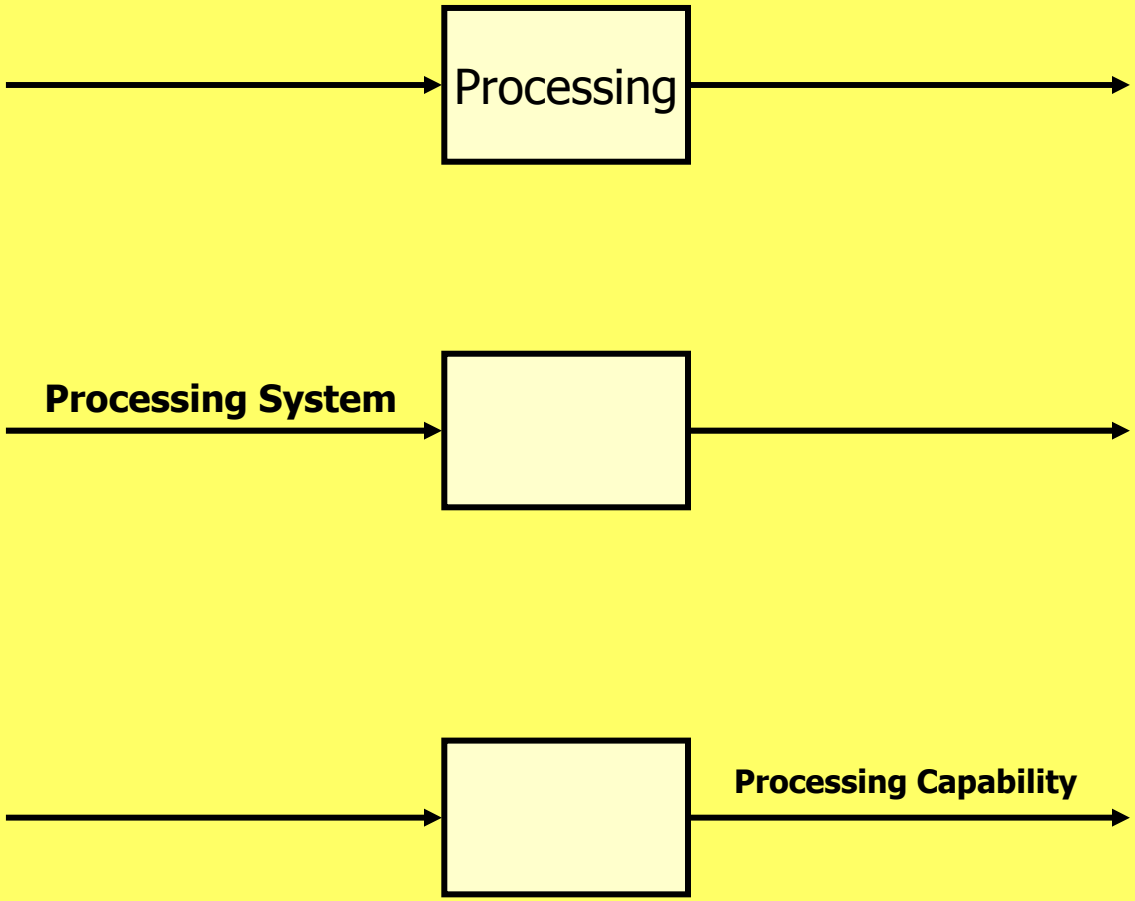
Business process is embedded in IT systems and functions. The process is *automated* by the system.

Augmentation

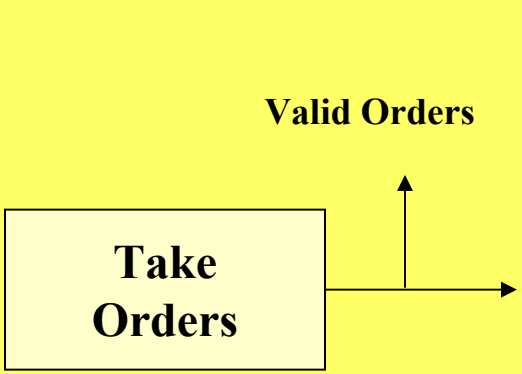
Business process depends on using certain IT systems or functions. The process is *augmented* by the system.

