Project Control & Management

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Lecture 4

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

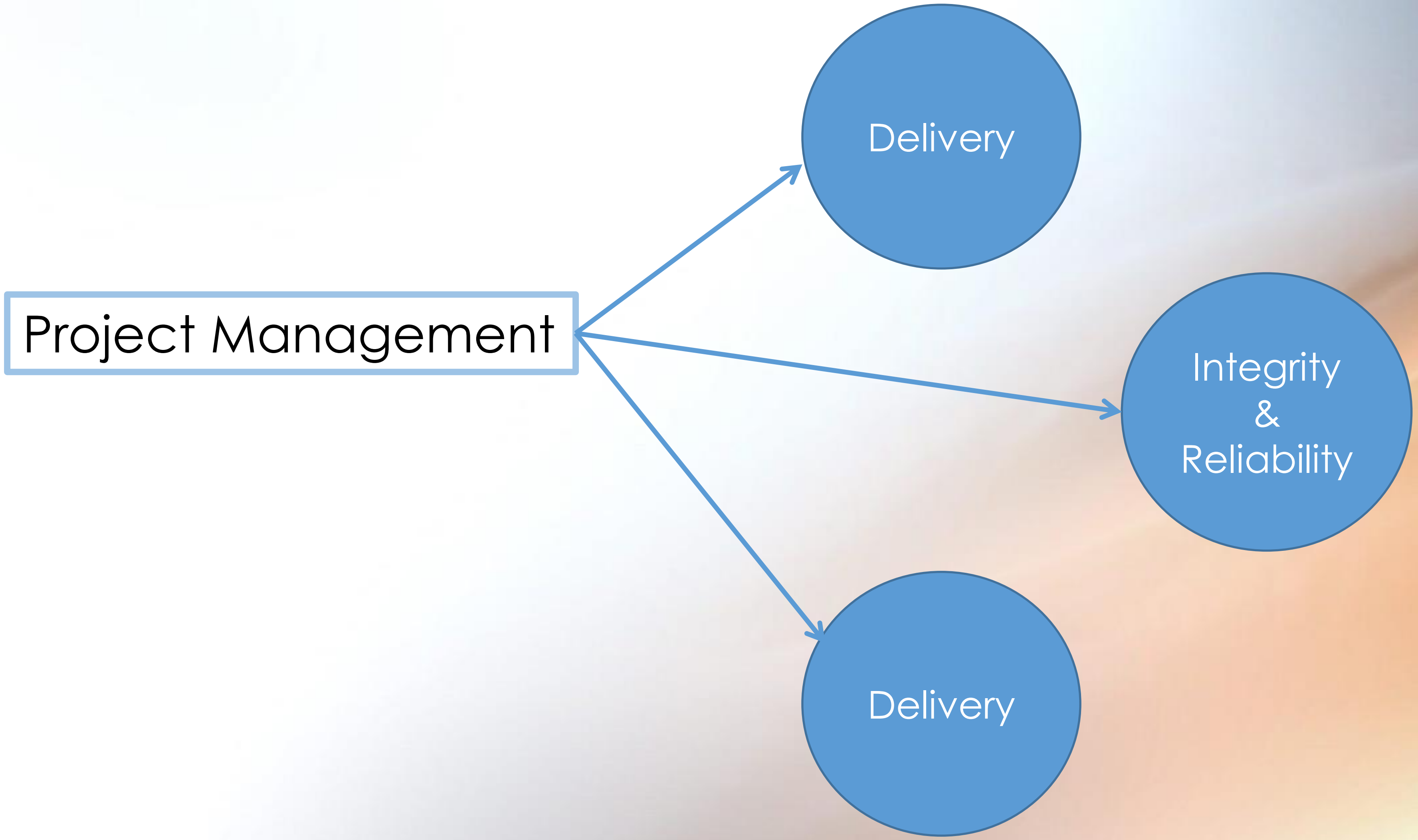
Subjects

Project Management in Engineering Environments

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

- Recommendation of software tools PERT Chat Pro® and Microsoft Project®

Project Management



1. Process Breakdown and Delivery

According to Pries & Quigley for the successful **Delivery** of project outcomes a set of activities are essential:

