



33rd Annual **INCOSE**
international symposium

hybrid event

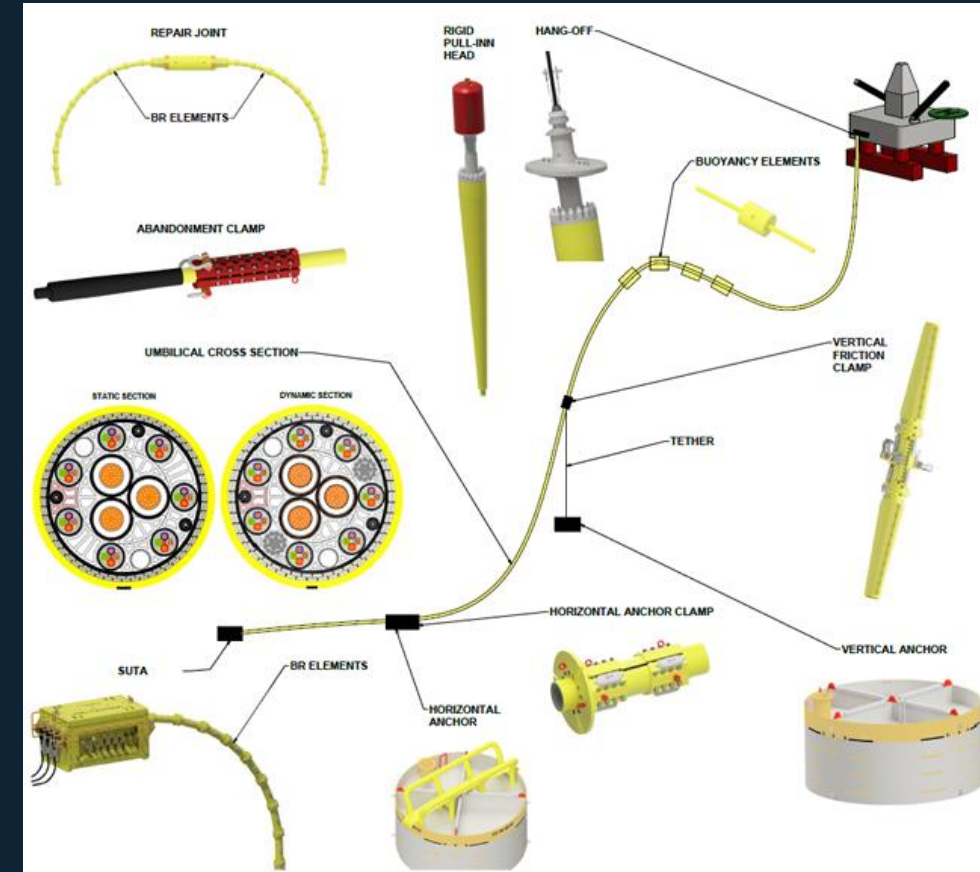
Honolulu HI USA



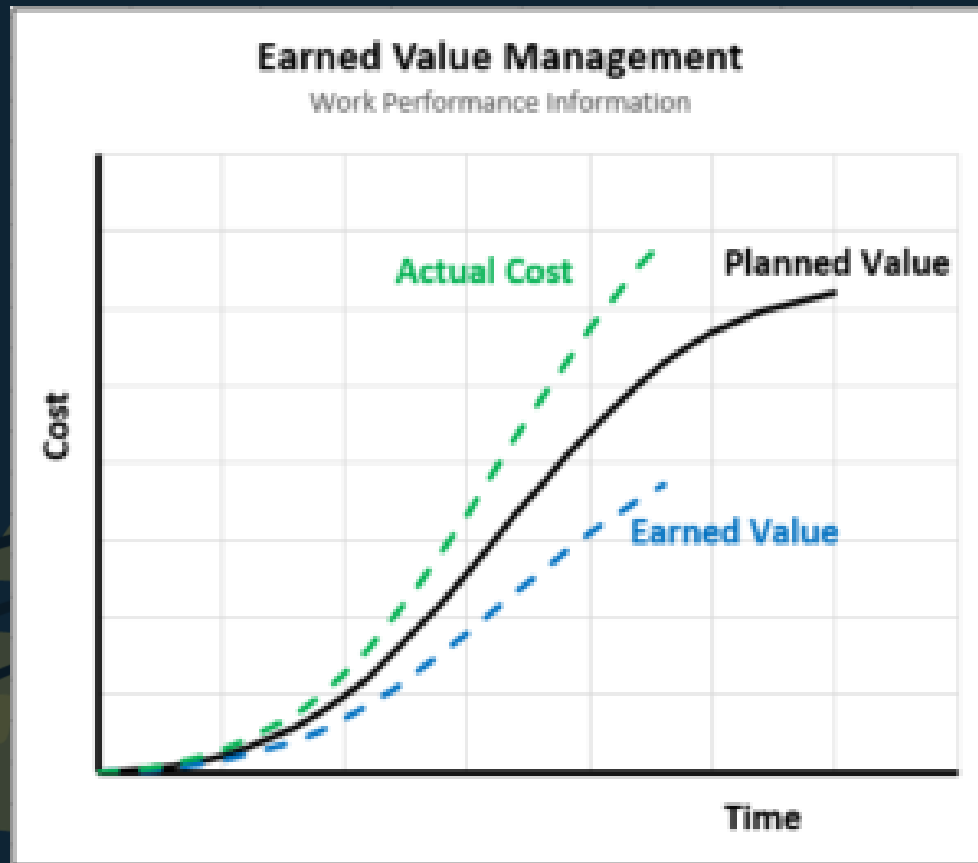
Proposing a novel combination of Earned Value Management and Requirements Management

