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Evaluating Investments in Technology: Five Approaches

Housel, Tom

Monterey, California. Naval Postgraduate School

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Evaluating Investments in Technology: Five Approaches

Dr. Tom Housel

Professor

Information Sciences Department

Naval Postgraduate School

Phone: 831-656-7657

Email: tjhousel@nps.edu

Agenda

- Problem Space: Tech Investment lifecycle Issues
- Continuous, Job Shop production models
- 5 Analysis and Management Tools:
    - Balanced Scorecard (BSC)
    - Earned Value Management (EVM)
    - Knowledge Value Added (KVA)
    - Lean Six Sigma (L6δ)
    - Integrated Risk Management (IRM)
- Selection Criteria to Consider
- When to Apply 5 Approaches in the Tech Investment Lifecycle

Problem Space

- The problem is that current analysis and management tools based on continuous production are not adequate to address the evolving requirements of complex IT systems.
- This is a problem because acquisitions of increasingly complex IT systems require a broader set of management and analysis tools to ensure successful acquisitions in a Job Shop production context.
- The purpose of this study was to suggest a set of criteria for selecting management and analysis tools that could help acquisition professionals successfully navigate the acquisition lifecycle of Job Shop products.
- This research is important because acquisition managers need a wider variety of tools to help them optimally analyze and manage their increasingly complex acquisition of IT based portfolios.

Continuous, Job Shop

- DOD acquisition economics: Job Shop, Continuous Production?
- Continuous production:
    - Takes advantage of production learning curve
    - Lot size – very large
    - Commodity valuation
- Job Shop:
    - Lot size of 1
    - Customized outputs
    - Higher premium on value

Tech Investment Lifecycle Management and Control Techniques

- Balanced Score Card (BSC)
- Lean Six Sigma **(L6δ)**
- Earned Value Management (EVM)
- Knowledge Value Added (KVA)
- Integrated Risk Management (IRM)

Five Approaches: Selection Criteria to Consider

Level of Analysis	Focus of Analysis	Time to Perform Analysis
Process: KVA, L6δ, BSC, IRM	Cost Savings: L6δ, EVM, BSC, IRM Schedule: EVM Value: KVA = outputs	BSC, IRM: 3-6 months
Task: L6δ, EVM	Cost Savings: L6δ, IRM Value = Cost+Schedule (on time) Cycle Time: L6δ, BSC	EVM: 5-? months set up time (depends on requirements)
Organization: BSC	Strategic Competitive Advantages: BSC, IRM Value = Revenue: BSC Strategic Real Options for Investment in IT	L6δ: 3-? months (depends on level of process complexity)
		KVA: 2 days – 1 month (depends on level of analysis)

Five Approaches: When to Apply in the Tech Investment Lifecycle

Pre-Investment	Strategic Goal Alignment	Implementation	Post Implementation
KVA (As-Is)	BSC (Align strategy with performance metrics)	EVM (Monitor cost and schedule, adjust as needed)	KVA (Monitor ROI, ROK)
L6(Id waste, value added)	IRM (Identify the strategic options for IT investments)	KVA (To-Be, ROI, ROK)	L6 (Assess and monitor cost, waste reduction)
Other	Other	IRM (Use the project management tools within the IRM suite)	Other

Aligning Methodologies with Acquisition Lifecycle

Pre-Materiel Solutions Analysis	Materiel Solutions Analysis	Technology Maturation and Risk Reduction	Engineering and Manufacturing Development	Production and Development	Operations and Support
-Strategic goal alignment -Pre-investment	Pre-Investment	Pre-investment	Implementation	Implementation	Post-implementation

Combined Map to Show How the Five Methodologies Might Be Used in the 5000 Series Phases

Materiel Solutions Analysis	Technology Maturation and Risk Reduction	Engineering and Manufacturing Development	Production and Development	Operations and Support
BSC	IRM	EVM	EVM	KVA
IRM	KVA	IRM	IRM	L6σ
KVA	L6σ	KVA	KVA	
L6σ				

Benefits and Challenges of the Five Methodologies

	Extensible, quantitative value measurement	Time to Perform	Cost	Bottleneck Analysis
BSC	No, subjective measurement (revenue is exception)	3-6 months (depends on level of analysis)	Accounting based financial metrics only	None
EVM	No, cost measurement only	5+ months set up time (depends on requirements)	Cost of resources and time	No, linear tracking only
L6σ	No, nominal value only	3+ months (depends on level of process complexity)	Activity Based Costing approach	Direct bottleneck analysis
KVA	Yes	2 days – 1 month (depends on level of analysis)	Common units of cost	Elapsed time versus work time
IRM	Yes, KVA	3-6 months (Relatively quick once initial steps completed)	Cost accounting and KVA cost metrics	Monte Carlo simulation

Conclusions

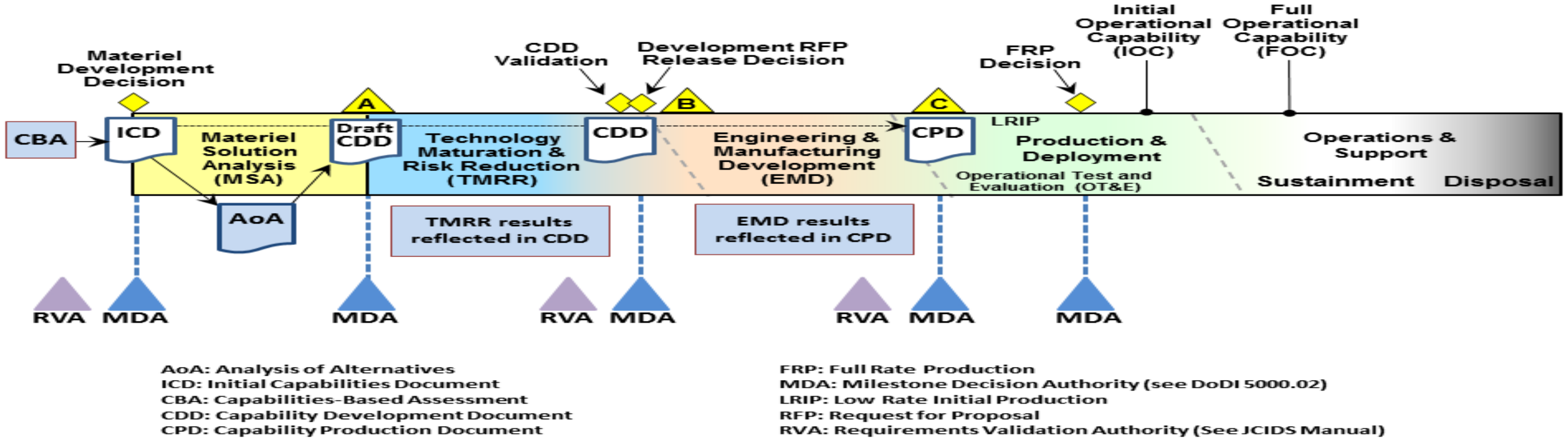
- Use the approach that fits with the selection criteria and point in the acquisition lifecycle (constrained by time and cost)
- Use continuous production economics for mature, simple products
- Use job shop, lot size of 1, economics for complex products that can be "intelligensized"
- Need new common unit of value to track upside of value of intelligensizing military products to stay ahead in the Great Power Competition race
- No current methodology in use provides adequate program value to risk-based forecasting

Back-UP for Reference Only Slides

Lifecycle Key events and Milestones

MSA	TMRR	EMD	P&D	O&S
Analysis of Alternatives	Preliminary Design Review	Complete detailed design	Low rate initial production	Lifecycle Sustainment Plan (LCSP)
Initial funding estimates	Capability Development Document	System-level Critical Design Review (CDR)	Initial Operational Test & Evaluation (IOT&E)	System Modifications
Technology Development Strategy	Competitive prototyping	Establish project baseline with Performance Measurement Baseline (PMB)	Full rate production decision	Sustainment
	Acquisition Program Baseline (APB) established		Initial and Full Operational Capability (IOC and FOC)	Disposal

