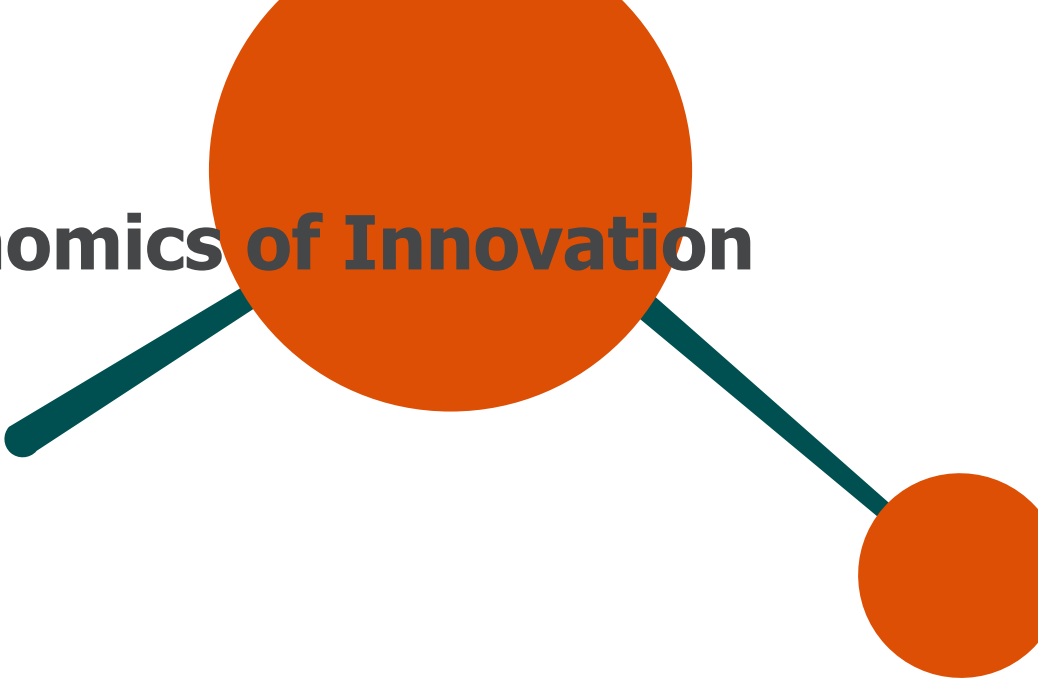
Course: Economics of Innovation



Topic: Agents and process of innovation

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COMPANY INNOVATION POTENTIAL

A company with high innovation potential scores high in the following areas:

- Strategy and planning
- Marketing
- Technological process
- Quality management
- Logistics
- Human resources

INNOVATION POTENTIAL ASSESSMENT

- For a company, it is important to know its innovation potential. It can use the questionnaire
- For every of the six areas, there are six question, each with four possible answers. The answers are formulated so that they reflect the existing situation in the company.

A. STRATEGY AND PLANNING

1. Idea about the company future
2. Vision and employees
3. Company innovation programs
4. Plan modifications
5. Financial indicators of the plan
6. Project management

B. MARKETING

1. Monitoring of current market trends
2. Evaluation of the market competition position
3. Customer-orientation
4. Monitoring of customers' attitudes to the company product
5. Market information flow inside the company
6. Marketing and financial control

C.TECHNOLOGICAL PROCESS

1. Future company's competitiveness in the industry
2. Changes of technologies
3. Collection of impulses for implementation of technology changes
4. Evaluation of the return on investment
5. Calculation of production costs and their monitoring
6. Creation of resources for development

