Project Control & Management

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Lecture 5

Subjects

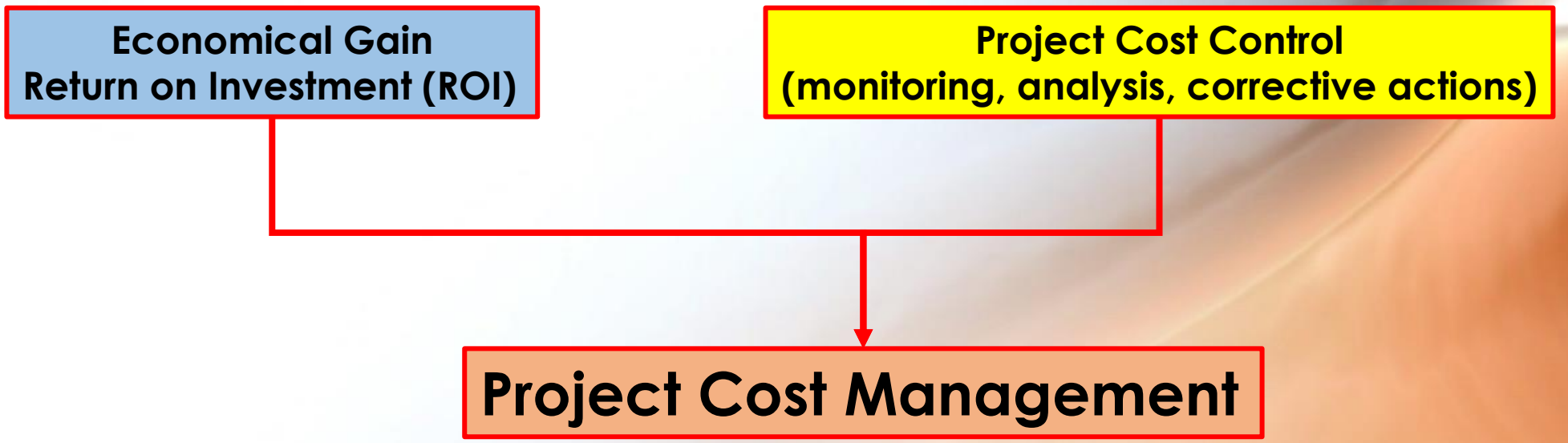
Project Management in Engineering Environments