Figure 1. The 5000 Series Acquisition Lifecycle

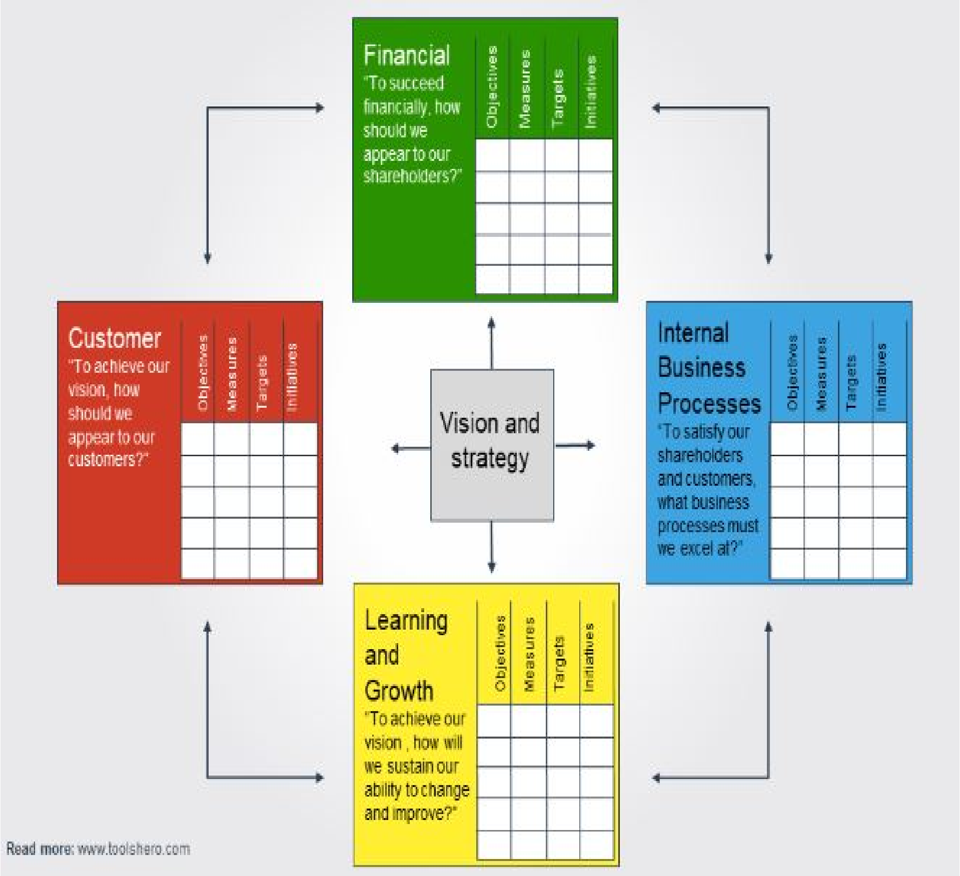


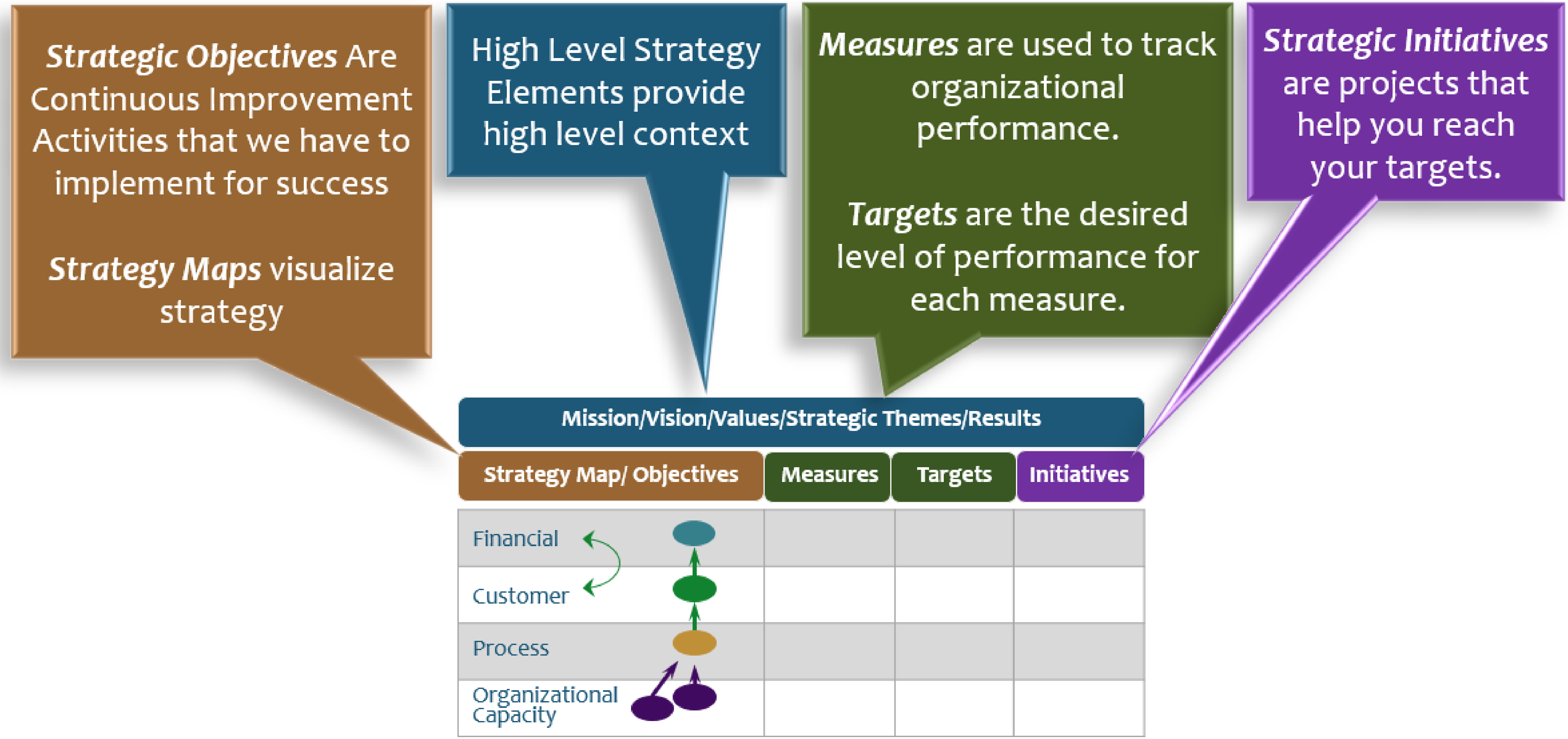
Taken from Defense Acquisition Guidebook, 2017

Balanced Scorecard (BSC)

Balanced Scorecard Strategy Map

- Is a strategic planning and management system that organizations use to:
- Communicate what they are trying to accomplish
- Align the day-to-day work that everyone is doing with strategy
- Prioritize projects, products, and services
- Measure and monitor progress towards strategic targets