Cable Supplier – EPCI provider of umbilical systems

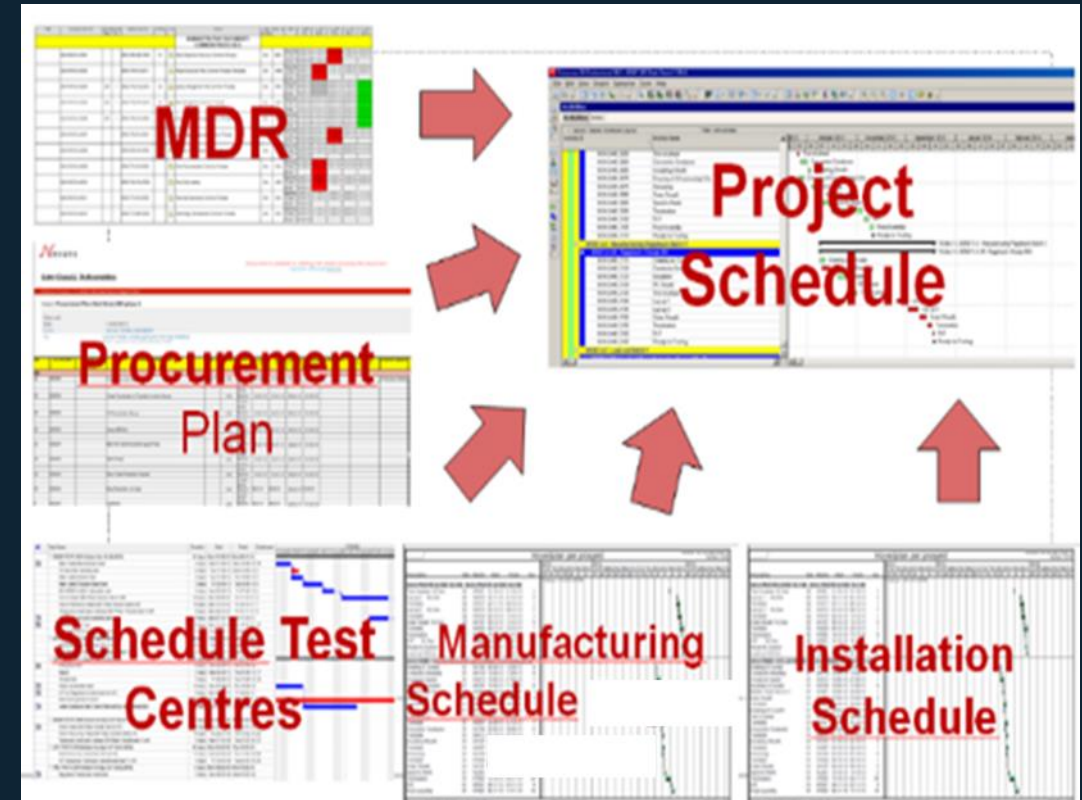
- A world leader
- One-off projects
- Project management department
- Earned Value Management – implemented 2015



Earned Value Management in Cable Supplier



B. Roseke (2018)



Why is it not used?

