Project Control & Management

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Lecture 6

Subjects

Project Management in Engineering Environments

1. Process breakdown for **Delivery**
2. Product **Integrity and Reliability**
3. **Cost** factors and management (Cost Control)

Recommended Reading

1. Mousavi, A ., Adl, P., Rakowski, R.T., and Gunasekaran, A. (2001) , " Customer Optimisation Route and Evaluation (CORE)", International Journal of Computer Integrated Manufacturing, Volume 14, Number 2, pp. 236 – 243.
2. Mousavi A. , Adl, P., Rakowski, R.T. and Gunasekaran, A. (2001), "Design of Production Planning System Using Customer Oriented Design And Resource Utilisation (CODARU)", International Journal of Advanced Manufacturing Technology, Volume 17, Issue 11, pp. 805-809.
3. www.satistica.com,
4. www.theCqi.org presentation by John Skinner 2012, CQI Wessex, rdaconsultancy.com

Cost Management Parameters

A. Earned Value Management (EVM):
   - Budget Controls
   - Cost Performance Index
   - Schedule Performance Index
   - Cost Variance
   - Schedule Variance
   - Estimate at Completion

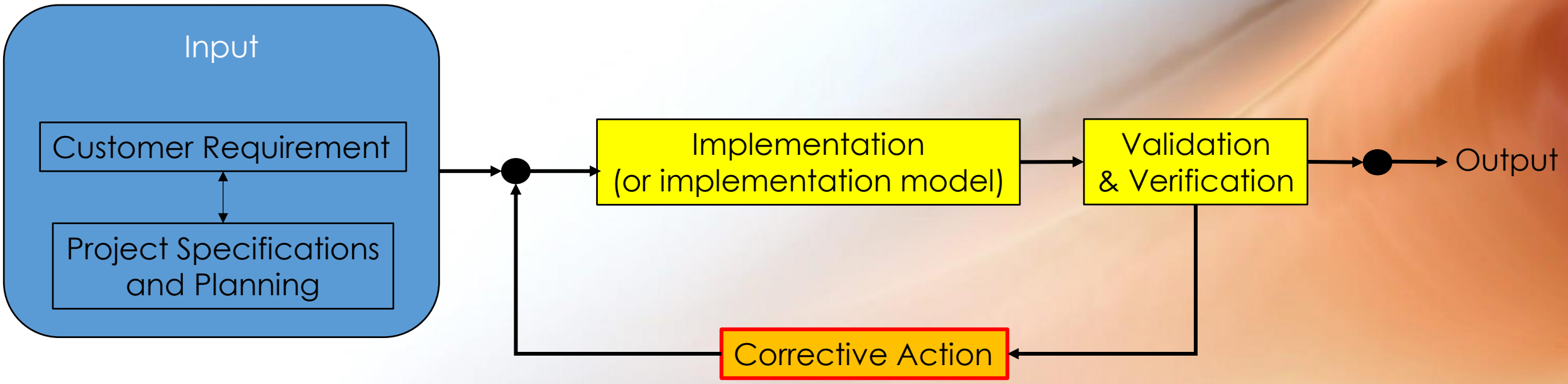
B. Project Process Quality Assurance and Customer Satisfaction
   1. Process efficiency (energy, material, effort, waste, and yield)
   2. Levels of customer satisfaction towards product attributes.

Instruments for Monitoring & Control 1

- Design and Process Planning
- Resource Planning (status of resources throughout the project life-cycle)
- Customer requirements and interpretation into product specification (Continuous/Discrete Events(intervals)/one-shot)

- Expenditure against product/project progress (people, material, equipment, and **customer satisfaction**)

Simple Closed-Loop Control Diagram



Project Process Quality Assurance

The are a wide variety of techniques you can develop in-house and deploy.