Enablement

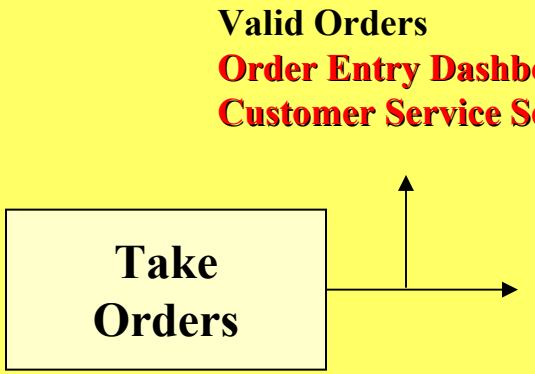
Business process includes making IT systems or functions available. The process *enables* the customers.



Automation vs. Augmentation



N Customer Requests
N Product Inventory (Future)
S Customer Profiles
S Prices & Promotions
S Shipping Schedules

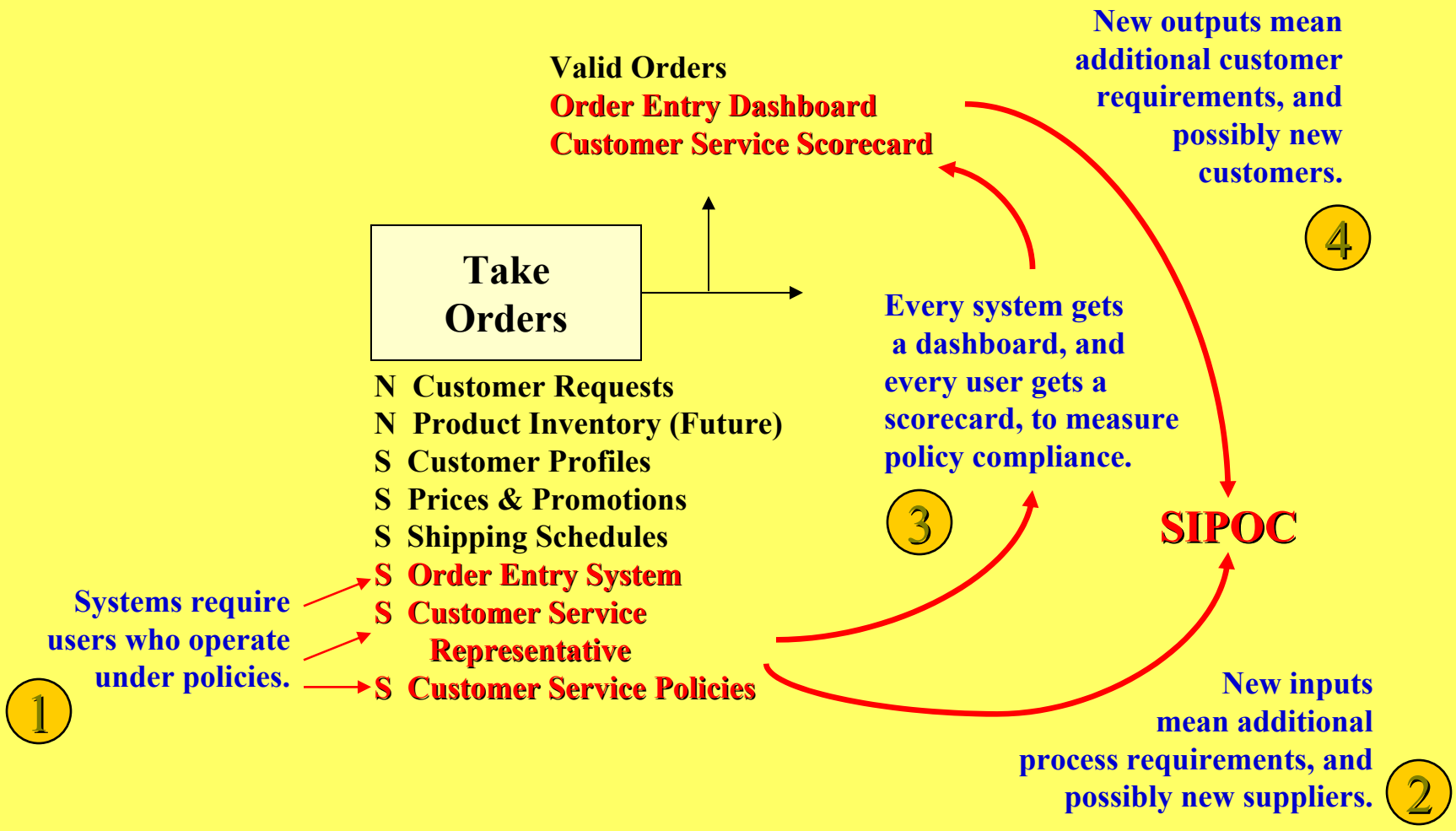


N Customer Requests
N Product Inventory (Future)
S Customer Profiles
S Prices & Promotions
S Shipping Schedules
S Order Entry System
S Customer Service Representative
S Customer Service Policies

Automation → **Augmentation**

Augmentation is more encompassing of a full DFSS design than simple automation.