- The graphs are sent to the clients
- No internal usage
- Can it be improved so that employees find it useful?

The limitations of EVM in Cable Supplier - Precision

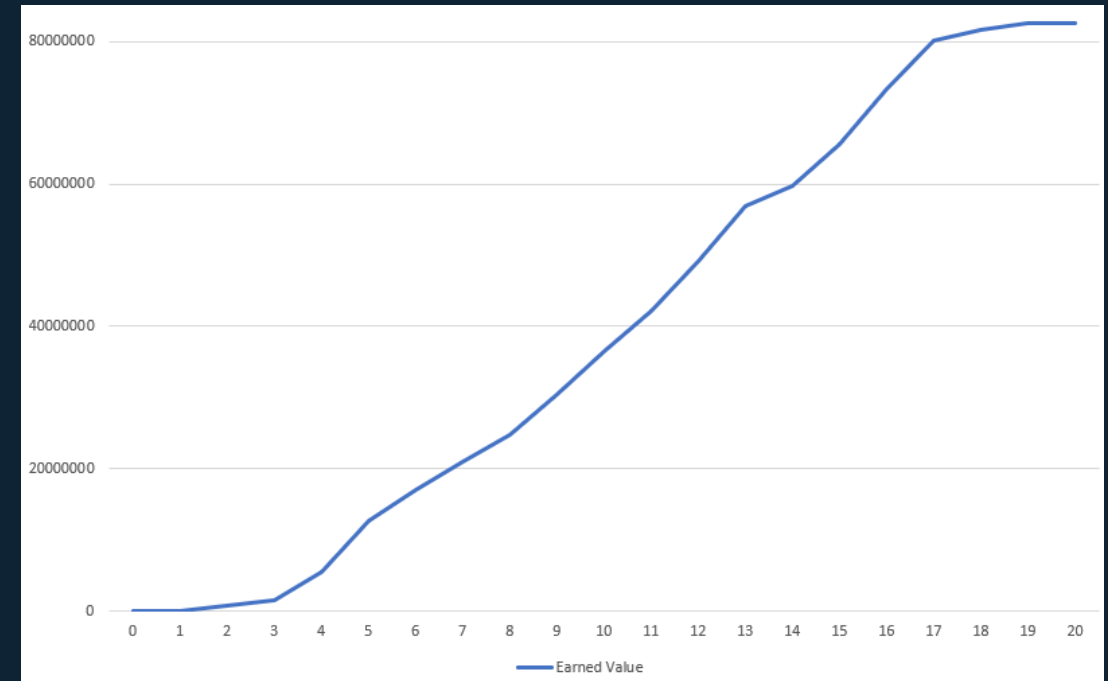
How good is the input used for reporting

- Dependent on a reliable and linear flow
- Important to accurately define value-generating work
- May lose focus
- Almost entirely based on the progress of documents

The limitations of EVM in Cable Supplier – Degree of coverage

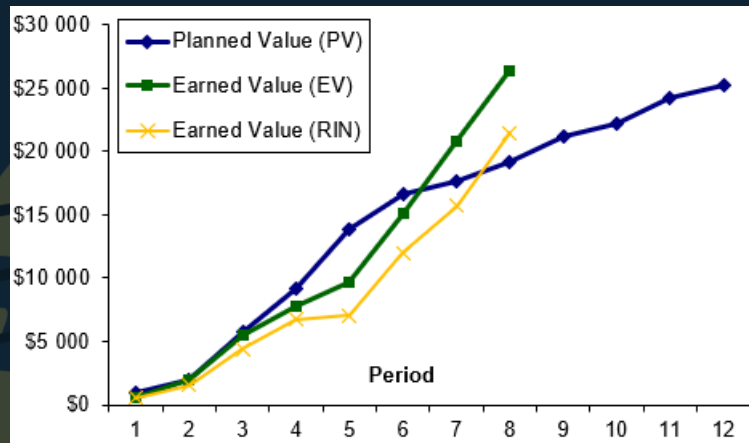
What does the values represent:

- Quality?
- Technical performance?
- Slack?
- Risk?