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

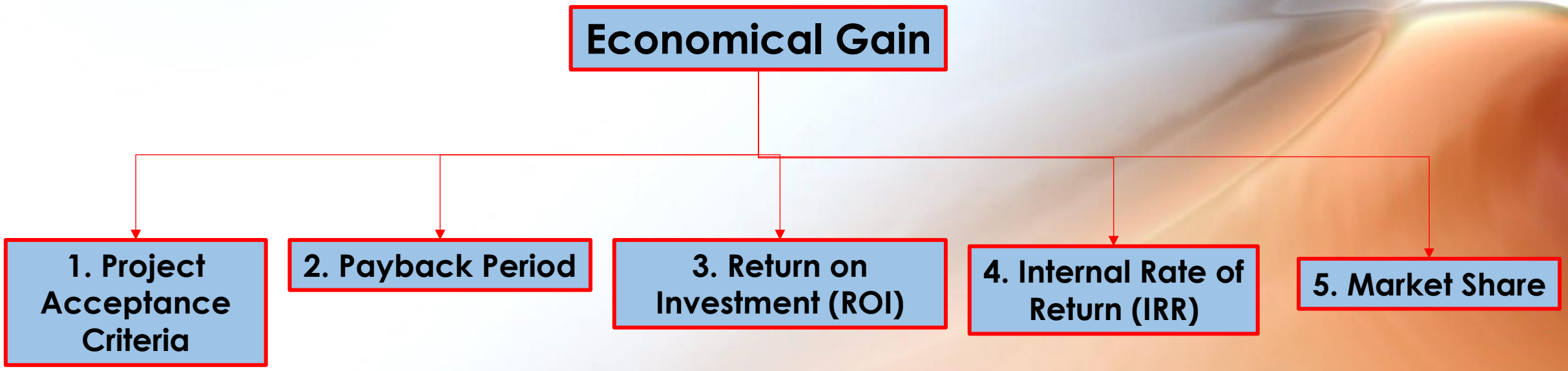
Recommended Reading

1. Project Management, A system approach to planning, scheduling and controlling; 11th Edition, **H. R. Herzner**, Wiley, 2013. ISBN: 978-1-118-02227-6
2. 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

Project Cost Management



Economical Gain Analysis



Economical Gain Criteria 1

1. Project Acceptance Criteria – the rationale
   - Rate of Investment analysis
   - The share of the annual rate of return of investment for all projects, of this particular project
   - Forging strategic relationship if the project is undertaken for possible future bigger gains
   - Immediate and long-term profitability rationale

Economical Gain Criteria 2

2. Payback Period
   - The period of time the company expects to recover the costs of the project.
   - Inflation, taxation and other accounting criteria needs to be considered to achieve a good estimate for the payback period.

For example if the company spend €100K on a product and is expecting to make €50K profit a year- the payback period is nearly 2 years. With an interest rate of 2% this just goes over 2 years by 2 weeks!

Economical Gain Criteria 3

3. Rate on Investment (ROI)
   - Simple way of estimating the return based on income on the investment incurred. It is expressed as a ratio:

$$ROI = \frac{Return}{Investment}\%$$

For a product/project that cost €1,000,000 and an annual return of €50,000 the ROI = 5%

Economical Gain Criteria 4

4. Internal Rate of Return (IRR):
   - Is the compounded return rate for investment on annual basis.
   - If a project rate of return is higher than alternative ones, this means the project is better than the others
   - The calculation of IRR with respect to **Net Present Value (NPV)** of the money spent.

What is NPV?

NPV is the difference in value of money at present to the value of money in future taking inflation into account

IRR calculation

$$NPV = \sum_{t=0}^{T} \frac{C_t}{(1 + \frac{IRR}{100})^t} - C_0$$

If NPV = 0

$C_0 = 1{,}000{,}000$ (cash at year 0)

$C_1 = 1{,}050{,}000$ (cash at year 1)

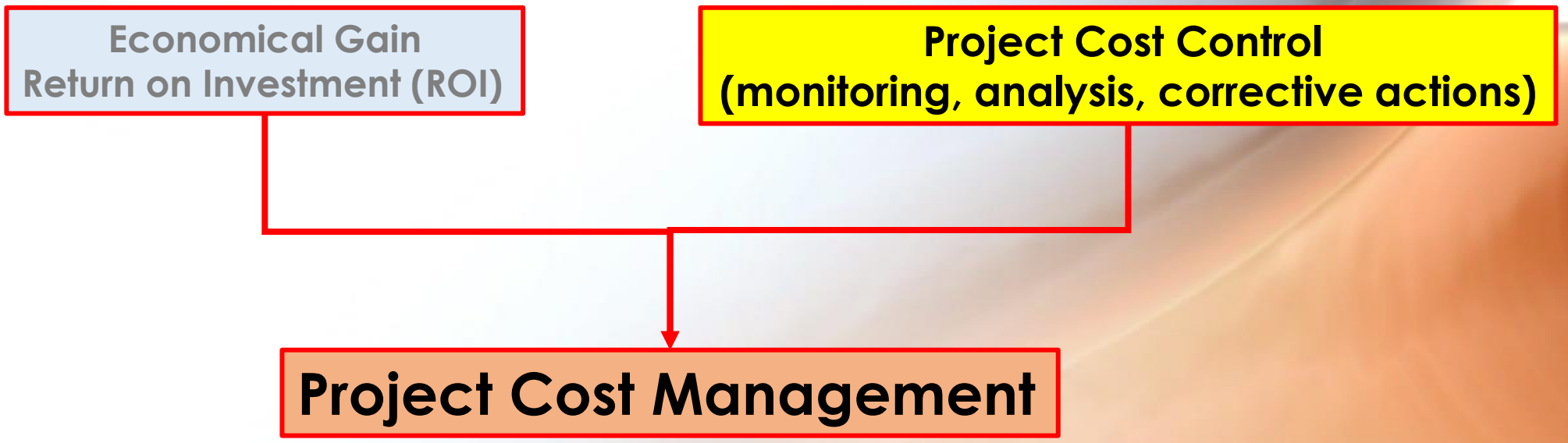
IRR =?