http://www.balancedscorecard.org/BSC-Basics/About-the-Balanced-Scorecard

Lean Six Sigma

Lean Six Sigma

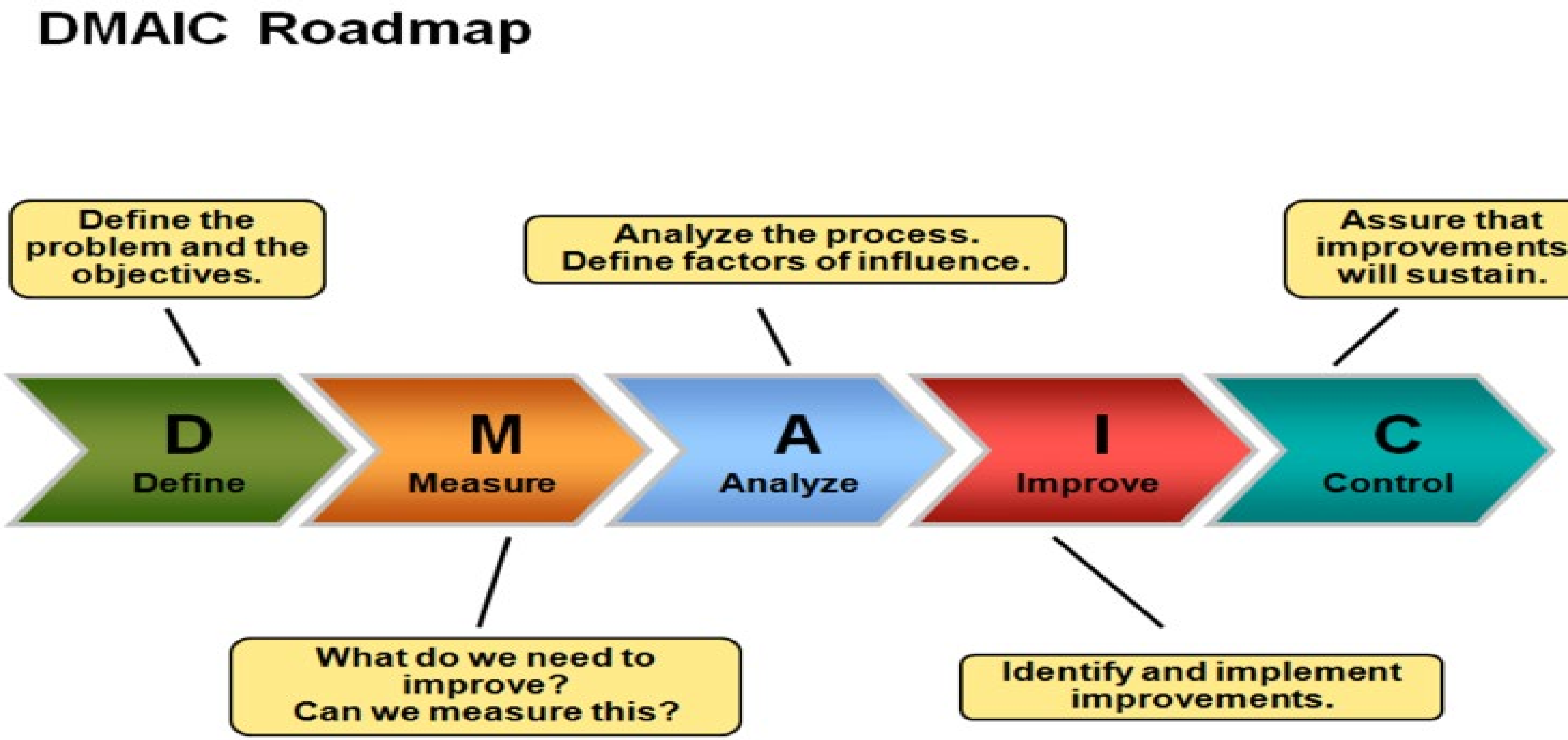
- What is Lean Six Sigma?
- Combination of 2 powerful processes improvement methods
  - Lean
  - Six Sigma
- Designed to improves process performance:
  - Cost, waste, defects reduction
  - Cycle time reduction

https://goleansixsigma.com/what-is-lean-six-sigma/

Combination of Lean and Six Sigma

https://www.greycampus.com/blog/quality-management/a-brief-introduction-to-lean-and-six-sigma-and-lean-six-sigma

Six Sigma: DMAIC



https://www.greycampus.com/blog/quality-management/a-brief-introduction-to-lean-and-six-sigma-and-lean-six-sigma

Earned Value Management (EVM)

EVM Definition

Earned Value Management (EVM) is a management tool intended to bring visibility to the planning for and execution of the **technical, cost, and schedule** aspects of acquisition programs to support decisions by program managers.

Earned Value Management (EVM) is a project management tool that integrates the technical scope of work with schedule and cost elements for investment planning and control. It compares the amount of work accomplished in a given period with the amount of the work expected in that period. Differences in expectations are measured in both cost and schedule variances

EVM – Why & What

Why

Provides an "early warning" signs for prompt corrective action

Provides an uniform unit of measure (dollars or work-hours)

Requires different measures of progress for different types of tasks

Need to consolidate progress of many tasks into an overall project status

What

Utilising Project Management methods, practices, process & tools

Accurate definition of the defined deliverable(s), timeframe & total cost (direct & indirect) to deliver the product

Detailed tasks / activities and work not in the WBS is out-of-scope

Baseline of budget control a/c, schedule, work measurement by Control Account (hours, $, unit)

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Definition

Planned Value (PV)	Actual Cost (AC)	Earned Value (EV)
Planned expenditure cash flows based on the completion of tasks in accordance with the project's budget and schedule Planned cost of the total amount of work scheduled to be performed by the milestone date	Actual Project Expense based on completed tasks Cost incurred to accomplish the work that has been done to date	The amount of the budget that should have been spent for a given amount of work completed The planned (not actual) cost to complete the work that has been done

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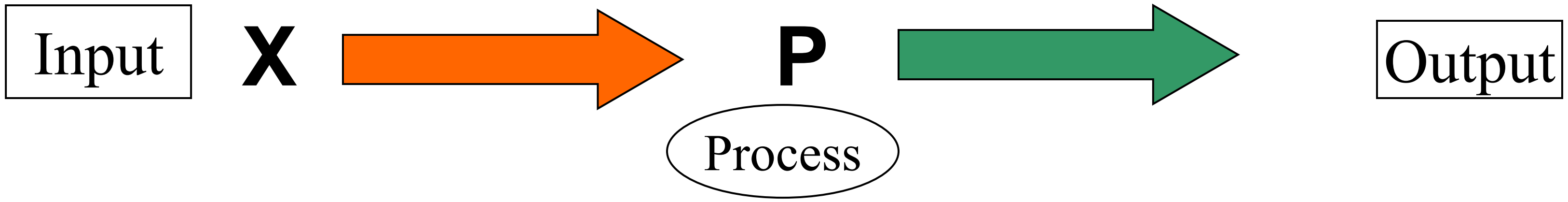
Knowledge Value Added (KVA)

What is Knowledge Value-Added?

- Knowledge Value Added (KVA) is a methodology for estimating the return on investment (ROI) between As-Is and To-Be process improvement
  - E.g., technology, automation improvement options
  - E.g., service process redesigns without technology, automation options
- Provides productivity performance ratios (e.g., ROI) for core processes and their subprocesses
- Provides productivity measure in terms of Return on knowledge (ROK) that is directly proportionate to ROI
- Provides cost per common unit estimates

Fundamental assumptions of KVA

- Underlying Model: Change, Knowledge, and Value are Proportionate



Fundamental assumptions:

1. If X = Y (P(X) = Y) no value has been added.
2. “value” ∝ “change”
3. “change” can be measured by the amount of knowledge required to make the change.