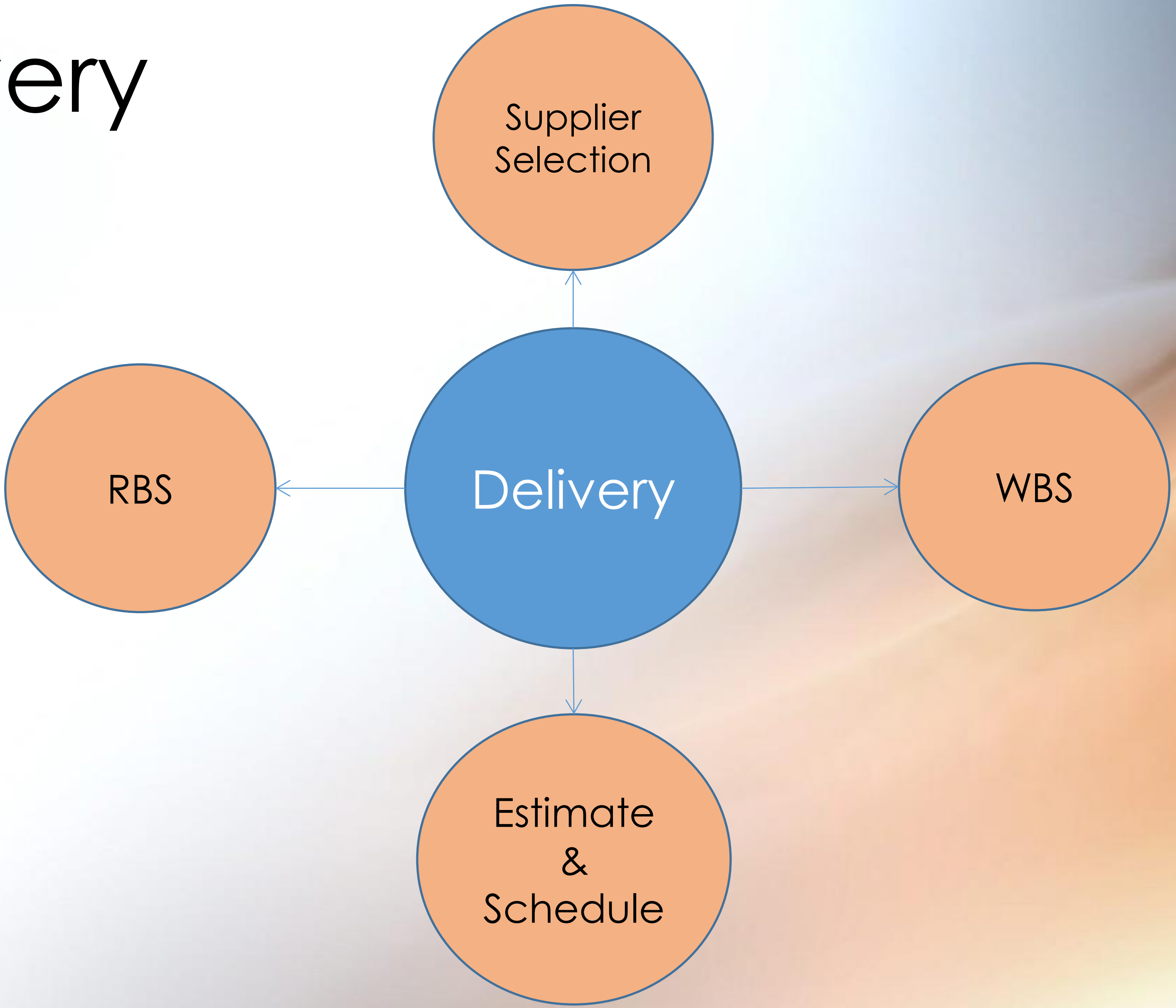
A. Supplier Selection

B. Work Breakdown Structure

C. Resource Breakdown Structure

D. Project Estimating and Scheduling

1. Delivery



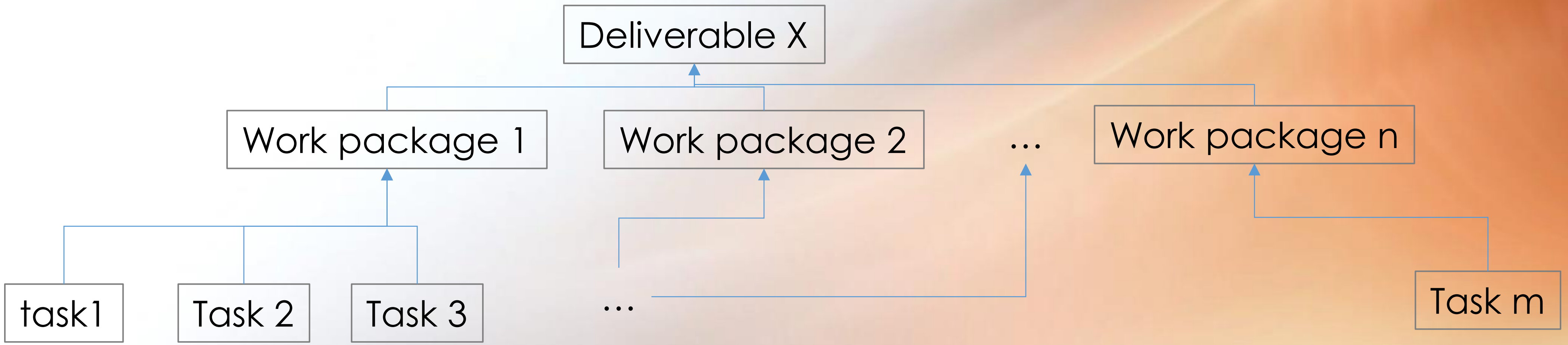
1.A. Supplier Selection: Supplier Evaluation

also see K.H. Pries and J.M. Quigley (2009) check list Chapter 2 pp 41

- Choice of suppliers is tantamount to the success of any engineering project. The selection can be *voluntary* or involuntary (e.g. customer choice, company policies, or the nature of design or product)
- Also economic and performance stability and reliability of the supplier is another evaluation criteria.
- Some companies may have established engineering evaluation criteria for selecting suppliers. The evaluation may include:
  - quantification of supplier capabilities to meet project requirements,
  - the evaluation process may result into a semi-subjective scoring
  - In Automotive industry normally the process of supplier evaluation using three representatives: the Supplier Quality Assurance procedures, the technical expertise from design staff and inputs from the purchasing department

1.B. Work Breakdown Structure

The concept is to identify the top-level deliverables of the project and systematically decompose the deliverables into units of work (its hierarchical)



Benefits of Work Breakdown Structure

- Systematic breakdown (roadmap) to the lowest components
- Helps with time planning and estimates
- Helps for resource assignment and allocation of responsibilities
- Helps in detecting risks and mitigations
- Allows for clarity of definition of tasks and the supporting activities
- Would help in devising project control parameters.