Augmentation Impact



Augmentation Metric Examples

Order Entry Dashboard

- Response & cycle times
- Number of screens required
- Remote processing demand
- Network bandwidth used
- Pop-up conditions encountered
- Help functions invoked
- Field errors by type

Customer Service Scorecard

- Pickup rings & abandon rate
- Cycle time per transaction
- Transactions per hour
- Error rates by type
- Satisfaction ratings
- Callbacks per transaction
- Exceptions handled
  w/ & w/o supervisor intervention

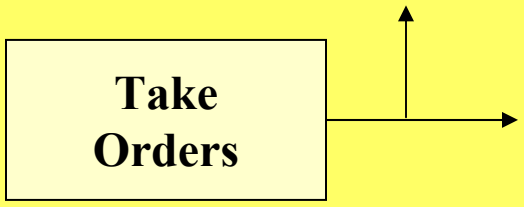
Unit Definition

Order *for* SKU *from* Warehouse *via* Shipment *on* Date

Unit Metrics

Unit { counts, value, volume } by { order, customer, product, warehouse, date } by { service rep, transaction, time period }

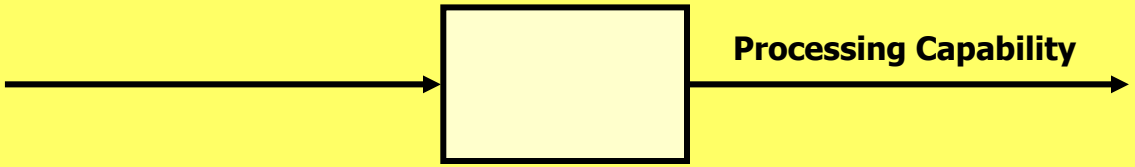
Valid Orders
Order Entry Dashboard
Customer Service Scorecard

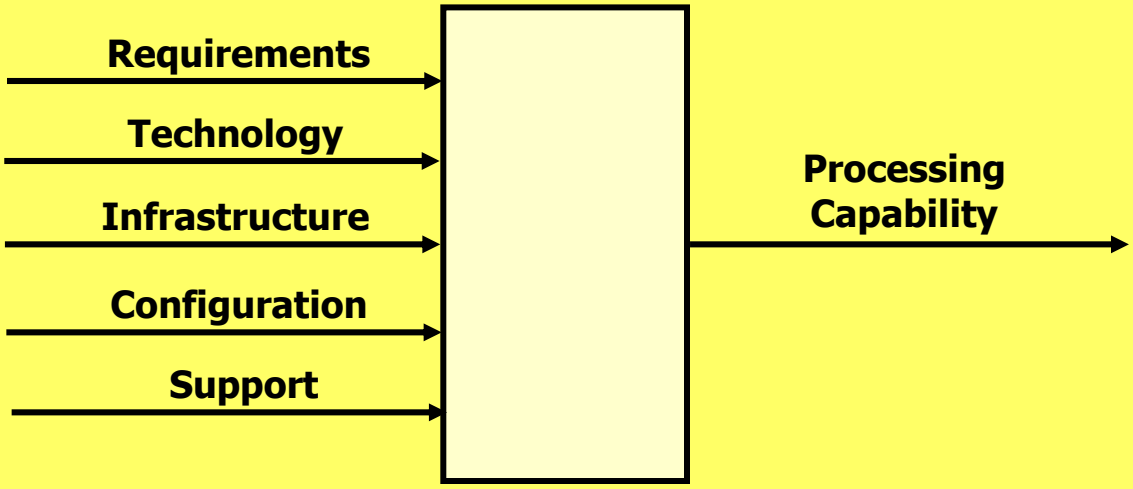


Enablement

Enablement

Business process includes making IT systems or functions available. The process *enables* the customers.





Enablement Focus

Enablement processes aren't about producing software systems or components.

Software systems are produced, installed, and operated from *within* the process to provide the processing capability.