Option 1 – Requirement Index Value

- Each requirement is given a numerical value (1-5), a verification method and date for completion.
- Verification method is typically documentation (GA drawings, analyses and procedures) and/or testing.
- The achievement of requirements are continuously traced, and the actual value is compared to the planned = Requirement Index Number (RIN)
- $\text{Earned Value (RIN)} = \text{EV} * \text{RIN} = \text{Earned value adjusted for late and earlier achievement of requirements.}$

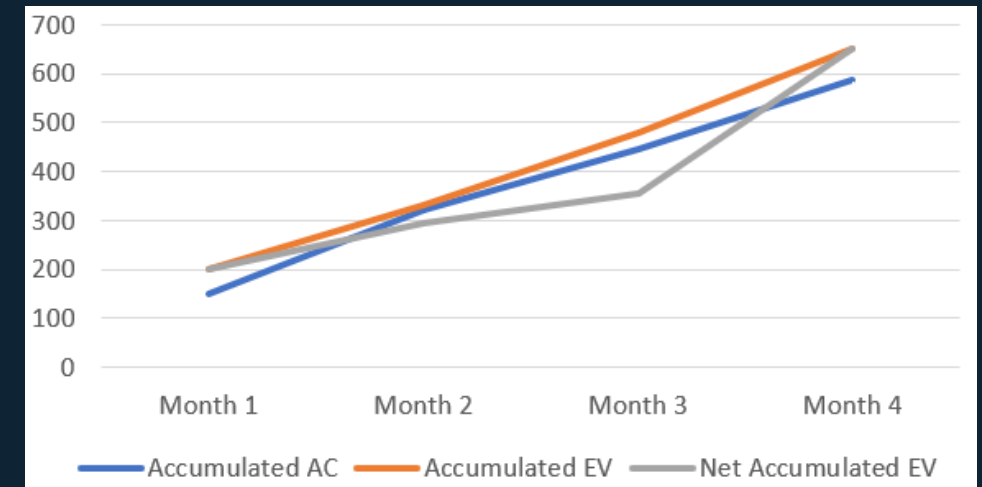


EVM								
Cumulative Planned Value (PV)	1000	2000	5700	9200	13900	16700	17700	18700
Cumulative Earned Value (EV)	525	1900	5500	7820	9725	15170	20770	26370
Completion of requirements								
Requirement value achieved to date	3	12	20	44	50	60	62	75
Planned requirement value	3	15	25	51	69	76	82	92
Requirement Index Number	1	0,8	0,8	0,862745	0,724638	0,789474	0,756098	0,815217
Earned Value (RIN)	525	1520	4400	6746,667	7047,101	11976,32	15704,15	21497,28

Option 2 – Performance based earned value

- Assign each requirement with the amount of workhours (or cost of resources) needed to verify it.
- Subtract or add this number to the Earned Value graph for a more accurate representation.

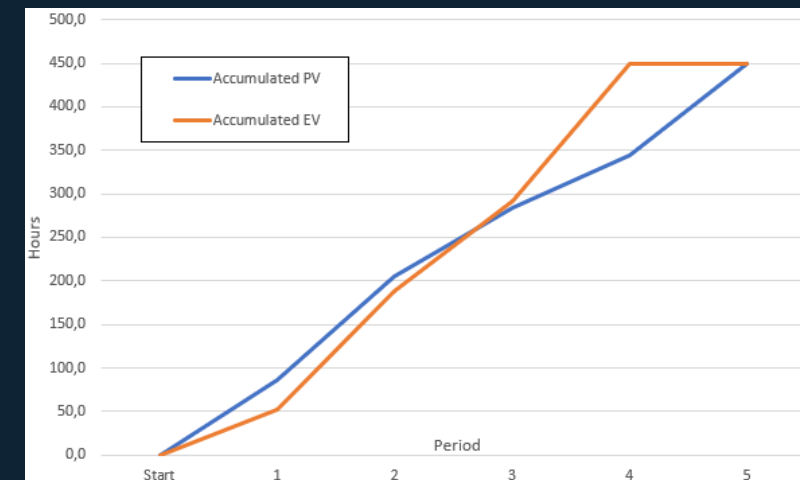
	Month 1	Month 2	Month 3	Month 4
Actual Cost (AC)	150	170	125	140
<i>Accumulated AC</i>	<i>150</i>	<i>320</i>	<i>445</i>	<i>585</i>
<i>Earned Value (EV)</i>	<i>200</i>	<i>130</i>	<i>150</i>	<i>170</i>
Accumulated EV	200	330	480	650
<i>Negative REV</i>		<i>35</i>	<i>90</i>	
<i>Positive REV</i>				<i>125</i>
Net Accumulated EV	200	295	355	650