1.C. Resource breakdown Structure

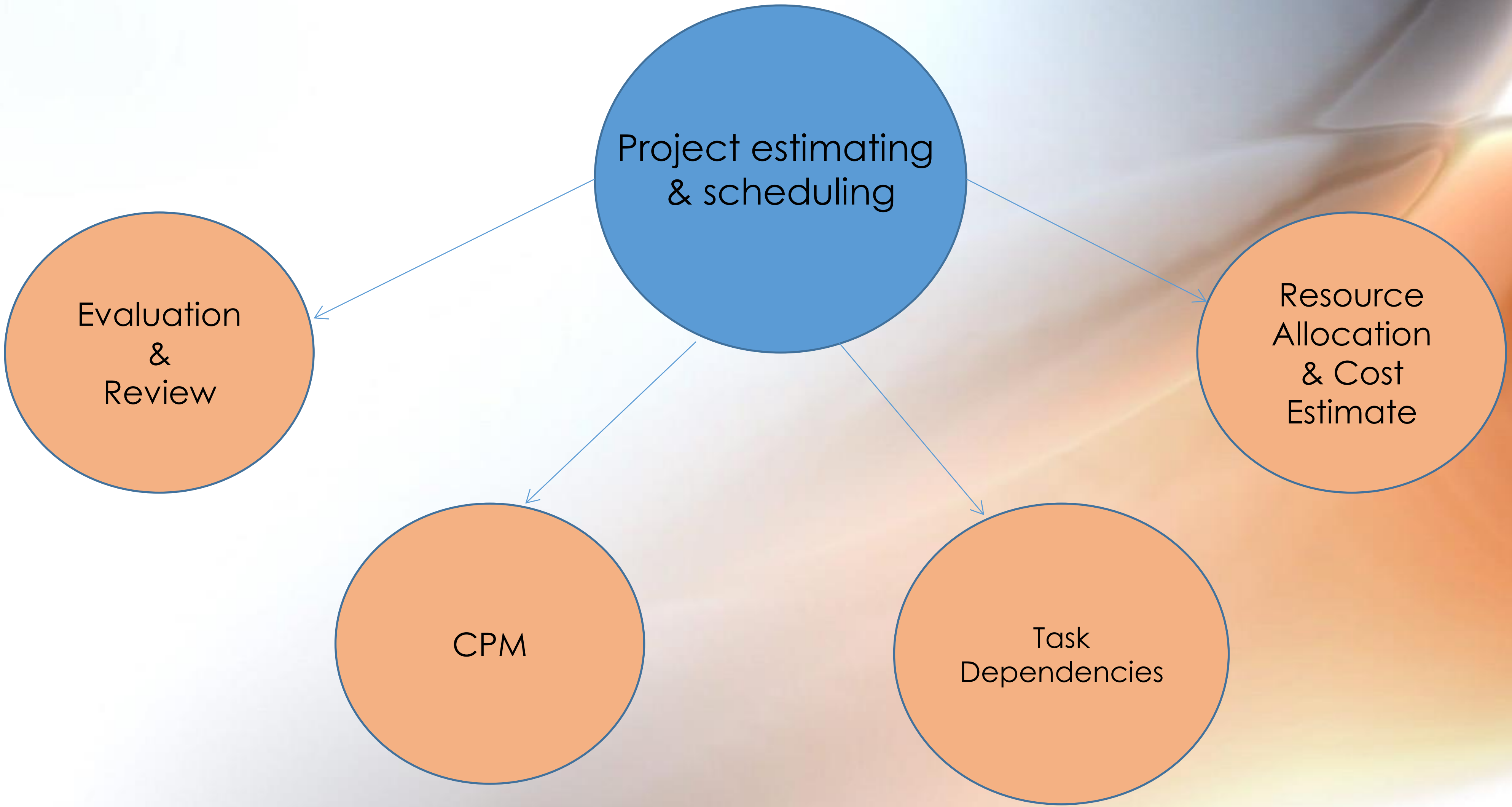
- Once the work breakdown is achieved the resource allocation takes place
- Human Resource capability evaluation
- Equipment and Machine Allocation (availability, schedules, capacity, process plan, and work balancing)
- Deterministic and random event analysis
- Possibly use of project and process management tools to simulate the whole project life cycle.
- We will discuss the use of Discrete Event Simulation (DES) as an aid

1. D. Project estimating and scheduling

- Some of the estimating **top-down** (small businesses) e.g. product development X%, production costs Y%, Testing and validation Z%.
- Some estimating **bottom up** (task X, cost X%, task Y, Y% total cost of WP Z = (X%+Y%)
- **Phase Estimating**, basically estimates cost on start of the task/work package and revisions happen at the end of each phase.

These methods are quite deterministic and may cause major variations in estimate. <u>*Reliance is mainly of experience*</u>.