$$0 = \frac{1{,}050{,}0000}{1+{}^{IRR}/_{100}} - 1{,}000{,}000 \rightarrow 1{,}000{,}000 = \frac{1{,}050{,}000}{1+{}^{IRR}/_{100}} \Rightarrow \text{IRR} = 5$$

Economical Gain Criteria 5

5. Market Share
   - Some projects are undertaking for long-term strategic gains such as important partnerships, gaining market advantage, getting an upper hand over competitors …
   - Calculating IRR and ROI may not be applicable, but such undertakings may have significant impact on the future of the company
   - Strong rationale is required.

Project Cost Control



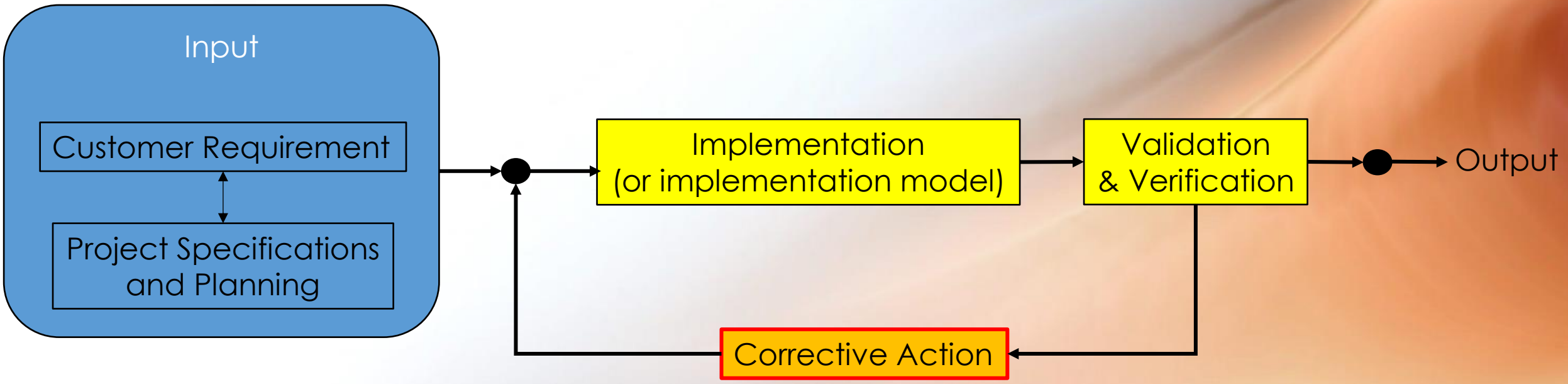
Project Cost Monitoring & Control

Project cost control requires:

1. Close monitoring of expenditure of labour, material, equipment, and energy during the project life cycle **[Data Acquisition Tools] – Input/Output**
2. Capabilities to analyse and assess project status (Progress and Expenditure) **[Analytical Tools] - Implementation**
3. Identify/predict threats and risks that cause delay or failure to achieve objectives and milestones **[Validation & Verification Methods] – V&V**
4. Explore, test and implement **corrective actions** throughout the life cycle. **[Product-Process Engineering Techniques]**