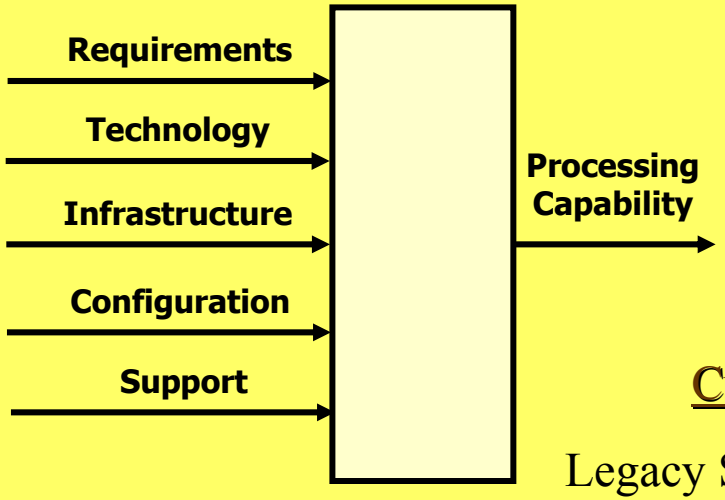
Decisions to buy, build, or adapt are visible only *within* the process.

Automation Example

Data Warehousing Process

Supplier	Input
Legacy Systems	Data to be transformed and loaded into the warehouse.
Analysts	Regular and ad hoc analysis report and query specifications.
System Administrator	User and group authorizations and profiles.
Customer	**Output**
Management	Analysis of the data stored in the warehouse.