Project estimating and scheduling



1.D.1 Project Evaluation and Review

- Activities can be split into two types:
  1. Well-defined recurring activities (nearly identical in all projects)
  2. One off activities that are quite project-specific
- Describing a task as a duration:

$$Duration = [(Pessimistic + 4 \times Most\ Probable + Optimistic)]/6]$$

- Task Variance:

$$Variance = 2 \times (Pessimistic - Optimistic)/6$$

The larger the task variance the higher the uncertainty

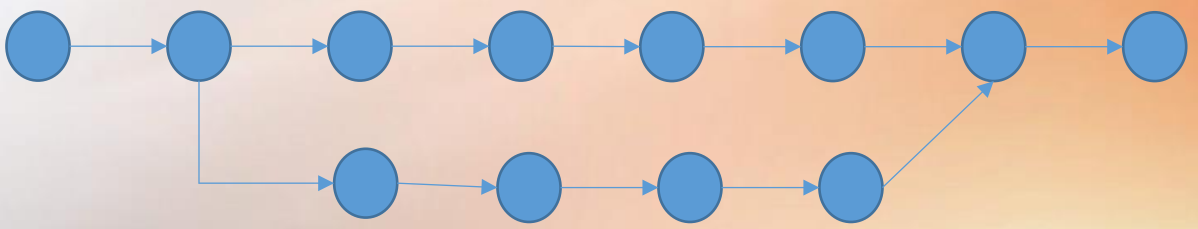
1.D.2 Critical Path Method

We will discuss this in further detail when discussing Planning

- The critical path in a project is the longest path in the network of cumulative tasks that completes a project.
- In other words it is the shortest possible time that a project can be completed.
- It is cumulative, slackless and connected lead time throughout the project.
- Management of uncertainties and slack becomes crucial.