Factors for Monitoring Process Quality

Factors	Definitions	Methods/Techniques
Process Quality Assurance	Defining set of standards and continuously measuring progress against those standards.	Statistical Process Control, Six Sigma, in-house quality monitoring methods. Could be analytical or heuristic methods
Quality Function Deployment	Modularisation and Conceptualisation ethos. Breaking down the process into key steps and deploying performance measurement activities –	Turning subjective parameters into measurable/comparable metrics – from words into numbers.
Product Specification	Design to manufacture process. Translating product functionalities into technical enablers.	Design for Manufacturing techniques, CAD, CAE, CAM …
Resource Capability Assessment	Human Resources, Machinery, and Equipment key characterises and properties that enable the project to progress	Individual/team capability assessment and Overall Equipment Effectiveness, and Processes capability assessment

Example Project Status Table (link)

source: Project Management of Complex and Embedded Systems, **K.H. Pries and J.M. Quigley**, Auerbach Publications, Taylor & Francis Group, 2009. ISBN: 978-1-4200-7205-1

Process and Product Planning Control

1. Failure Mode and Effect Analysis (FMEA):
   - Design FMEA (DFMEA)
   - Process FMEA (PFMEA)
2. Process Plan and Control
3. Process Capability

Failure Mode and Effect Analysis (FMEA)

DMFEA and PFMEA are a set of systematic activities to:

a) Recognise and assess the potential causes and effects of failure
b) Identify corrective actions to prevent and minimise damage caused by failure

at both design and manufacturing process planning stages.

J. Skinner suggests for DFMEA:

DFMEA							System					FMEA Number:	001				
FMEA Team:	xxxxxxxx						Subsystem					FMEA Date: (Original)	xxxxxxxxxx				
Team Leader:	xxxxxxxx					X	Component	xxxxxxx				(Revised)					
													Action Results				
Item and Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence	Current Controls - Prevention	Current Controls - Detection	Detection	RPN	Recommended Action	Responsibility and Target Completion Date	Action Taken	Severity	Occurrence	Detection	RPN
			9			5			5	225				9	3	3	81

$$RPN = Severity \times Occurence \times Detection$$

J. Skinner suggests for PFMEA

PFMEA							System			
FMEA Team:	xxxxxxxx						Subsystem			
Team Leader:	xxxxxxxx					X	Component	Wheel hub/new design		
Item and Function/ Requirements	Potential Failure Mode	Potential Effect(s) of Failure	Severity	Class	Potential Cause(s)/ Mechanism(s) of Failure	Occurrence	Current Controls - Prevention	Current Controls - Detection	Detection	RPN
			9			5			6	270

		FMEA Number: 001				
	FMEA Date: (Original) xxxxxxxxxx					
	(Revised)					
		Action Results				
Recommended Action	Responsibility and Target Completion Date	Action Taken	Severity	Occurrence	Detection	RPN
			9	5	3	135

Process Control

- Could be a direct output from DFMEA and PFMEA
- Detailed description of product development (design, prototyping, testing, and production)
- Each part and component need to be trackable and traceable throughout the project life-cycle

J. Skinner suggests for Process Control

Control Plan								
Part #:		N/A	Prepared By:		xxxx			
Part Name/Description:		Wheel Hub / new design	Core Team:		xxx, xxx, aaa, bbb, ccc		Notes:	
Latest Change Level:		#REF!	Supplier/Plant App./Date:				Production Control Plan	
Vendor ID:		#REF!	Other Approval/Date:					
		#REF!	Supplier Plant/Code:					
Oper. #	Process Description	Machine/Device/Jig/Tools	Characteristics			CC		
			Item#	Product	Process	SC	Process/Pdt. Spec./Tolerance	G.ID
70	OP 70; Finish machine bearing bores (CNC)	XXX CNC machining centre		Bearing Inner Bore diameter	Finish machine; 25mm/min, CBN tip (XYZ)	CC	75 +0.008 -0.000 mm 0.003 mm run out max	In cycle gauging.

