Improving monitoring of project technical performance by using CRIP charts

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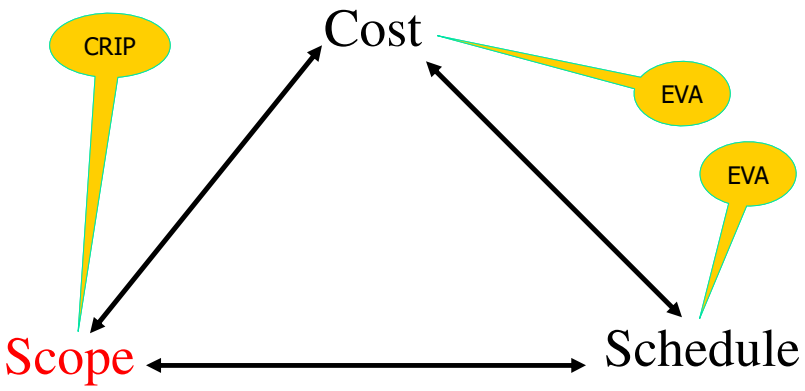
Objectives

1. To understand the need for the CRIP Chart or equivalent
2. To learn about the CRIP Chart
3. To understand the associated benefits of the CRIP approach
   - You can do things that cannot be done in the current paradigm

Discussed in the context of a complex project taking months or longer to complete

Triple constraints



A change in one affects the others

Earned Value Analysis

- Based on financial numbers
- Tells you
  1. Amount (%) of budget spent
  2. Amount (%) of planned work done
  3. Amount (%) of time elapsed
- Does not
  1. Answer the question "How much of the project has been completed?"*
  2. Identify potential technical problems in near real-time so as to be able to mitigate them

Kasser J.E., *What Do You Mean, You Can't Tell Me How Much of My Project Has Been Completed?*, proceedings of INCOSE 7th International Symposium, Los Angeles, CA, 1997.

Need to measure instead/as well*

- Requirements
  - Various shapes and sizes
  - Can be a large number
- Function points
  - Applies to
    - software projects, software sections of a project
  - Various shapes and sizes
  - Can be a large number
  - Complex to calculate
- Something useable (need)
  - Roll up the detailed information into a summary that can be displayed in one or two charts
  - Readily relate to the existing cost and schedule information

* *Continuum* perspective

Work Package (WP)*

Identification number	Estimated cost to implement
Name of activity/task	Accuracy of cost estimate (±%)
Traceability to source of work (**Requirements**)	Prerequisites (milestones and products)
Narrative (description) of activity/task	Resources (people, equipment, material)
	Name of person responsible for activity/task
Reason activity/task is being done	**Risks** (probability, seriousness, mitigation WP IDs)
Priority	Lower level WP ID's (if any)
Schedule (± accuracy)	Decision points (if any)
Products (outputs)	Internal key milestones (if any)
Acceptance criteria for products	Assumptions not stated elsewhere

* The systems approach to planning

Categorized Requirements in Process (CRIP)*

- Work is based on meeting requirements
  1. Identify categories for requirements
     - Cost, complexity, priority, risk, etc.
  2. Quantify each category into ranges
  3. Place each requirement into a range
  4. Summarise requirements in range
  5. Monitor the **changes** in the **state** of each **of the** category **summaries** of requirements between the reporting milestones
     - Over time

* Perceptions of Systems Engineering, Chapter 19, "A way to measure technical progress"

1. Identify categories

- Cost (estimated)
- Complexity
- Priority
- Risk probability
- Risk severity
- Estimated completion time
- Technology Readiness Level (TRL)
- Function
- Custom for project
- Etc.