1.D.3 Task Dependencies

- A clear understanding of the sequence of tasks to be undertaken is very important.
- A graphical representation allows a clear visual appreciation and communication
- Project Diagrams (software tools or sketched by hand)
- Process Flow Chart (PFC)



1.D.4 Resource Allocation & Cost Estimate

- Based on the tasks find the team with highest capability
- Assess Availability (Utilisation Factor) – Back to Lecture 3
- Establish the relationship between product attributes (e.g. software/hardware, size, complexity, performance, data systems, communication requirements …)
- Organisational attributes (priorities, preferences, processes, state…)

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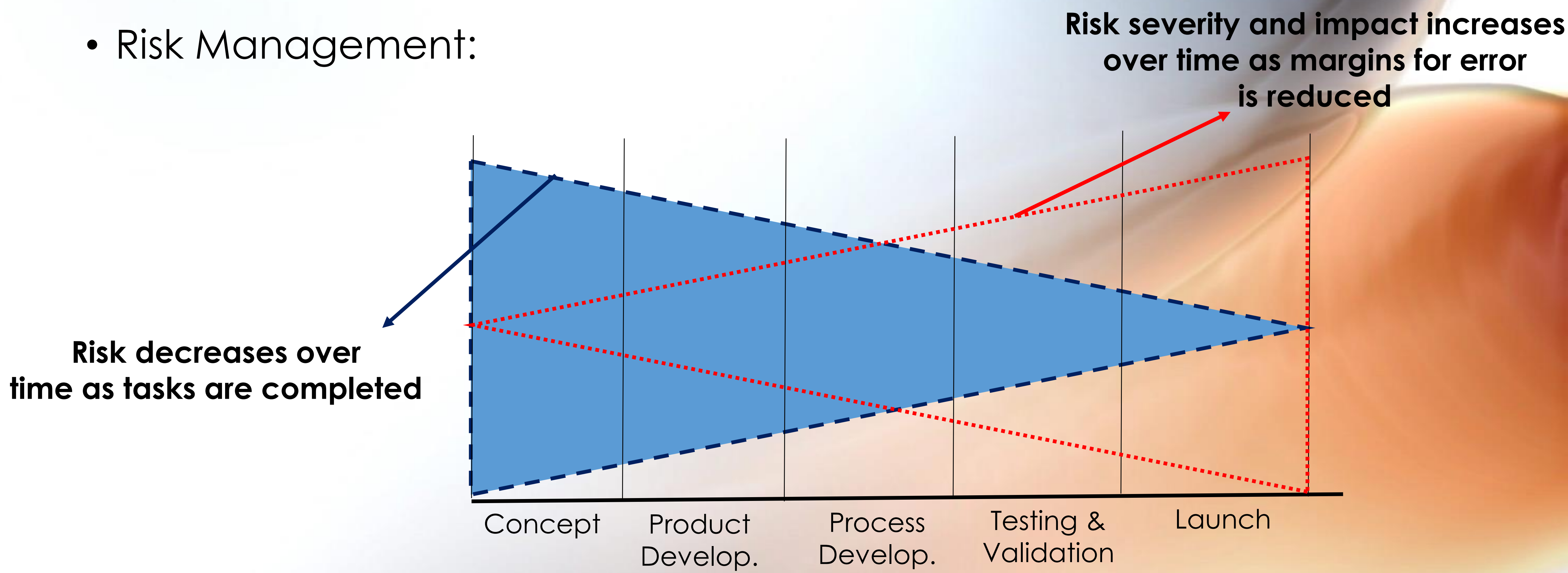
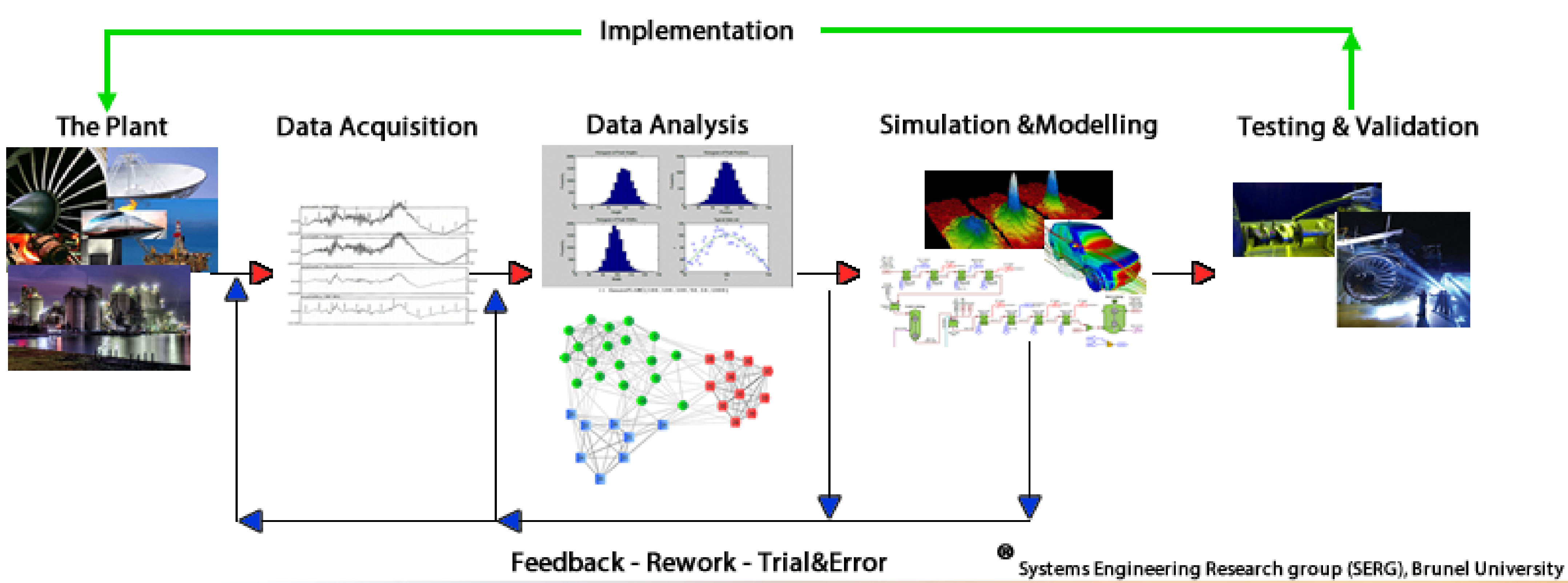
2. Product Integrity and Reliability