Option 3 – Requirement related progress

- If Req. management. is fully implemented, requirements ARE the system, not the documents.
- Requirements are valued in the same manner as documents currently are.
- Define:
 1. Validate (against client)
 2. Validate verification method (against client)
 3. Allocate (internally)
 4. Verify document (issue to client)
 5. Verify requirement (code 1 from client or passed test)

Umbilical Cable Design		1	2	3	4	5
Planned	Define	13	8			
	Validate	9	9	3		
	Validate Methods	2	17	2		
	Allocate	1	9	11		
	Verify Document		9	10	2	
	Verify Requirement			4	6	11
	Planned Value	85,7	120,0	78,2	60,0	106,1
Accumulated PV		85,7	205,7	283,9	343,9	450,0
Actual	Define	9	10	2		
	Validate	4	12	4	1	
	Verify Methods	2	11	5	3	
	Allocate	2	14	3	2	
	Verify Document		12	8	1	
	Verify Requirement			6	15	
	Earned Value	52,5	135,0	103,9	158,6	0,0
Accumulated EV		52,5	187,5	291,4	450,0	450,0



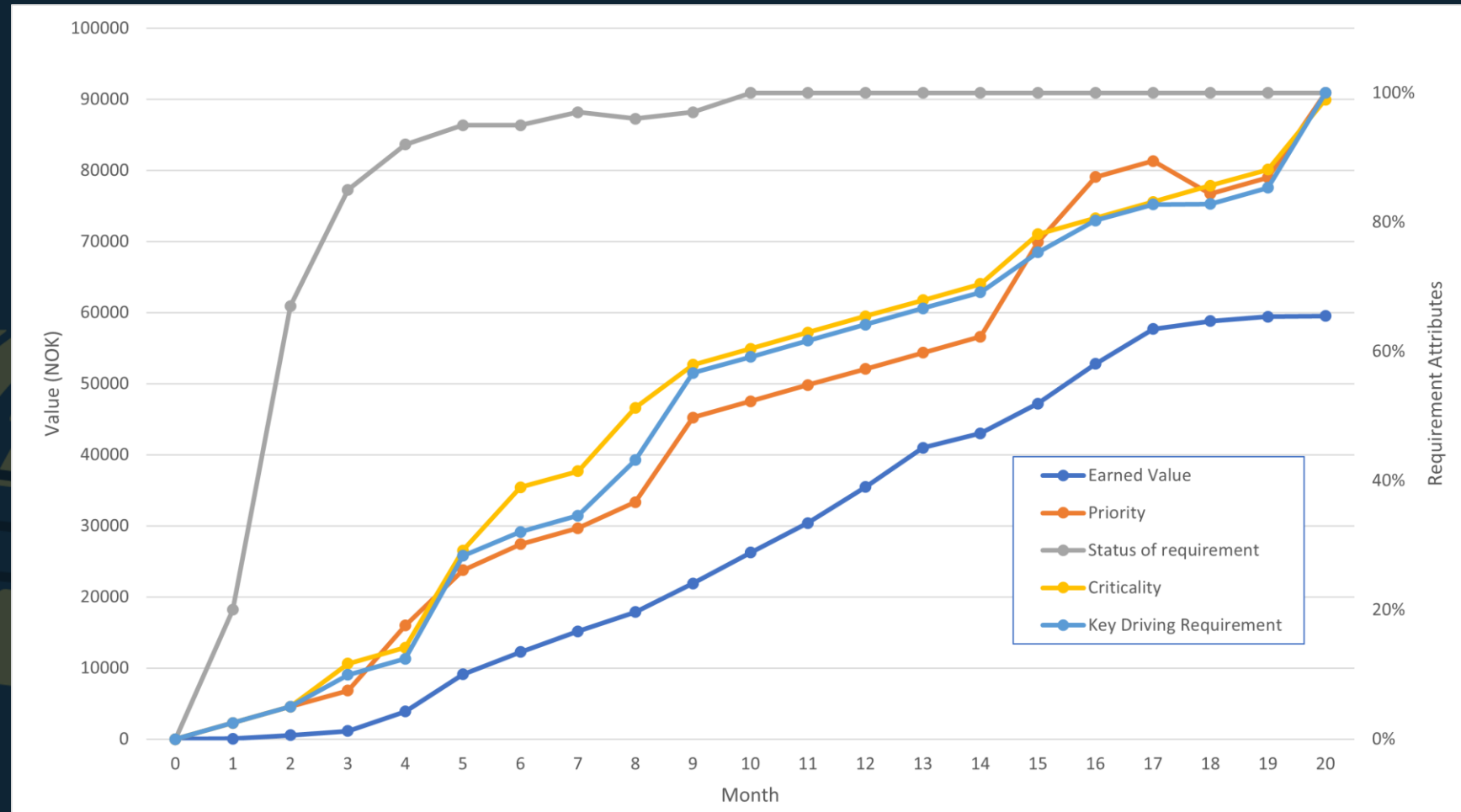
Option 4 –Requirement attributes

Using requirements and its attributes to explain the EVM-graphs.

Attribute	Scale	Meaning
Status of Requirement	Draft, in development, ready for review, in review, and approved.	How well defined is the scope and its technical challenges.
Priority	Value 1-10	How important it is to the stakeholder but does not have to be the most critical in terms of functionality
Criticality	Value 1-10	Describe requirements that the system must achieve for the system to function.
Key Driving Requirement	Value 1-10	A requirement that, to implement, can have a large impact on cost or schedule, and can be of any priority or criticality.

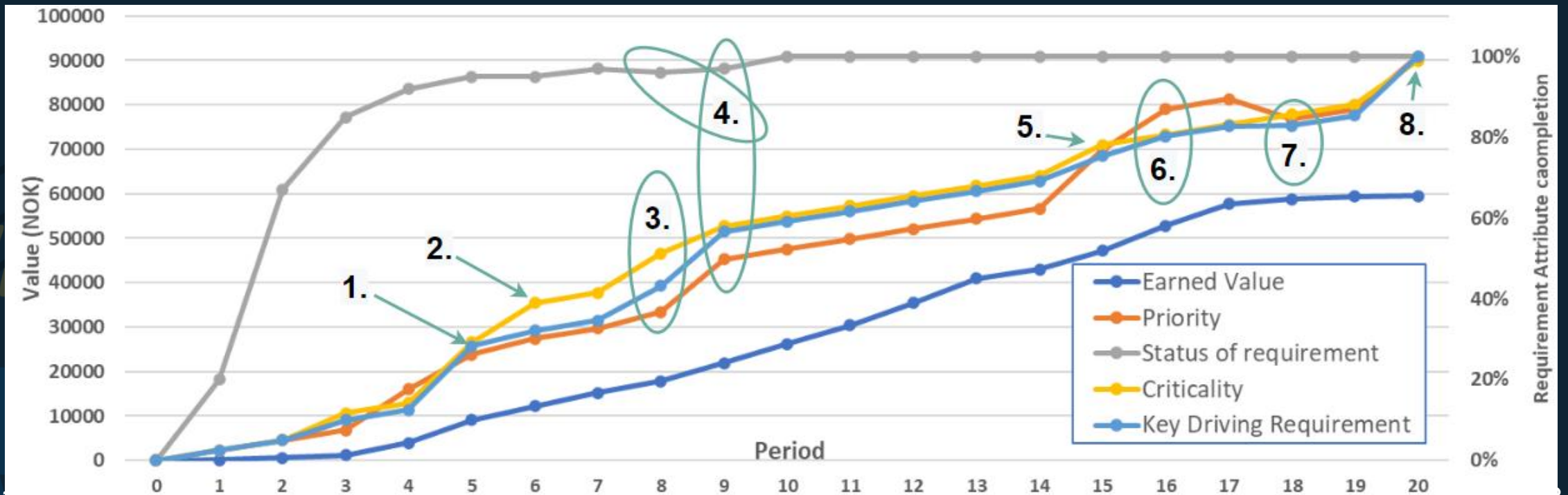
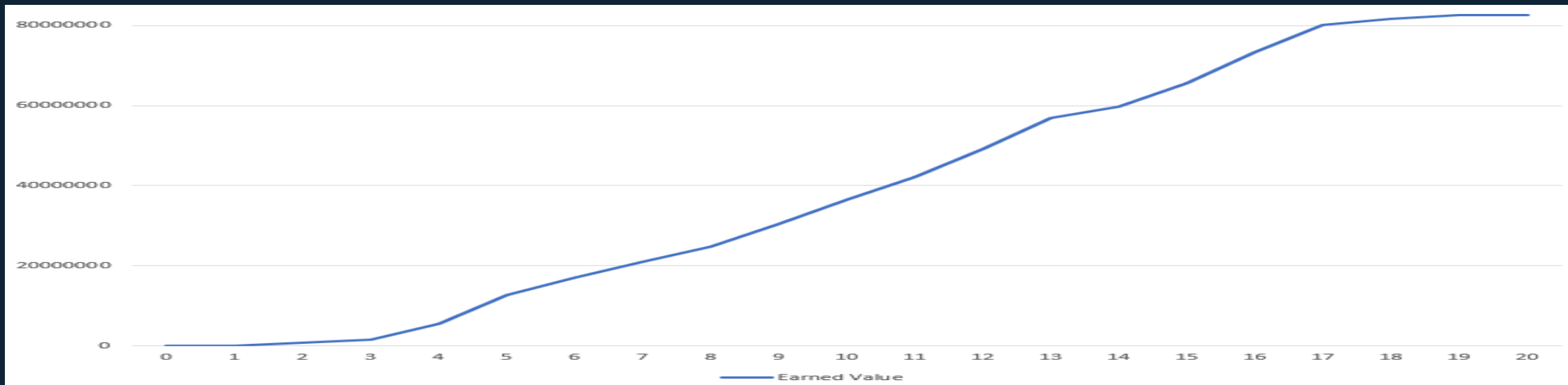
Each requirement must be assessed for this attributes, and its completion will be indicated over reported values from EVM.