Different perspectives or attributes of requirement

2. Quantify each category into ranges

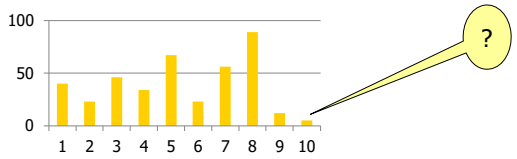
- Ranges determined by buyer/supplier
  - 1 … 10, 1 … 5 (risk)
  - A … J
  - Easy , Medium, Ugly, Hard
  - Etc.
- **Rules for range assignment shall not change over project lifecycle**
- **Requirements can move between ranges as work progresses**
  - If actual is different to estimate
- Examples
  - Cost:
    - Range 1: <$50
    - Range 2: >=$50 and <$100, etc.
  - Complexity:
    - Range A: <100 FP
    - Range B: >=100 and <300 FP etc.
  - Risk probability and severity
    - 1 … 5

3. Place each requirement into a range

- Assign/calculate value for each requirement in each category
- Category 'priority'
  - Assign priority to each requirement
- Category 'risk'
  - Assign risk probability to each requirement
  - Assign risk severity to each requirement
- Category 'complexity'
  - Estimate complexity of system that will perform function specified
    - **Estimates do not need to be very accurate, but must be consistent**
- Category 'cost'
  - Estimate cost to realize each requirement
    - **Estimates do not need to be very accurate, but must be consistent**

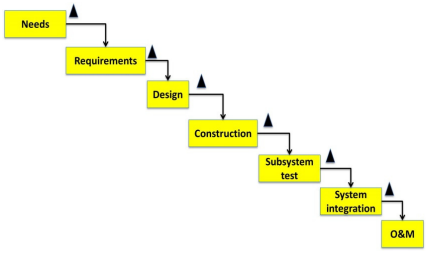
4. Summarize requirements in ranges

- For each category
- Use spreadsheet or tool to:-
  - Sum number of requirements in each range
  - Display histogram bar chart of totals
- If necessary, balance numbers in each range by adjusting range limits
  - E.g. if 90% of requirements are in same range



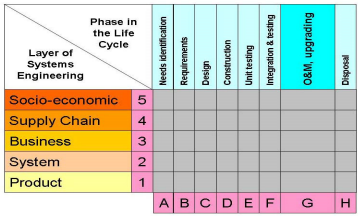
5. Monitor the **changes in the state** of each of the **category summaries** of requirements over time

- System Development Process (SDP) states
- Milestones transition between SDP states
- CRIP states
- CRIP Charts



- Prepare and present CRIP Charts as part of a milestone review

System Development Process (SDP) States

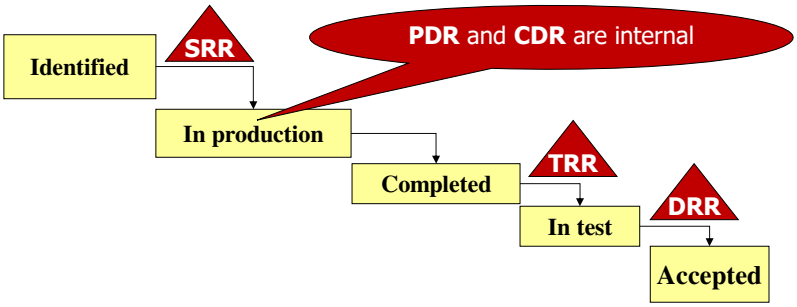


A. The Needs Identification State
B. The Requirements State
C. The System Design State
D. The Subsystem Construction State
E. The Subsystem Test State
F. The System Integration and System Test States
G. The Operations, Maintenance (O&M) and Upgrade States
H. The Disposal State

Summary of Milestone reviews

- Start of project
  - *Operations Concept Review (OCR)* at the end of the Needs State
  - *Systems Requirements Review (SRR)* at the end of the Requirements State
  - *Preliminary Design Review (PDR)* at the end of the Preliminary design sub-State of the System Design State
  - *Critical Design Review (CDR)* at the end of the System Design State
  - *Test Readiness Review (TRR)* at the end of the Subsystem Construction State
  - *Integration Readiness Review (IRR)* at the end of the Subsystem Testing State
  - *Delivery Readiness Review (DRR)* at the end of the System Integration State
- End of project