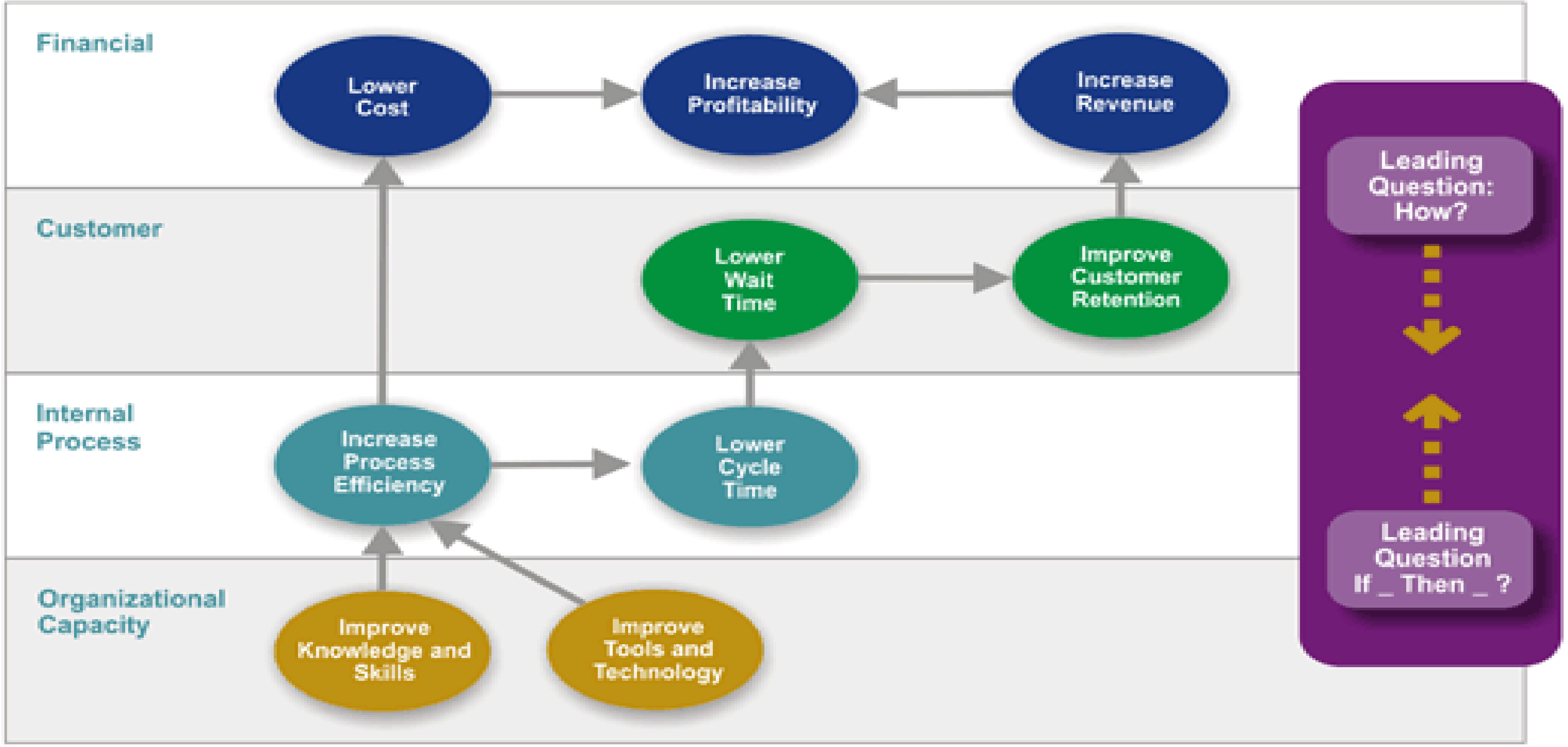
So “value”∝ “change” ∝“amount of knowledge required to make the change”

(Principle of replication)

Knowledge Value Added Steps

- Step 1: Identify Core process and its subprocesses
  - E.g., Evidence Retrieval and Destruction Process
    - E.g., Access Evidence
- Step 2: Identify subprocess outputs
  - E.g., Access Evidence → Item location
- Step 3: Convert outputs into common units
  - E.g., Item location → Time to learn how to locate item (i.e., Learning Time – LT)
- Step 4 **(Using Spreadsheet Template):** Estimate cost to produce the outputs
  - E.g., Cost to locate item (i.e., Work Time: WT)
  - Market Comparables = cost * 1.5
- Step 5 **(Using Spreadsheet Template):** Generate ROK and/or ROI productivity ratios
  - E.g., ROK, ROI on Item location subprocess

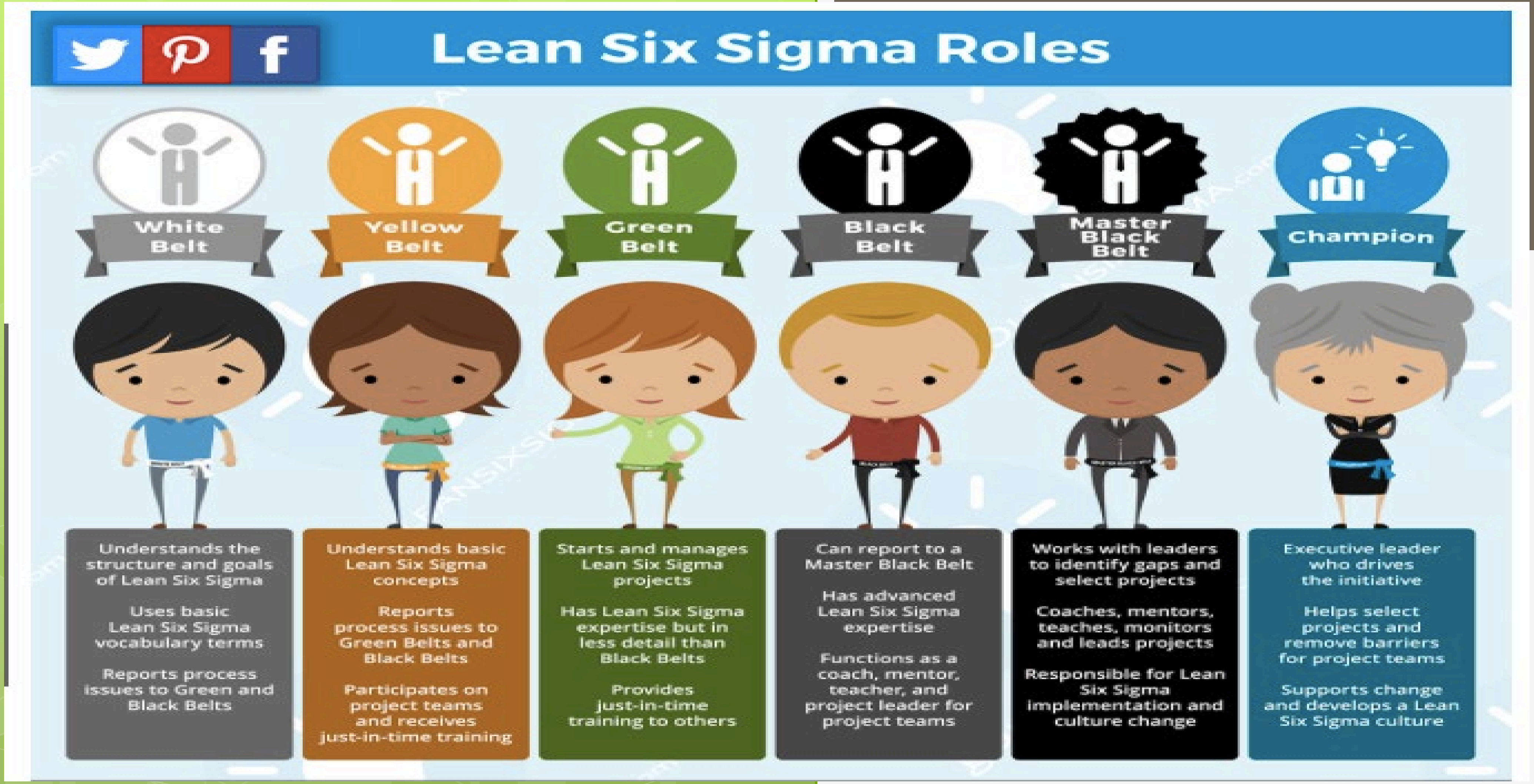
Strategy Mapping BSC



Reference: The Institute Way: Simplify Strategic Planning & Management with the Balanced Scorecard.