D. QUALITY, ENVIRONMENT

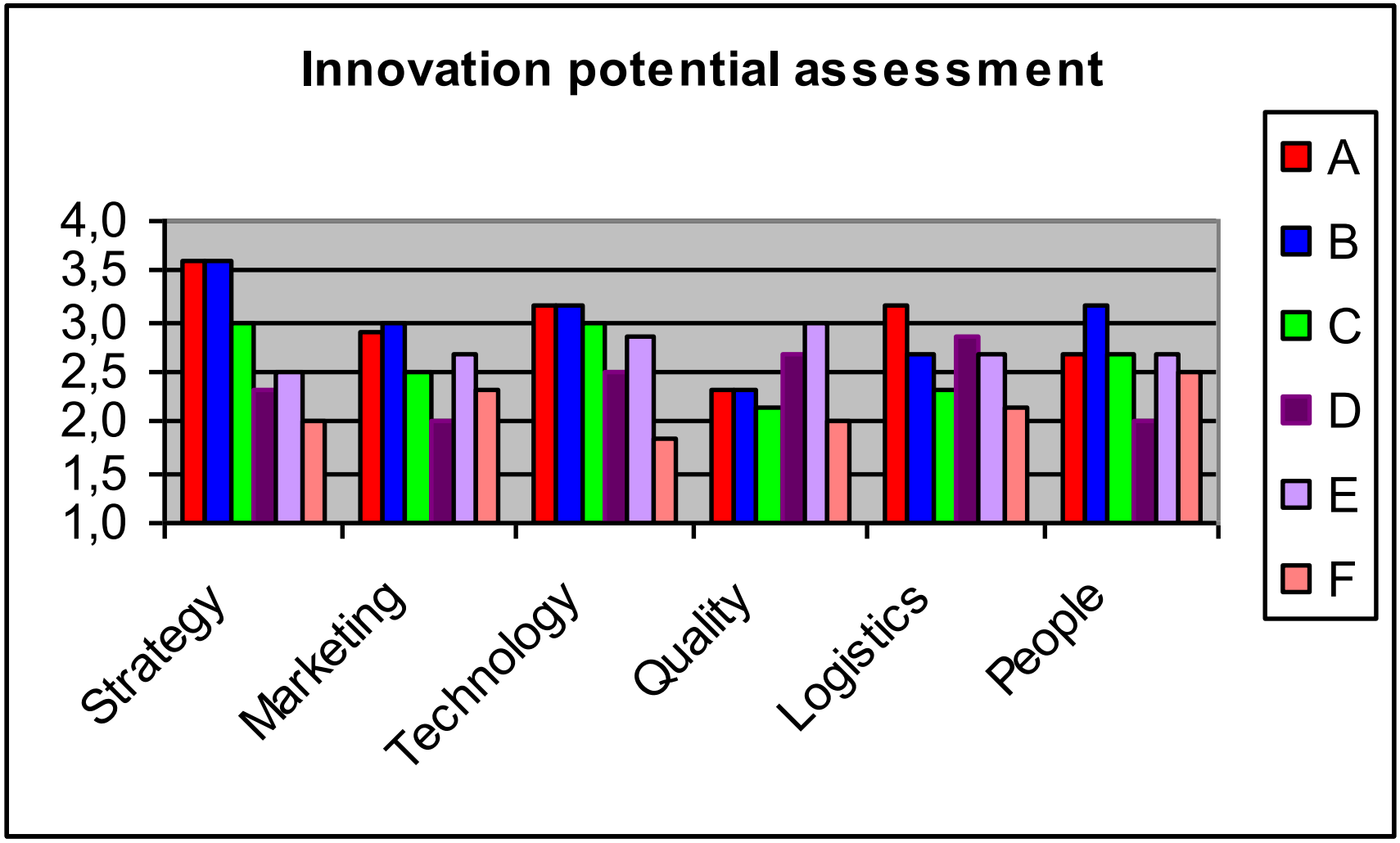
1. Monitoring of changes conditioning the quality management in the company
2. Employees' personal contribution to the quality system
3. External quality audit in the company
4. Monitoring of the environmental impact
5. Impact of quality monitoring on the company processes
6. Covering of costs resulting from modifications of standards, regulations and legislation in the sphere of quality and environment

E. LOGISTICS

1. Organization of purchase and distribution channels in the company
2. Optimization of the company logistics
3. Information and communication flows between the company and its partners
4. Flexibility of logistics processes
5. Introduction of innovations in logistics
6. Logistics and financial control

F. ORGANIZATION AND HUMAN RESOURCES

1. Employees satisfaction
2. Employees motivation
3. Management and communication
4. Conflict resolution
5. Company information system
6. Company culture