Five CRIP states for a requirement



In production of single system or prototype

As work progresses, any requirement shall only be in one state at a time

CRIP Chart (Category X)

Planned **E**xpected **A**ctual

Range	Identified			In process			Completed			In test			Accepted		
	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1															
2															
3															
4															
5															
6															
7															
8															
9															
10															

'P' links to 'Work to be scheduled for **next reporting** period'
'E' links to 'Work Scheduled at last milestone for **this reporting** period"
'A' links to 'Work Performed in **this reporting** period'

Movement in chart rows

Identified				In process		
P	E	A		P	E	A

- The columns in each CRIP state
- In a column (e.g. Identified)
  - **P**lanned CRIP Chart at <u>from last</u> milestone ➔ **E**xpected in CRIP Chart at <u>this</u> milestone
    - Provides baseline for this milestone (just copy the numbers)
  - **E**xpected CRIP Chart at <u>from last</u> milestone ➔ (±~) **A**ctual in CRIP Chart at <u>at this</u> milestone*
    - Represents actual work accomplished (**A** may or may not = **E**)
- Across columns (e.g. Identified ➔ In process)
  - **A**ctual in CRIP Chart at <u>at this</u> milestone ➔ (provides input to) **P**lanned <u>for next</u> milestone
    - Represents baseline for work planned in next phase (**P** may or may not = **A**)

Movement in chart rows

Partial CRIP Chart at CDR for a specific row

	In process			Completed		
P	E	A		P	E	A
20	10	10		10		

Partial CRIP Chart at TRR (subsequent milestone) for the same row

	In process			Completed		
P	E	A		P	E	A
0	20	10	Catch up (10+10)	20	10	

- P→E in same CRIP State in subsequent Charts
- Depending on work done
  - E→A same CRIP State
- Depending on work planned
  - A→P in subsequent CRIP State in same Chart

CRIP chart at start of project for category X

	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	86	0												
2	0	73	0												
3	0	23	0												
4	0	34	0												
5	0	26	0												
6	0	15	0												
7	0	8	0												
8	0	7	0												
9	0	5	0												
10	0	2	0												
Totals	0	279	0												

CRIP Chart at SRR for category X

	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	86	81	81											
2	0	73	78	78											
3	0	23	35	35											
4	0	34	30	30											
5	0	26	26	26											
6	0	15	20	20											
7	0	8	8	8											
8	0	7	7	7											
9	0	5	5	5											
10	0	2	2	2											
Totals	0	279	292	292											

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CRIP Chart at PDR for category X (nominal)

	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	0	0	0	81	81	0								
2	0	0	0	0	78	78	0								
3	0	0	0	0	35	35	0								
4	0	0	0	0	30	30	0								
5	0	0	0	0	26	26	0								
6	0	0	0	0	20	20	0								
7	0	0	0	0	8	8	0								
8	0	0	0	0	7	7	0								
9	0	0	0	0	5	5	0								
10	0	0	0	0	2	2	0								
Totals	0	0	0	0	292	292	0								

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CRIP Chart at CDR for category X (nominal)

	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	0	0	0	0	81	81								
2	0	0	0	0	0	78	78								
3	0	0	0	0	0	35	35								
4	0	0	0	0	0	30	30								
5	0	0	0	0	0	26	26								
6	0	0	0	0	0	20	20								
7	0	0	0	0	0	8	8								
8	0	0	0	0	0	7	7								
9	0	0	0	0	0	5	5								
10	0	0	0	0	0	2	2								
Totals	0	0	0	0	0	292	292								