vs. Enablement Example



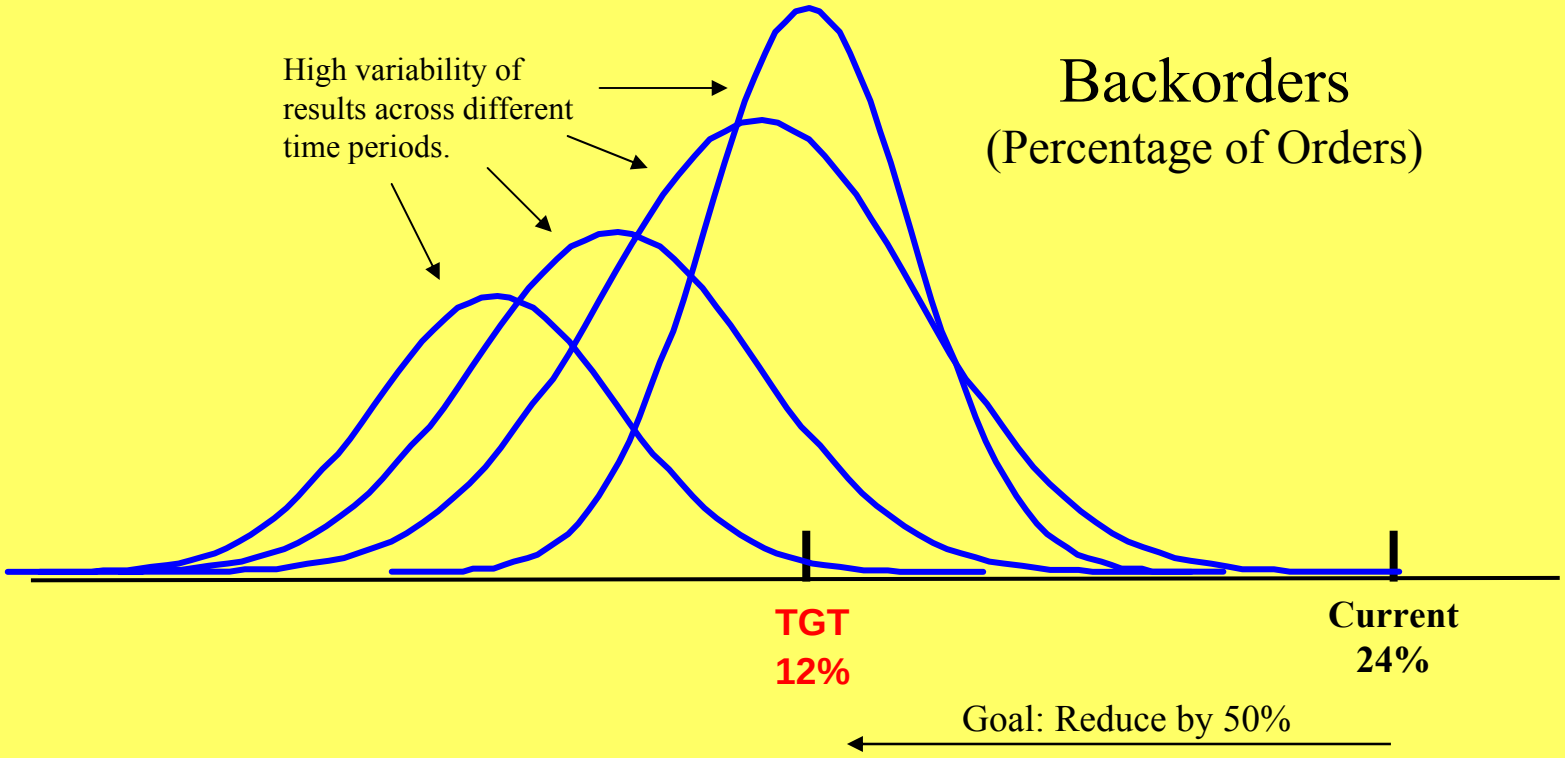
Data Warehousing System Process

Customer	Output
Legacy Systems	Capability to send required data to be transformed and loaded into the warehouse.
Analysts	Capability to specify regular and ad hoc analysis reports and queries.
System Administrator	Capability to define and manage user and group authorizations and profiles.
Management	Capability to request and receive analysis of the data stored in the warehouse.