J. Skinner suggests for Process Control cont.

	Date (Original):		xxxxx		
	Customer Engg. Appr./Date (Opt):				
	Cust. Quality Appr./Date (Opt):				
	Other Approval/Date (Optional):				
	Control Plan No.:		CP001		
Methods					
Eval. Mst. Technique	Sample Size	Sample Frequency	Control Method	Reaction Plan	
In cycle gauging.	100%	100%	Machine control datalogger	Lock out; setter informed, machine checked and re-set. Suspect material quarantined; (Corrective Action Report - CAR)	

Process and Product Planning Control

1. Failure Mode and Effect Analysis (FMEA):
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   - Process FMEA (PFMEA)
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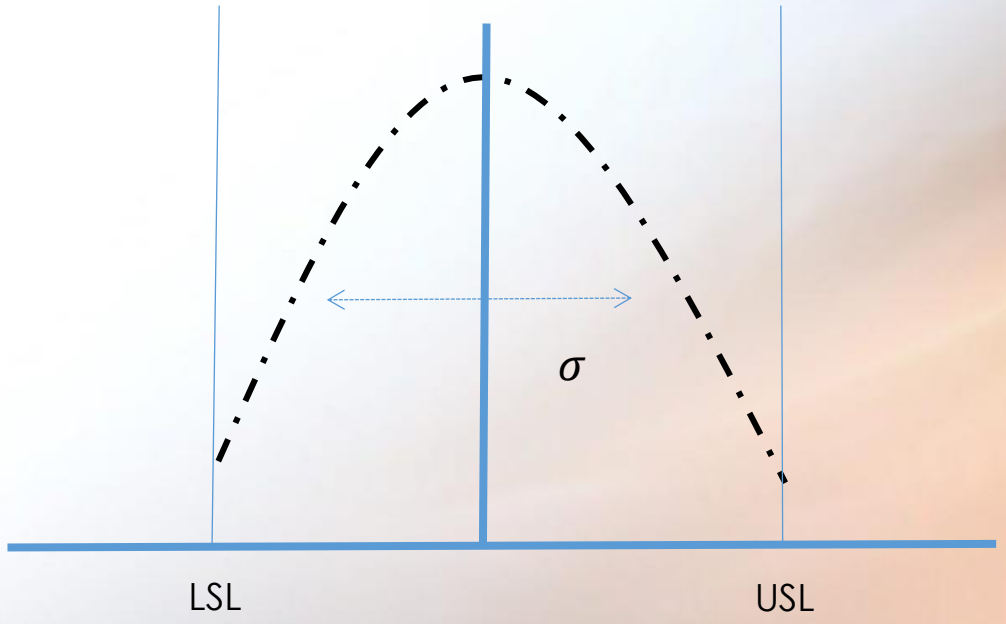
Process Capability

- Similar to human resource capability, estimates the capability of the processes to meet project requirements
- It provides indications of the performance variability and where the output is against expectations and system constraints

CP: Estimates what the process is capable of producing if the process mean were to be centred between the specification limits.
CP lower: Estimates process capability for specifications that consist of a lower limit only (for example, strength)
CP higher: Estimates process capability for specifications that consist of an upper limit only (for example, concentration)

Process Capability Indices

- Assuming a normal distribution of a process variation possibility of occurrence



Process Variation

σ : Standard deviation

$$Capability\ Index:\ CP = \frac{USL - LSL}{6\sigma}$$

$$CP_k = \frac{\mu - LSL}{3\sigma}$$

$$CP_k = \frac{USL - \mu}{3\sigma}$$

Given a Normal Distribution

C_{pk}	Sigma level (σ)	Area under the probability density function $\Phi(\sigma)$	Process yield	Process fallout (Defects per million)
0.33	1	0.6826894921	68.27%	317311
0.67	2	0.9544997361	95.45%	45500
1.00	3	0.9973002039	99.73%	2700
1.33	4	0.9999366575	99.99%	63
1.67	5	0.9999994267	99.9999%	1
2.00	6	0.9999999980	99.9999998%	0.002

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