CRIP Chart for category X at DRR

	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	0	0	0	0	0	0	0	0	0	81	81	81		
2	0	0	0	0	0	0	0	0	0	0	78	78	78		
3	0	0	0	0	0	0	0	0	0	0	35	35	35		
4	0	0	0	0	0	0	0	0	0	0	30	30	30		
5	0	0	0	0	0	0	0	0	0	0	26	26	26		
6	0	0	0	0	0	0	0	0	0	0	20	20	20		
7	0	0	0	0	0	0	0	0	0	0	8	8	8		
8	0	0	0	0	0	0	0	0	0	0	7	7	7		
9	0	0	0	0	0	0	0	0	0	0	5	5	5		
10	0	0	0	0	0	0	0	0	0	0	2	2	2		
Totals	0	0	0	0	0	0	0	0	0	0	292	292	292		

CRIP Chart for category X showing requirements creep at PDR

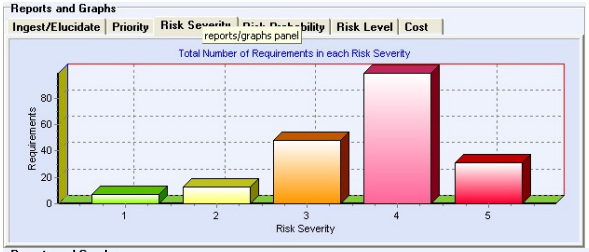
	Identified			In process			Completed			In test			Accepted		
Range	P	E	A	P	E	A	P	E	A	P	E	A	P	E	A
1	0	0	20	0	81	101	0								
2	0	0	0	0	78	78	0								
3	0	0	0	0	35	35	0								
4	0	0	0	0	30	30	0								
5	0	0	2	0	26	28	0								
6	0	0	0	0	20	20	0								
7	0	0	4	0	8	12	0								
8	3	0	0	0	7	7	0								
9	0	0	0	0	5	5	0								
10	0	0	0	0	2	2	0								
Totals	3	0	26	0	292	318	0								

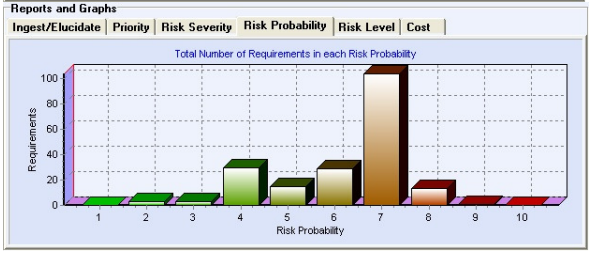
Impact of additional work should show on EVA cost and schedule charts

Associated benefits

1. Questions at SRR that cannot be asked currently
   - Are requirements that are 'low priority' + 'high risk' really needed?
   - Are requirements that are 'low priority' + 'high cost to realize' really needed?
   - Are requirements that are 'high risk' + 'high cost to realize' really needed?
2. Functionality lost due to budget cuts are those with lowest priorities
3. Shows if high priority requirements are being worked on before lower priority requirements
4. Risk
   - Management Plans are mainly printouts from WP database
   - Profiles
     - Risk, priority and other categories

Project Risk profiles at SRR





Risk: Are these reasonable?

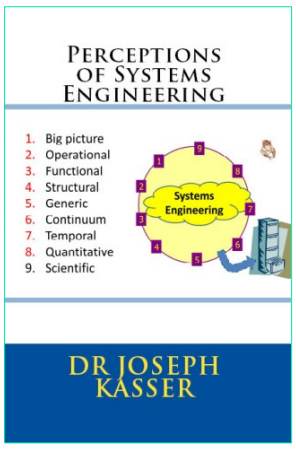
Charts from Tiger Pro, educational holistic requirements management tool

Meeting the objectives

1. Explained the need for the CRIP Chart or equivalent ✔
2. Explained the CRIP Chart ✔
3. Explained the associated benefits of the CRIP approach ✔
   - Doing things that cannot be done in the current paradigm

By the way,
CRIP Charts can also be used for scenarios, use cases or other ways of describing system functionality

Any questions ?



Chapter 19