Option 4 – Cont.

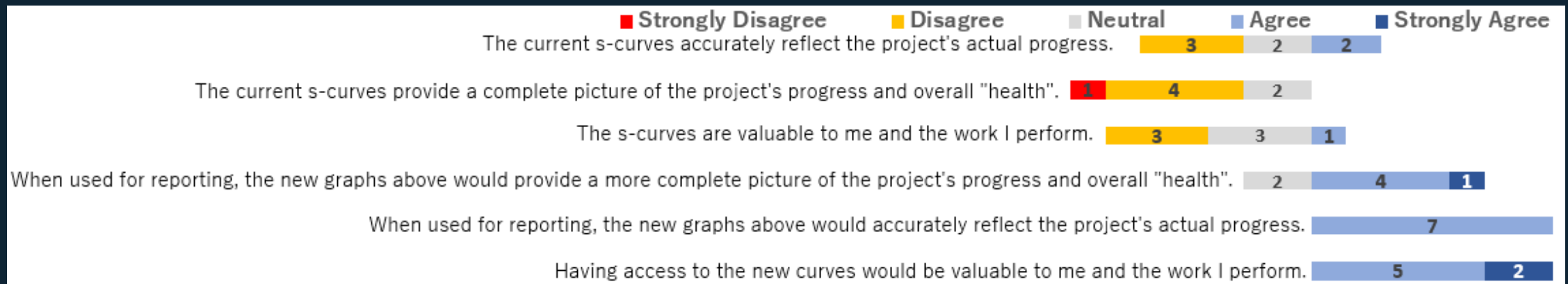


Pugh Matrix

Criteria	Option Null	Option 1 - RIN	Option 2 - PBEV	Option 3 – Req. progress	Option 4 - Attributes
Ease of implementation	5	3	3	2	2
Resources required to maintain	4	3	3	2	2
Intuitiveness	4	4	4	3	3
Accuracy and trustworthiness	1	3	2	4	5
Ability to provide full picture	1	2	2	4	5
Sum	15	15	14	15	17



Survey results



Questionnaire results

- Everyone understood the basics
- Everyone found it to provide a more complete picture
- Improved accuracy
- Fits the vision
- Several barriers to implementation

References

Borges, W. (2018). Schedule Variance: A Monetary Value to Determine Time Variance in Construction Project. *International Business Management*, 12, 244–252.

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Ruiz, C. (2019, September 1). *Foundations of Good Earned Value Management | EcoSys*. <https://www.ecosys.net/blog/foundations-of-good-earned-value-management/>

Roseke, B. (2018). *The Earned Value Management System*. <https://www.projectengineer.net/the-earned-value-management-system/>



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www.incose.org/symp2023
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