http://www.balancedscorecard.org/BSC-Basics/About-the-Balanced-

BSC Development



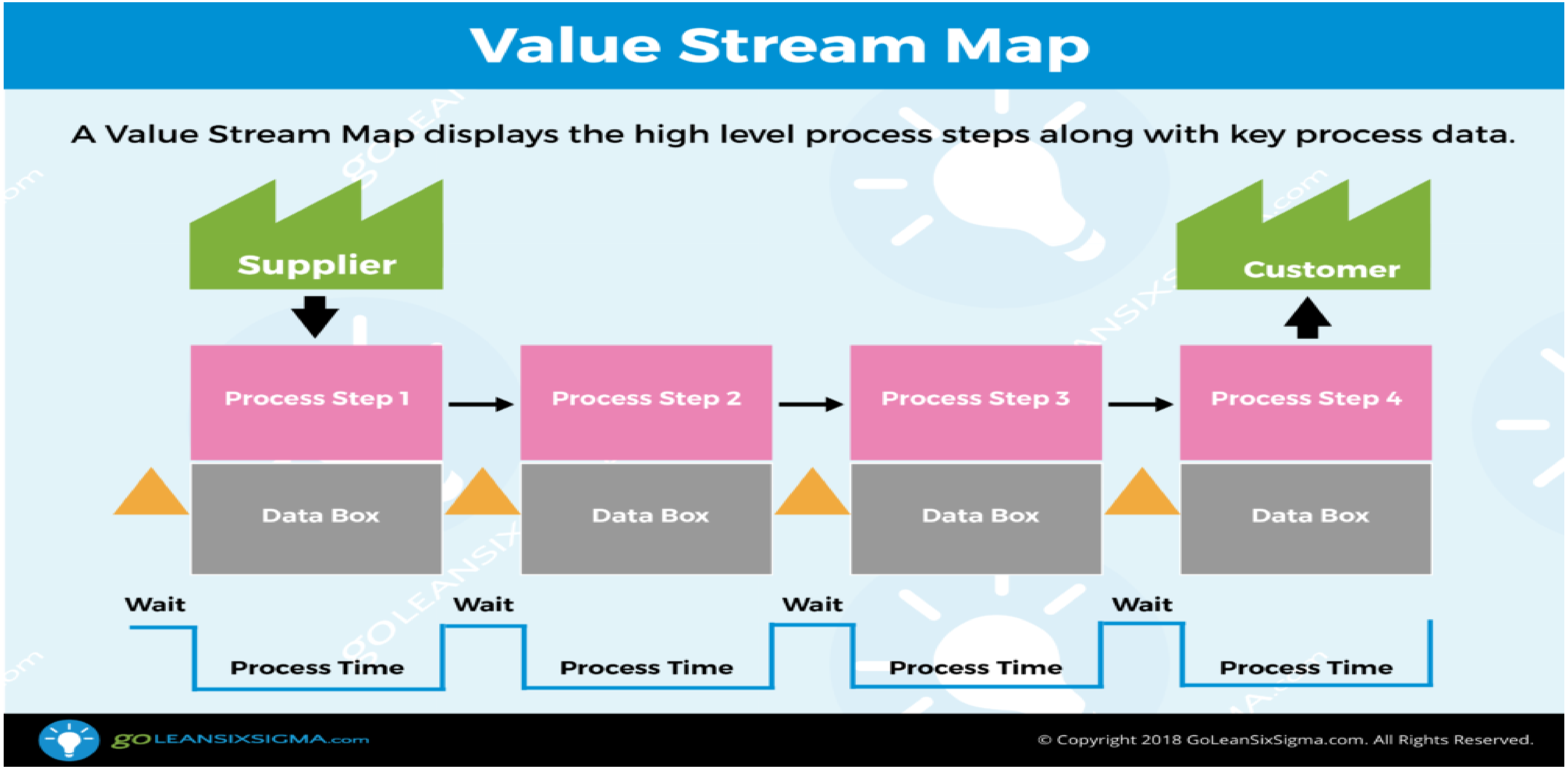
https://goleansixsigma.com/what-is-lean-six-sigma/

Value Added Analysis

Value-Added: An activity is value-added if a customer is willing to pay for; it changes form, fit or function of a product or service; it converts input to output; it is not waste.

Non-value Added (NVA): These activities are unnecessary: they provide no value for internal or external customers, and can be immediately eliminated. (sometimes called Type II NVA)

Business Value Added (BVA): These activities provide no value to customers, but are necessary given current process limitations. Common examples are inspections, management approvals, most quality assurance activities; technical support activities. (sometimes called Type I NVA)



https://goleansixsigma.com/value-stream-mapping/

Schedule Metrics

Schedule Variance (SV)

Difference between the current progress and originally scheduled progress

SV = EV – PV or BCWP – BCWS

A negative variance means the project is behind schedule

Deviations from work planned – not a measure of changes in cost

Schedule Performance Index (SPI)

Ratio of the work performed to the work scheduled

SPI = EV ÷ PL or BCWP ÷ BCWS

Ratio > 1 = ahead of schedule and / or under budget (vice versa)

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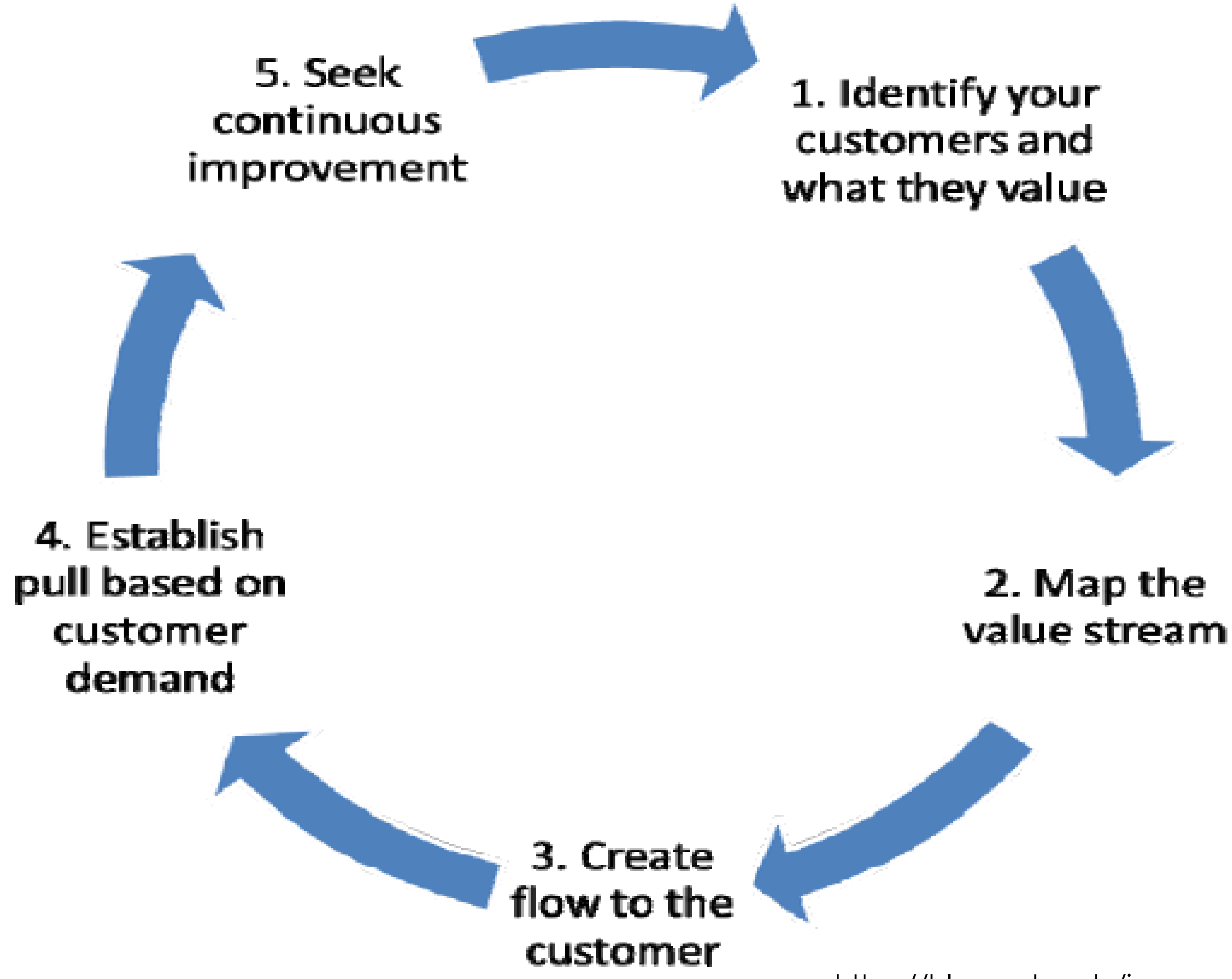
5 Principles of Lean



https://blogs.mtu.edu/improvement/2014/01/08/back-to-the-basics-5-principles-of-lean/

Cost Metrics

Cost Variance (CV)

Difference between a task's estimated cost and its actual cost

CV = EV – AC or BCWP – ACWP

Negative Value = over budget and / or behind schedule (vice versa)

Deviations from the budget – not a measure of work scheduled vs. work completed

Cost Performance Index (CPI)

Percentage of work completed per dollar spent

CPI = EV ÷ AC or BCWP ÷ ACWP

Ratio > 1 = ahead of schedule and / or under budget (exceptional performance) – vice versa