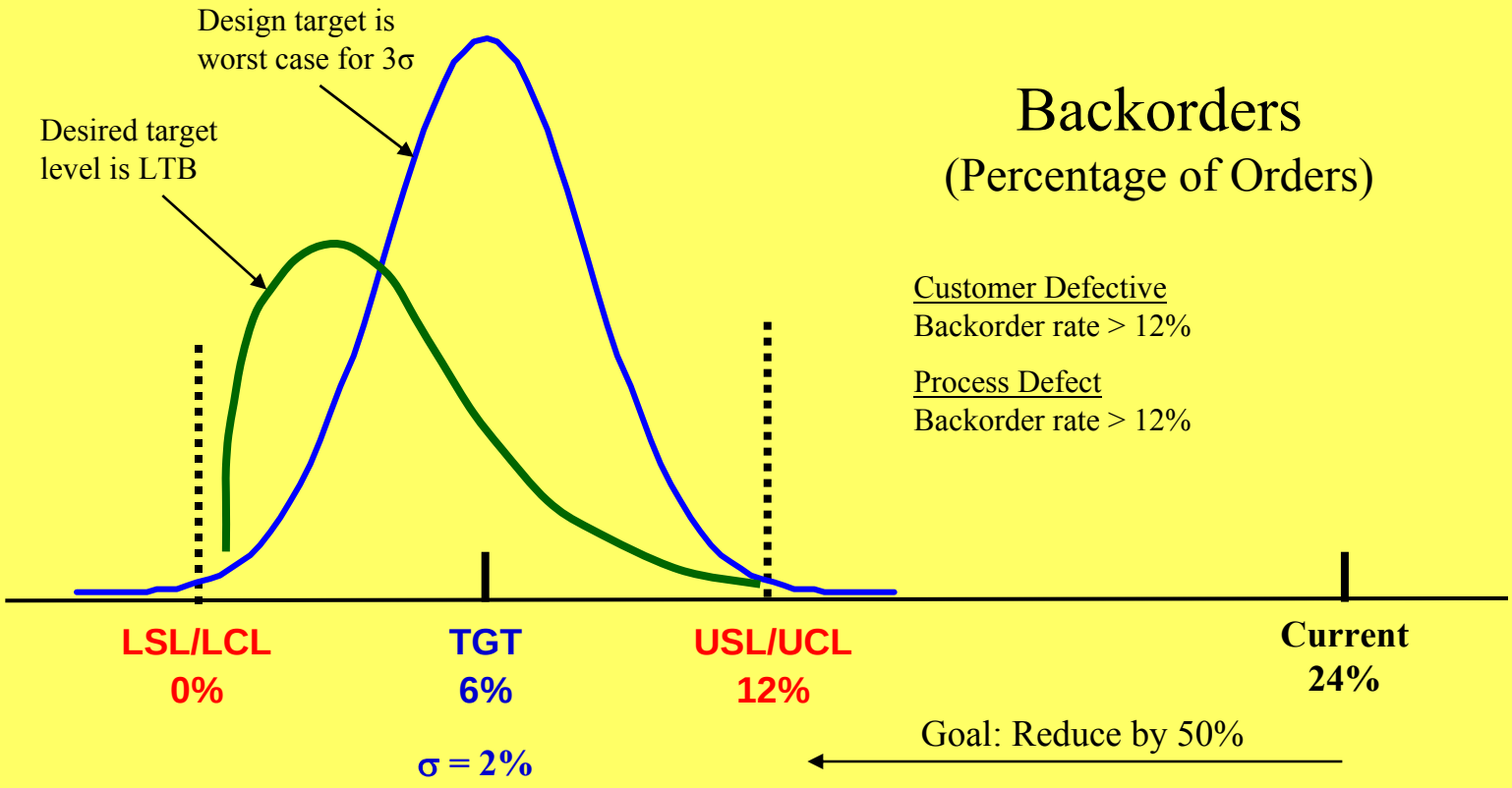
Key Question #4

- **How does Six Sigma use the dashboard and scorecard measures to build 6-sigma levels of quality into software systems?**