- Risk Management:

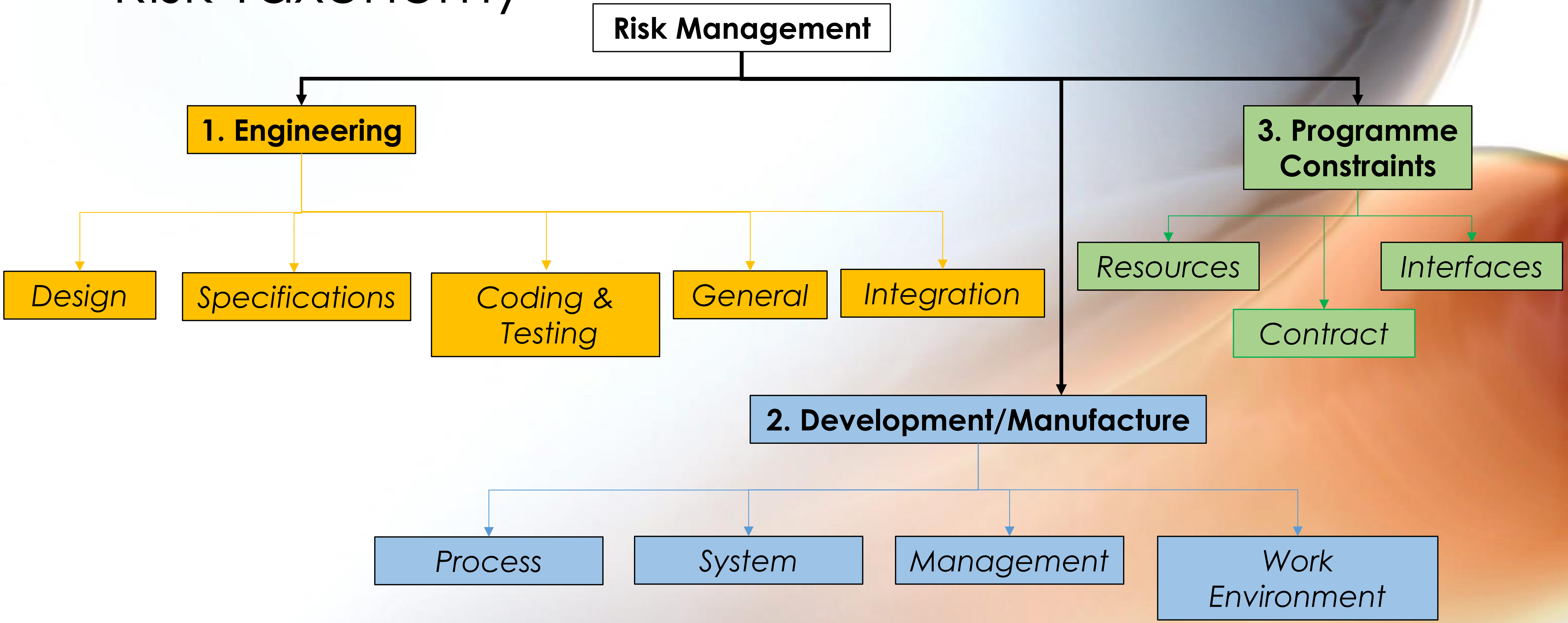


Source: Project Management of Complex and Embedded Systems, **K.H. Pries and J.M. Quigley**, Auerbach Publications, Taylor & Francis Group, 2009. ISBN: 978-1-4200-7205-1

Typical Engineering Project Life Cycle



Risk Taxonomy



Risk Taxonomy (Engineering)

1. Engineering

- ***Specifications***
  - Stability
  - Completeness
  - Clarity
  - Validity
  - Feasibility
- ***Design***
  - Functionality
  - Difficulty
  - Complexity
  - Performance
  - Testability
  - Hardware Constraints
  - Software capabilities
  - Reusability
- ***Coding & Testing***
  - Modularity
  - Testing
  - Implementation
- ***Integration***
  - Product
  - System
  - Destination site/cloud
- ***General***
  - Maintainability
  - Reliability
  - Safety
  - Commissioning

Risk Taxonomy (Development)

- **2. Development/Manufacture**
  - ***Process***
    - Formality
    - Suitability
    - Process Control
    - Product Control
  - ***System***
    - Capacity
    - Usability
    - Reliability
    - System Support
    - Deliverability
    - Suitability
  - ***Management***
    - Processes
      - Planning
      - Project Org.
      - Experience
      - Program Interfaces
    - Methods
      - Monitoring
      - Personnel
      - Quality Ass.
      - Configuration
  - ***Work Environment***
    - Attitude
    - Cooperation
    - Communication
    - Morale

Risk Taxonomy (Programme Constraints)

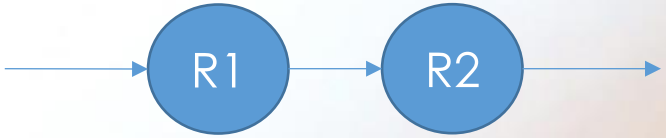
3. Programme Constraints

- ***Resources***
  - Capacity
  - Schedules
  - Capabilities
  - Equipment
  - Facilities
  - Supply Chain
- ***Contract***
  - Fixed-Variable
  - Restrictions
  - Dependencies
  - Obligations
  - Penalties/Rewards
- ***Interfaces***
  - Customers
  - Suppliers
  - Partners
  - Bureaucracy
  - Vendors
  - Politics

Quantifying Risk

$$Risk = Probability\ of\ Occurance\ \times Cost$$

- In a series of processes: The Reliability of an estimate (and):



$$R_{Total} = R_1 R_2$$

- In a parallel process(or)

$$R_T = 1 - (1 - R_1)(1 - R_2)$$

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