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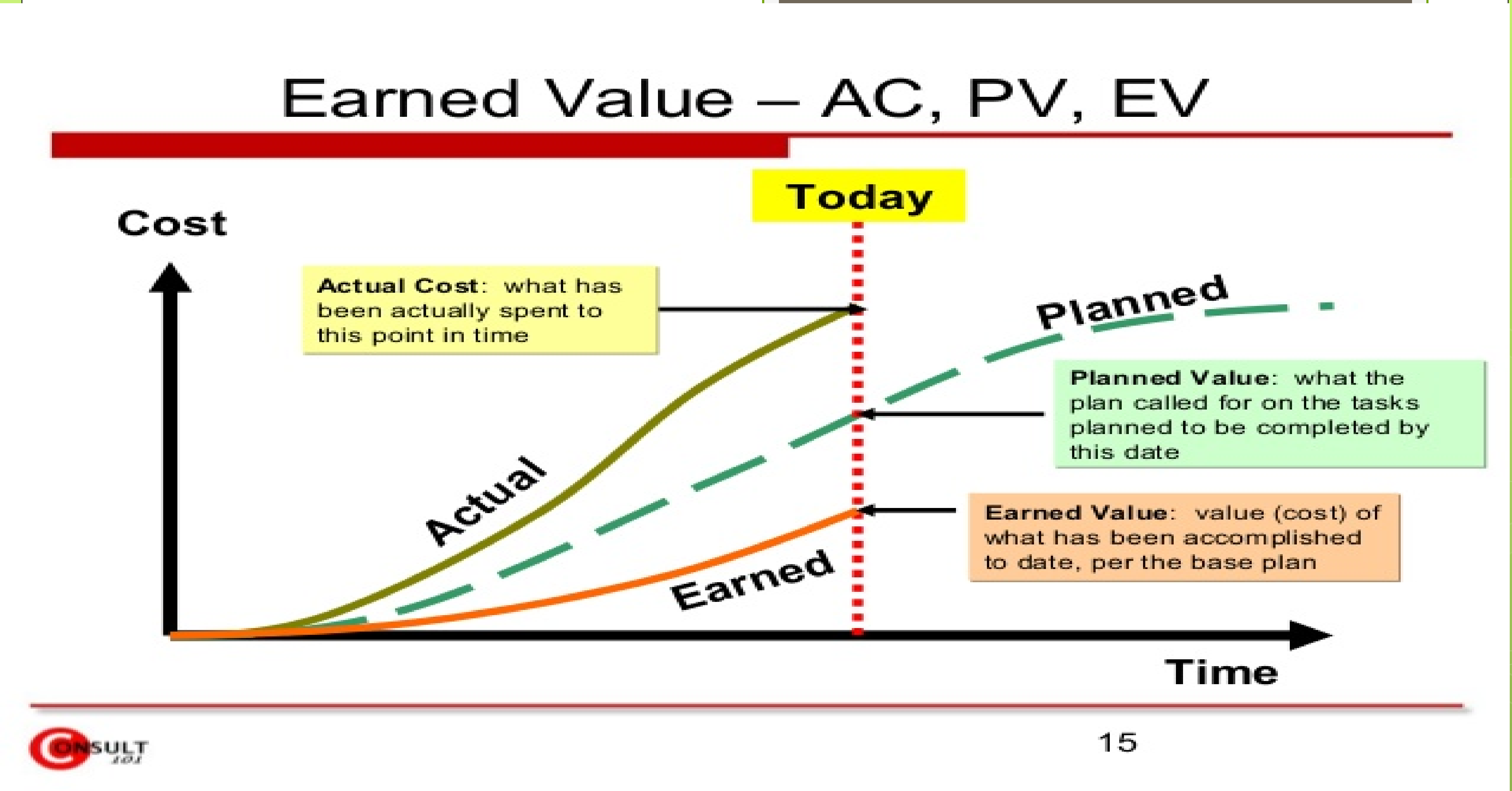

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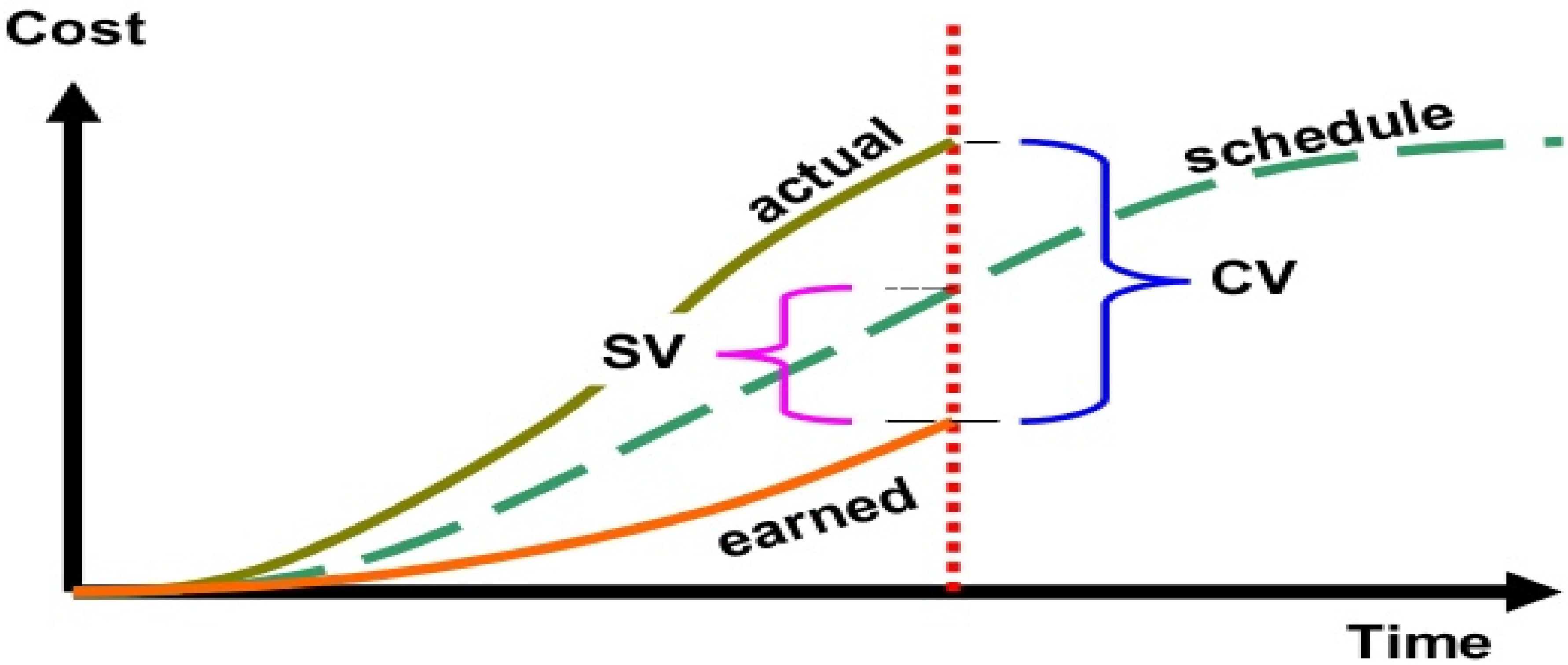
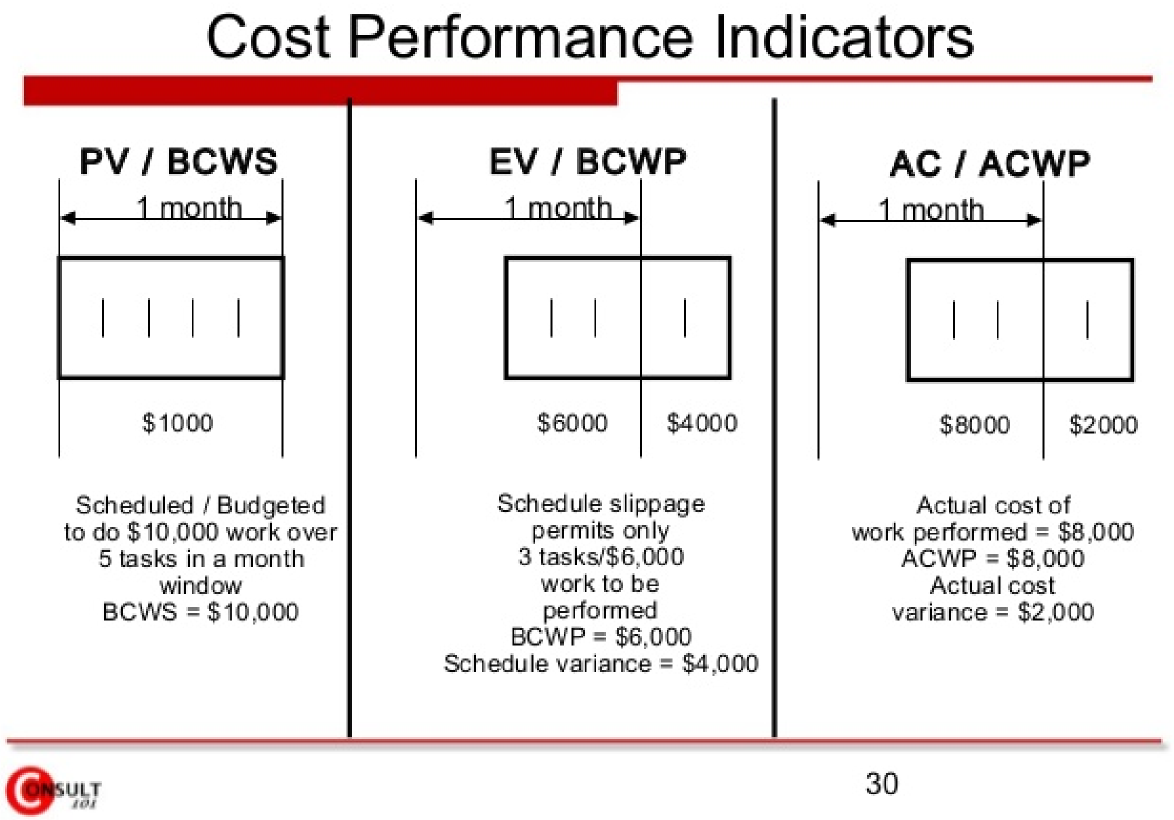
Variance – SV & CV illustration