Innovation potential assessment
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Strategy
Marketing
Technology
Quality
Logistics
People
A
B
C
D
E
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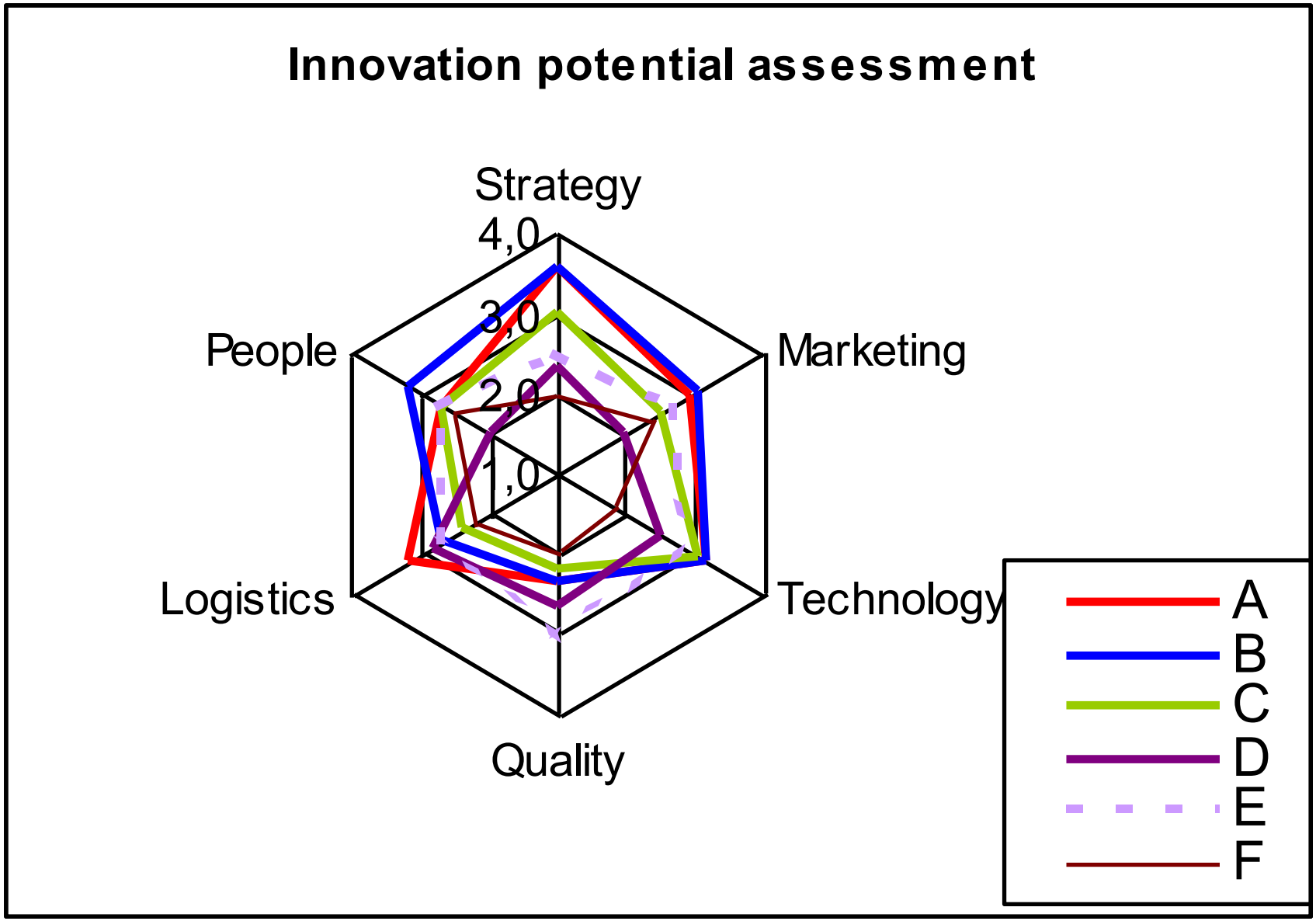
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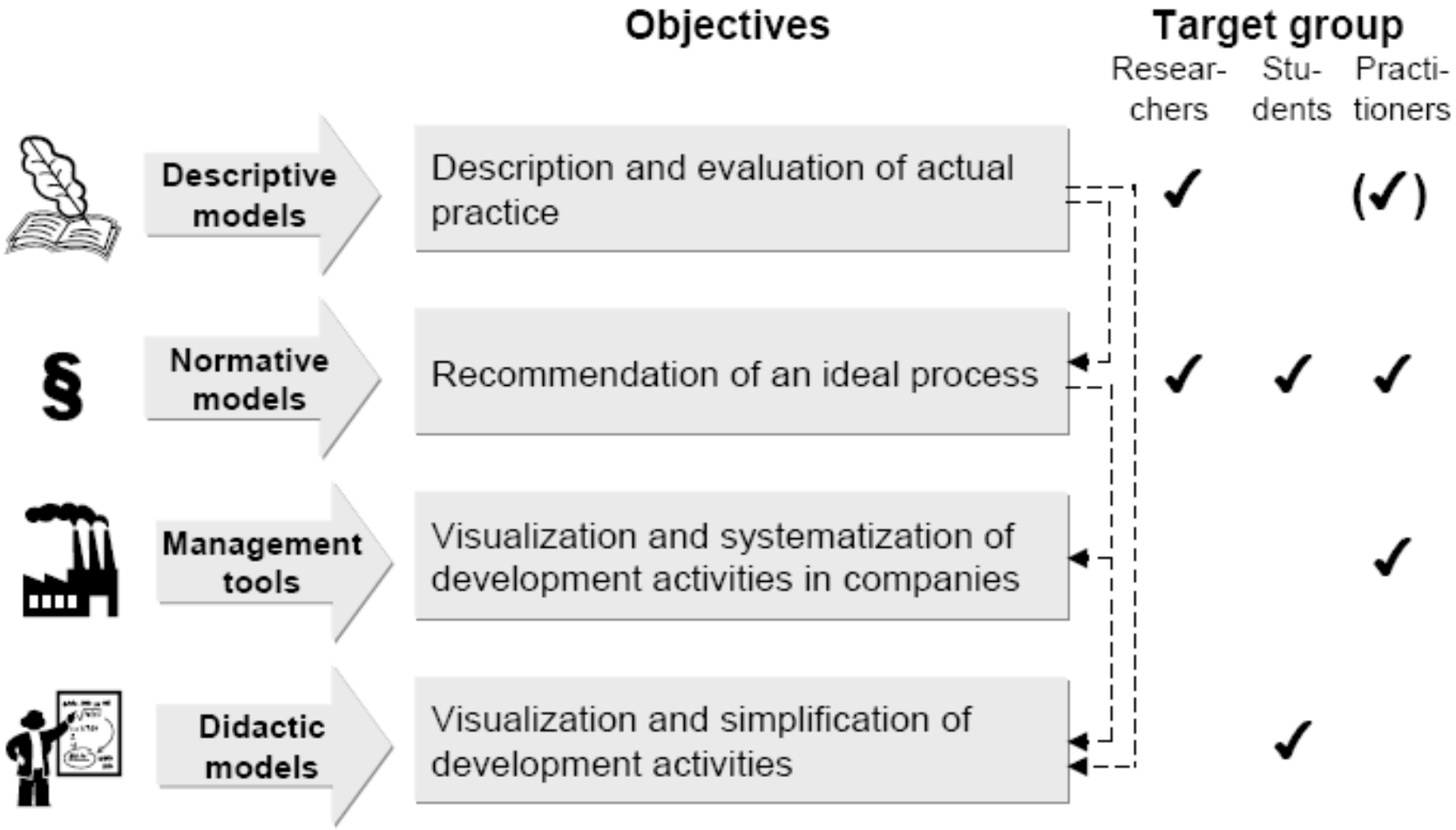
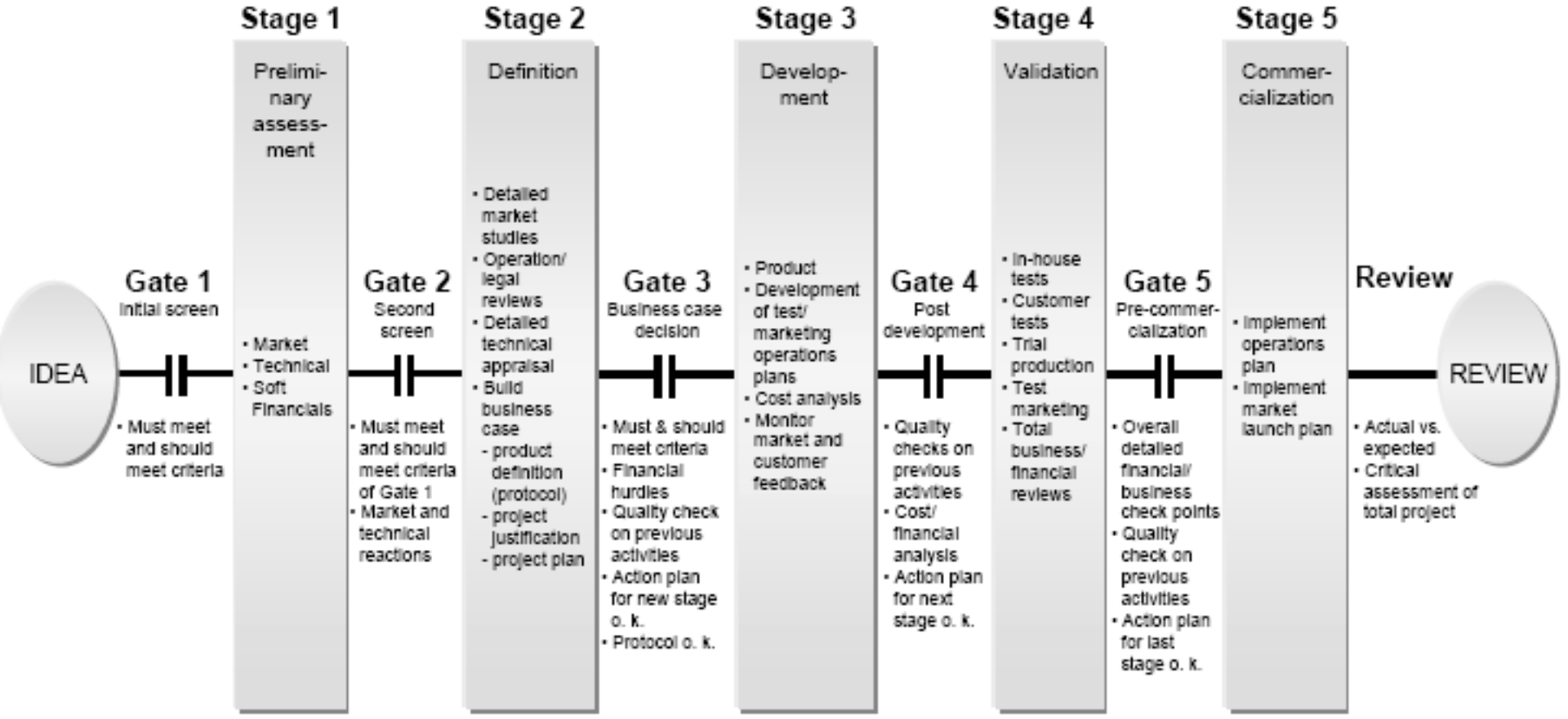
The objectives of process models