"In effect it is a closed-loop control system"

Simple Closed-Loop Control Diagram



Instruments for Monitoring & Control 1

1. **Data Acquisition Tool should enable:**
   - Customer requirements and interpretation into product specification (Continuous/Discrete Events(intervals)/one-shot)
   - Design and Process Planning
   - Resource Planning (status of resources throughout the project life-cycle)

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

Instruments for Monitoring & Control 2

2. The Analytical Tools should:

- Measure material, energy, and resources consumed
- Potential usage of techniques to simulate the project process using available modelling tools and relating it to cost functions. These include: work breakdown, work descriptions, process sequencing, task allocation, scheduling, planning, and budgeting.
- Measure levels of accomplishment of tasks and compare against expected targets
- Provide the platform for diagnosis and re-planning

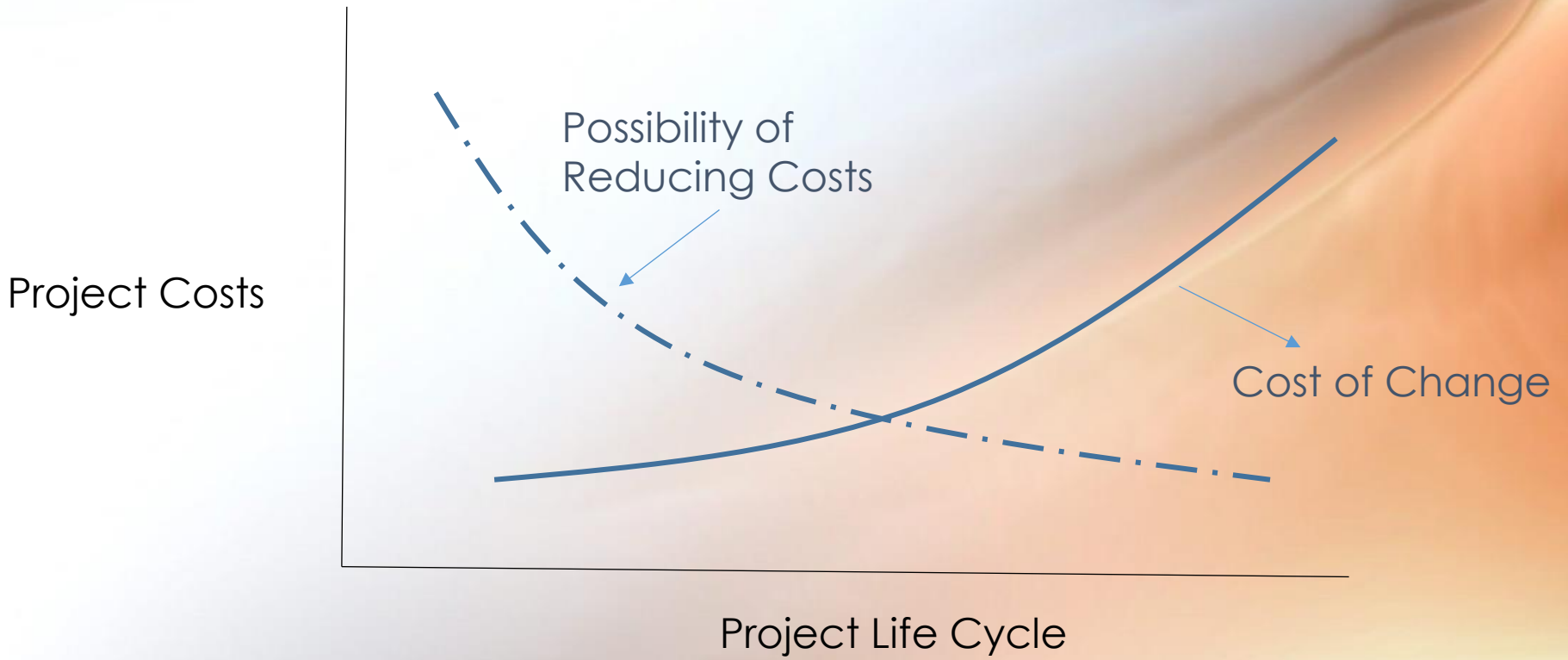
Instruments for Monitoring & Control 3

3. Validation and Verification tools should:

- Compare product specifications against technical/engineering standards
- Compare progress of project against targeted milestones
- Compare customer requirements against product development **(Voice of Customer)**
- Compare budget against actual expenditure
- Identify and formulate problems/shortcomings for corrective actions

Possibility to Reduce Project Costs

According to **H. R. Herzner** Project Management, A system approach to planning, scheduling and controlling; 11th Edition, Wiley, 2013. pp 742-743



Instruments for Monitoring & Control 4

4. Corrective Actions should be able to adjust the:

- Personnel, equipment and team capabilities
- Product technical and engineering specifications
- Customer requirements and possible evolution of such requirements throughout the project life cycle
- Test and validate the output (i.e. product)
- Budgetary requirements, project slacks, contingency, and support.

Cost Management Parameters

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

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

Earned Value Management 1

1. Budget Control:
   - there needs to be clear and accurate allocation of fund to specified Work Breakdown Structures (i.e. Who does what? and for How much?)
   - Parameters such as budgeted cost of work scheduled (BCW) and actual cost of work completed (ACW)