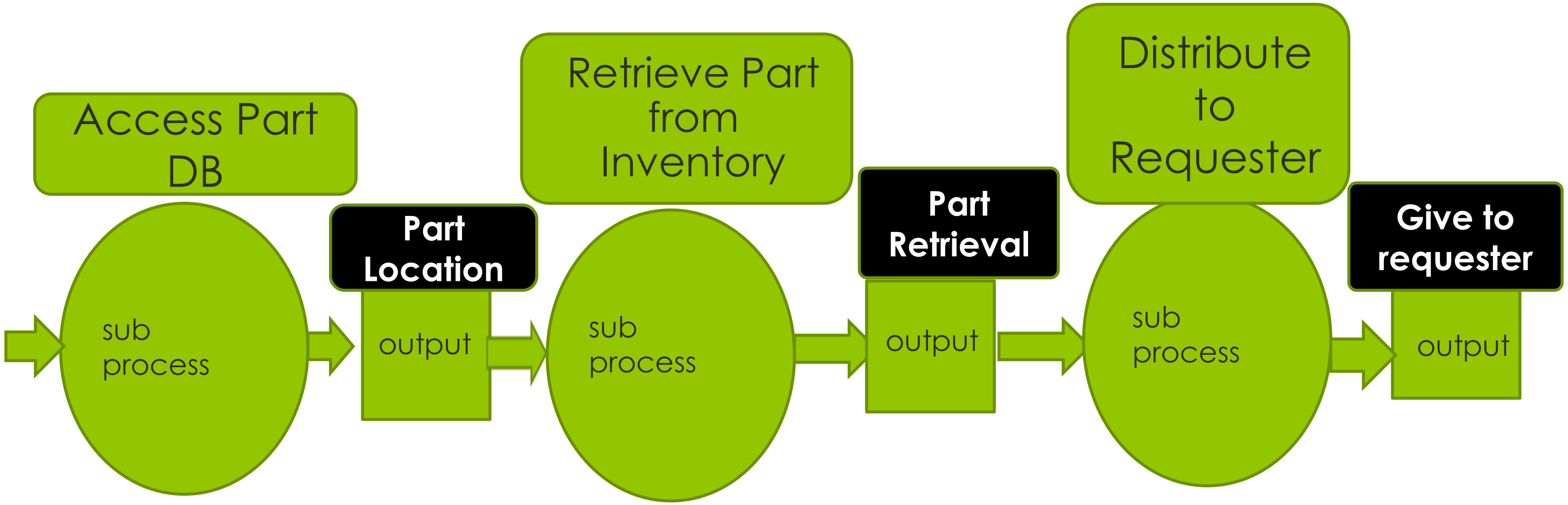



Cost Performance Indicators
PV / BCWS
1 month
$1000
Scheduled / Budgeted to do $10,000 work over 5 tasks in a month window BCWS = $10,000
EV / BCWP
1 month
$6000
$4000
Schedule slippage permits only 3 tasks/$6,000 work to be performed BCWP = $6,000 Schedule variance = $4,000
AC / ACWP
1 month
$8000
$2000
Actual cost of work performed = $8,000 ACWP = $8,000 Actual cost variance = $2,000
CONSULT 101
30

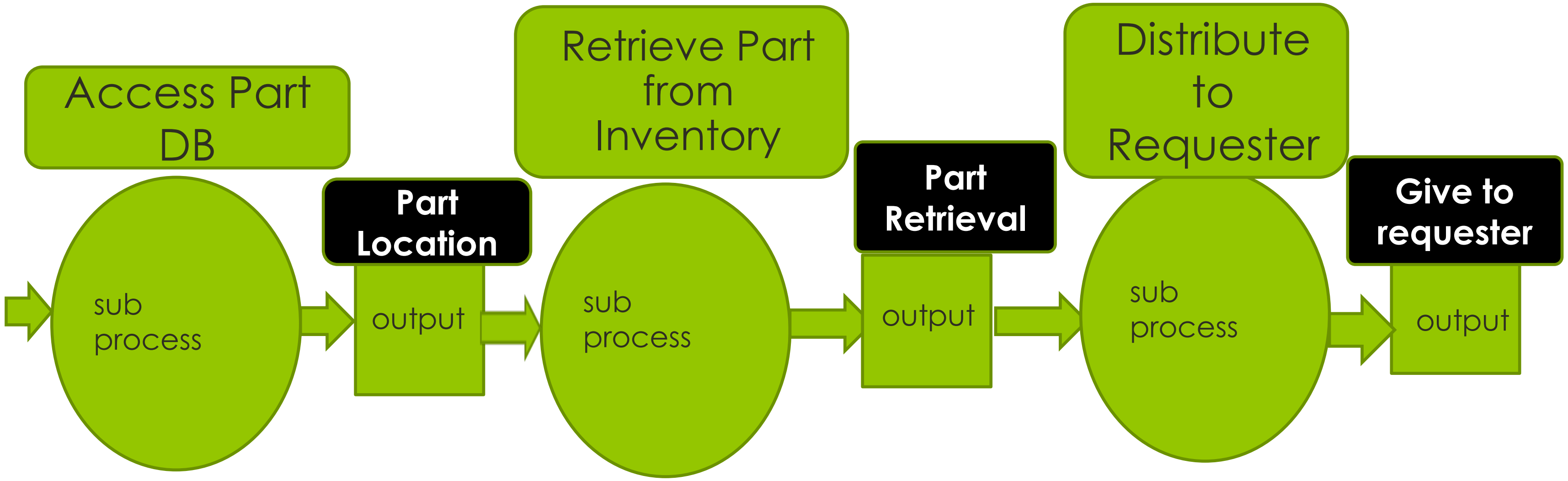
Are We Safer since 9/11/01?