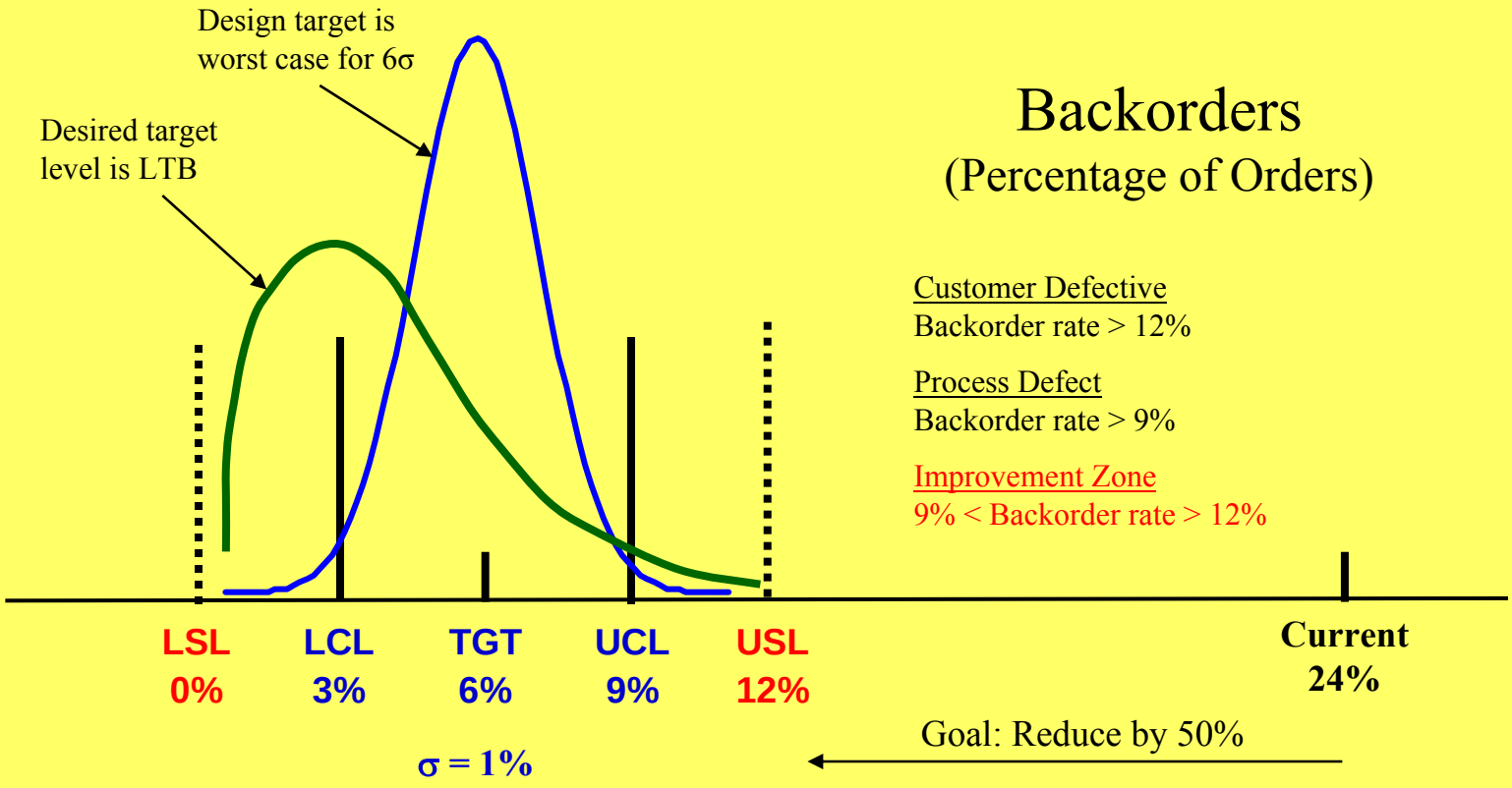
Goal-based Improvement



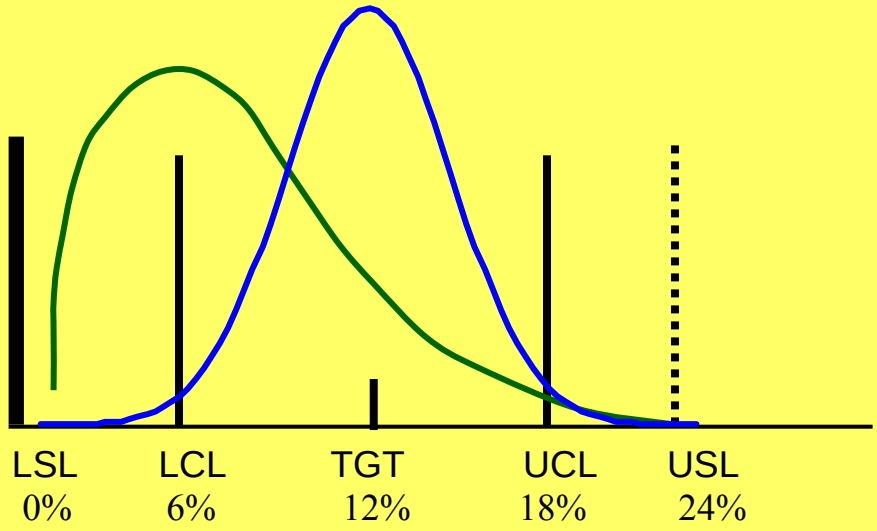
TQM-based Improvement (3σ)



Six Sigma Improvement (6σ)



Video Store Example
"ABANDON RATE" QFD



QFD1
(Business Requirements)

Maximize Visits with Rentals

(Rental Rate = Rental Visits / Total Visits

Abandon Rate = 1 - Rental Rate **< 24%**

QFD2
(Functional Spec)

Count Visits

(Individuals/Groups renting as a Unit, not necessarily arriving or departing together)

Monitor Rate

(Rolling 3 hrs, skip closings, compute every 20 minutes)

Alert Zone

(AR > 18%)

QFD3
(System Design)

Data for Visit Counts

(timestamp event, or 20 minute buckets incremented, boundary error for uncount)

Alerts for staff when in Zone

(Pop-up window for client-registers)

F8 for counts

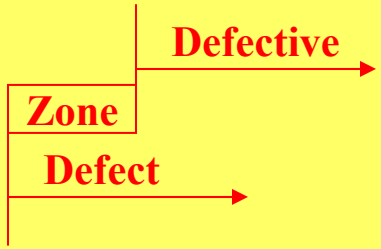
(Record event, or increment current bucket)

F9 for uncounts

(Record unevent, or decrement current bucket)

Java Scripts for monitoring

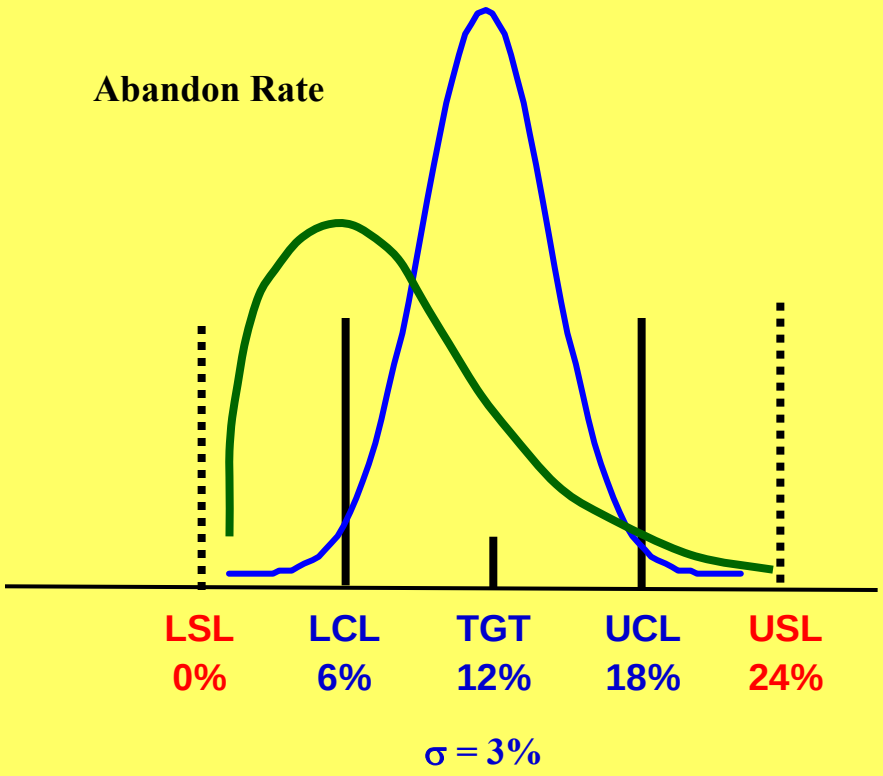
(Background tasks)