   - The Earned Value (EV) is the product of budget at completion (BAC)and the % of project completion.

$$EV = BAC \times \%Completed$$

Earned Value Management 2

2. Cost performance Index (CPI): is the ratio of EV to the actual cost.

$$CPI = EV/AC$$

$CPI > 1$ means the money spent is less than estimate

$CPI = 1$ money spent equal estimate (approval)

$CPI < 1$ money spent greater than estimate (budget overrun)

Earned Value Management 3

3. Schedule Performance Index (SPI): is the ratio of value of work performed to the value of work planned.

$$SPI = EV/PV$$

Example: The estimated budget for a given task is €20,000 and is expected to finish in 4 weeks. After two weeks 25% of the job is done (i.e. €5,000), what is the SPI?

$$SPI = \frac{5000}{10000} = 0.5$$

$SPI > 1$ means the time accomplished is less than time estimated

$SPI = 1$ means the time to accomplished and the estimate are equal (approve)

$SPI < 1$ means the time to accomplish task longer than estimate (behind Schedule)

Earned Value Management 4

4. Cost Variance: is the difference between actual spending (Actual Cost) and the planned spending at any given time in the project life cycle:

$$CV = EV - AC$$

Example: A task planned budget was €5,000, but €6,000 was spent to complete. What is the CV? 5,000-6,000 = -1,000 (over spent)

Earned Value Management 5

5. Scheduled Variance: represents the amount spent with respect to the planned value at any time

$$SV = \frac{\text{EV-PV}}{PV}$$

$SV > 1$ means project ahead of plan

$SV = 1$ on budget

$SV < 1$ behind planned and over budget for level of achievement.

Earned Value Management 6

6. Estimate at Completion: a metric to show the project spend estimates

$$EAC = \frac{AC}{\%Completion}$$

Actual Cost

Example: An project was originally estimated to cost €100,000, it is now at 20% completed and has spent €40,000.

$$EAC = \frac{40{,}000}{20\%} = €200{,}000$$

the Estimate amount of money needed to complete (ETC) the project from this date will thus be ETC = 200,000-40,000 = €160,000

Variance at completion: 100,000-200,000= - €100,000

Cost Management Parameters

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

B. Customer Satisfaction and Process Quality Assurance
   - Process efficiency (energy, material, effort, waste, and yield)
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Next Session

Customer Satisfaction and Process Quality Assurance

(Product conceptualisation and continuous measurement of customer satisfaction levels)