- Spent $1Tril since 9/11
- "We've spent hundreds of billions since 9/11. The question is how much of that was wasted …." (GAO Senior Auditor: The Atlantic, Sept 2016, p. 64)
  - FirstNet = Cost from $12 Bil to $47 Bil (GAO estimate) and may be 10-15 yrs in the future
  - BioWatch cost $200 mil. + $1 bil in maintenance fees (Canceled in 2014: it was a "dud", with no replacement of a better bio detection system, p. 65)
- "If you're shocked and scared and you know there's a threat out there, you'll do anything, spend anything, to deal with it…even if what you spend it on hasn't been tested and you haven't even set any ***<u>standards to evaluate it.</u>***" (GAO Senior Auditor, p. 66)
- Since 9/11/01: $100-$150Bil wasted on failed DHS projects, equipment (pg. 68)

Part Retrieval and Distribution Steps 1 and 2: Identify Core Process, Subprocesses, and Subprocess Outputs Diagram



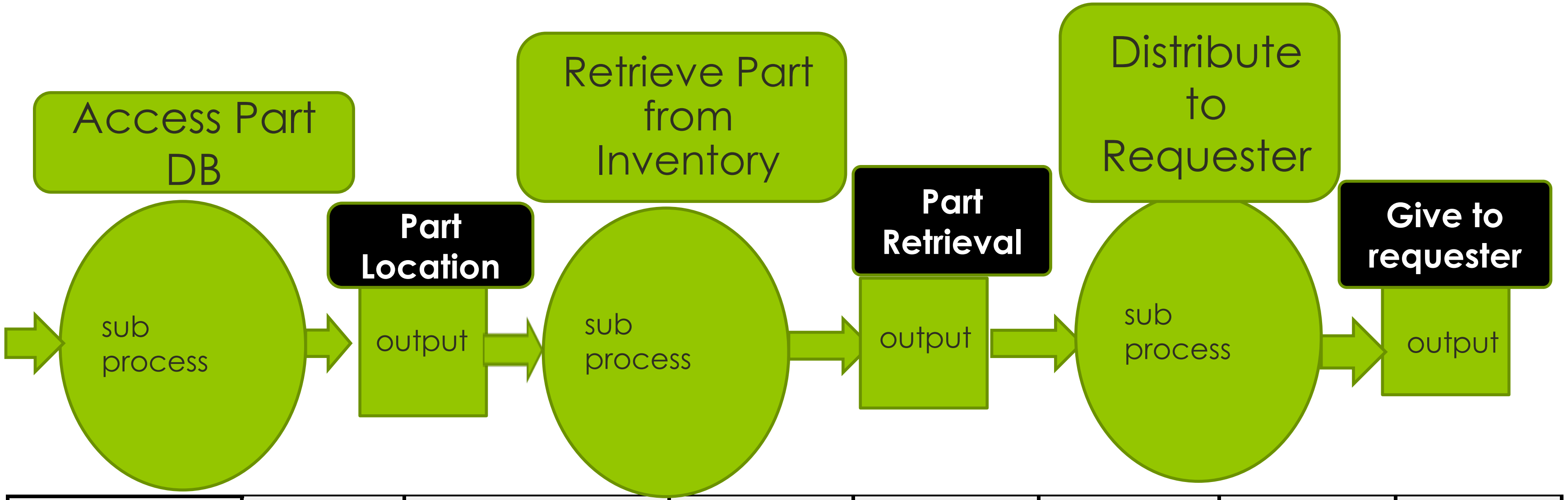
Part Retrieval and Distribution Step 3: Convert Outputs Into Common Units



Process Description	Number of Employees Performing the Subprocess	Automation Cost (AC) = Total Cost of Ownership per year / Number Subprocess Executions per year	Learning Time (LT) in Hrs	Average Hourly Labor Cost per Subprocess (AHCS)	Percent (%) Subprocess Automated (PA)	Times Performed In a Year (TPY)	Average Time to Complete (ATC) hrs
Access Evidence Information	1	$ 5.00	35	$ 15.00	50%	690	0.5
Retrieve Evidence	1	$ 15.00	15	$ 35.00	10%	690	0.33
Sign out Evidence	1	$ 10.00	50	$ 80.00	30%	690	0.5

Note: Convert subprocess outputs into common units using learning time

Part Retrieval and Distribution
Step 4: Estimate cost to produce the outputs



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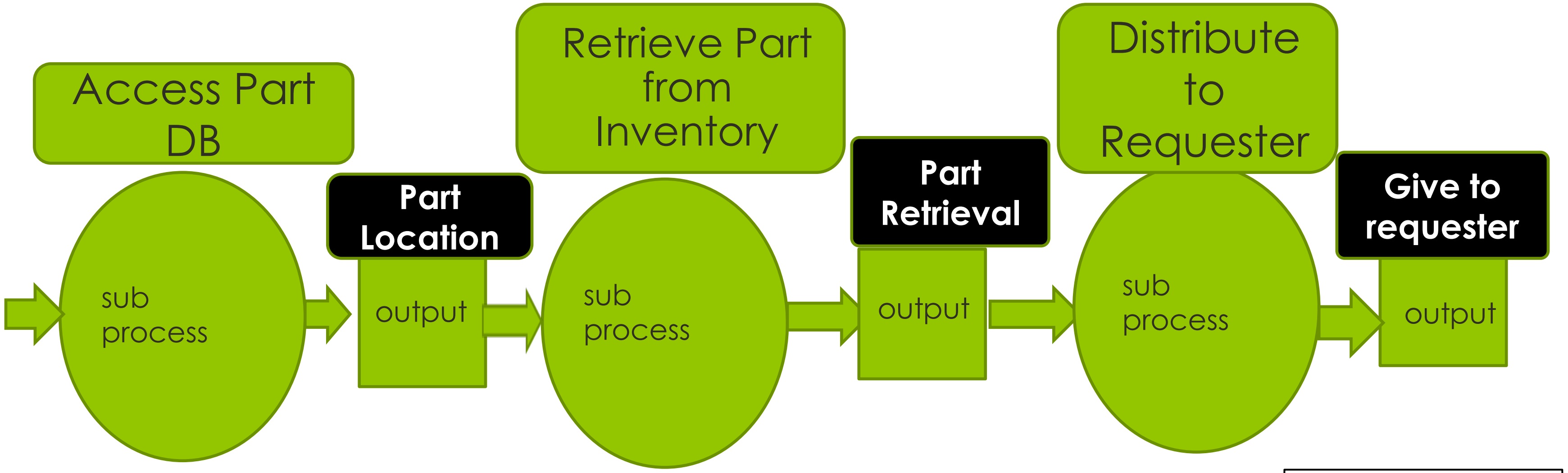
Part Retrieval and Distribution
Step 5: Generate ROK and/or ROI productivity ratios



Value Value Cost Cost Value **Value/Cost**

Process Description	Single Execution of a Subprocess Learning Time (SESLT) = LT + (LT * PA)	Total Learning Time Units (TLTU) per year =SESLT * TPY	Cost per year = AHCS*TPY*ATC	Surrogate Rev/Mrk Comp per year = Labor and Automation Cost * 1.5	Denominator = Cost per year	ROI and ROK Numerator = TLTU * Rev/unit	ROK = Numerator / Denominator	ROI= (Numerator - Denominator) / Denominator
Access Evidence Information	67	45,885	$ 6,900.00	$ 10,350.00	$ 6,900.00	$ 27,711.4	**402%**	**302%**
Retrieve Evidence	17	11,385	$ 11,500.00	$ 17,250.00	$ 11,500.00	$ 6,875.77	**60%**	**-40%**
Sign out Evidence	95	65,550	$ 31,050.00	$ 46,575.00	$ 31,050.00	$ 39,587.78	**127%**	**27%**
Totals	**178**	**122,820**	**$ 49,450.00**	**$ 74,175.00**	**$ 49,450.00**	**$ 74,175.00**	**150%**	**50%**

Monetization

What is Return on Knowledge (ROK)?

- Return on Knowledge is a new organizational performance ratio
  - Numerator = amount of K(Value) required to reproduce process outputs
    - How is this calculated? What does the resulting number represent?
  - Denominator = cost to use K to produce output
    - How is this calculated? What does the resulting number represent?
  - ROK = Output/Input = K Units/Input = Revenue/Input

Continuous, Job Shop

- DOD Acquisition economics: Job Shop, Continuous Production?
- Continuous production:
  - Takes advantage of production learning curve
  - Lot size – very large
  - Commodity valuation
- Job Shop:
  - Lot size of 1
  - Customized outputs
  - Higher premium on value
- How do we use the four approaches with each of these models?