QFD4
(Operations)

Zone Procedure

Staff Training



QFD4

Alert Zone	
Active for Defects	Active for Defectives
3	3
3	3
3	3
3	3
3	3
3	3
3	3
3	3
18% < Abandon Rate < 24%	Abandon Rate > 24%

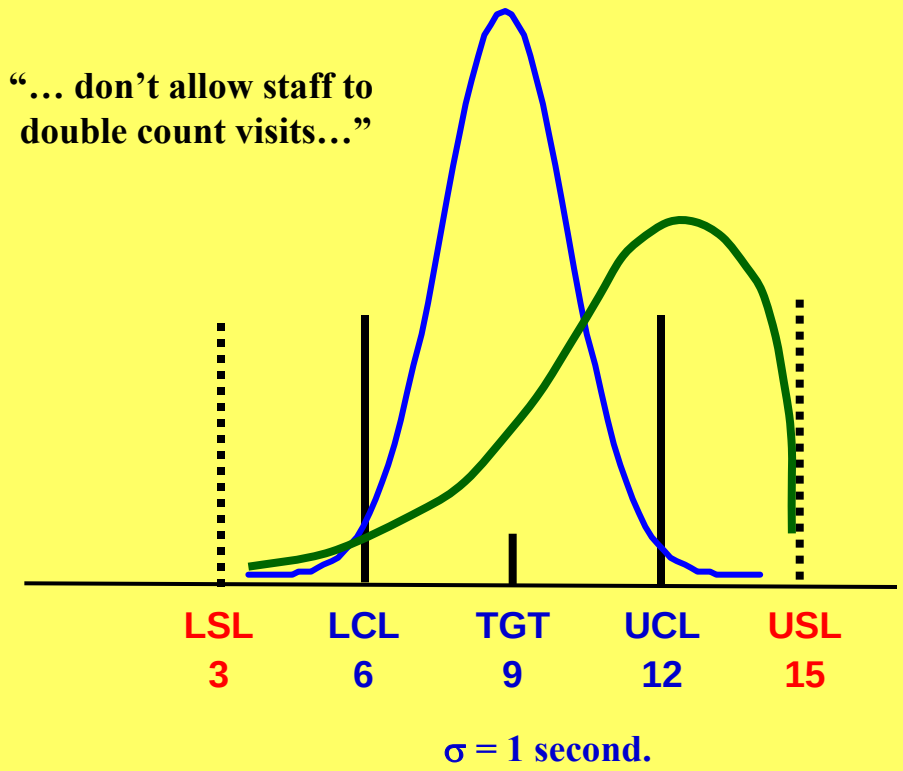
Control Plan

USL – Review by management for service/inventory weakness

UCL – Immediate customer-focused reaction by staff in store

LCL – Review by management for possible growth options

LSL – n.a.



QFD2

Count Visits
Multi-user Multi-count Gap
3
3
3
3
3
3
3
3
LSL=3, MTB, TGT=9, σ=1 second

Control Plan

USL – n.a.

UCL – n.a.

LCL – Review frequency for possible double counting

LSL – Presume erroneous double count by staff

Implications for Software Organizations

- **As processes are redesigned to align with Six Sigma thinking, software engineers have an opportunity to implement controls that take advantage of the improvement zone between 3σ and 6σ process performance.**
- **By building critical customer metrics into software solutions, applications can be made self-correcting by enabling specific actions to be taken when process defects are seen in the improvement zone.**
- **These actions need not always involve sophisticated technical solutions to be beneficial. Controls can be as simple as an e-mail notifying support staff of defects above the 3σ level, or a periodic report highlighting activity in the 3σ to 6σ zone.**
- **The point isn't to build software without defects, but to build software solutions that can be kept from producing defectives in spite of their defects. That is the essence of Six Sigma for software.**

Thank you!

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