Stage-gate process

- R. Cooper, 1960´s
- phases with inputs and outputs specified beforehand
- gates, in which the gatekeepers decide about the continuation of the process
- Activities were standardized and the indicators of the process performance significantly improved.

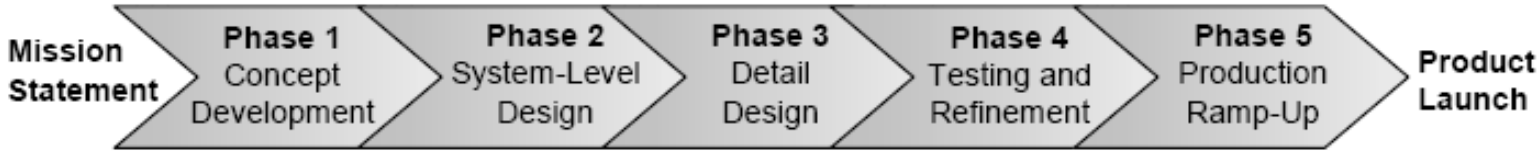
2-nd generation SG process



Evaluation criteria

- Operational, realistic, differentiating
- **Must meet**: to kill not well proceeding projects as soon as possible
- **Should meet**: prioritization, support of portfolio management
- **Strategic buckets**: resources allocated to various strategic goals

Interdisciplinary view



	Phase 1 Concept Development	Phase 2 System-Level Design	Phase 3 Detail Design	Phase 4 Testing and Refinement	Phase 5 Production Ramp-Up
Marketing	• define market segments • identify lead users • identify competitive products	• develop plan for product options and extended product family	• develop marketing plan	• develop promotion and launch materials • facilitate field testing	• place early production with key customers
Design	• investigate feasibiliy of product concepts • develop industrial design concepts • build and test experimental prototypes	• generate alternative product architectures • define major sub-systems and interfaces • refine industrial design	• define part geometry • choose materials • assign tolerances • complete industrial design control documentation	• do reliability testing, life testing and performance testing • obtain regulatory approvals • implement design changes	• evaluate early production output
Manufacturing	• estimate manufacturing cost • assess production feasibility	• identify suppliers for key components • perform make-buy analysis • define final assembly scheme	• define piece-part production processes • design tooling • define quality assurance processes • begin procurement of long-lead tooling	• facilitate supplier ramp-up • refine fabrication and assembly processes • train work force • refine quality assurance processes	• begin operation of entire production system
Other functions	• finance: facilitate economic analysis • legal: investigate patent issues	• finance: facilitate make-buy analysis • service: identify service issues		• sales: develop sales plan	

Fuzzy Front End (FFE, FEI)

- quality of pre-development phases significantly influence the product success
- early phases to a large extent influence, which projects will be realized, why, what will be final costs, time, and – in the end – the final success in the market
- highly dynamic, not strictly documented, creativity competes with systemization.

Phase 0

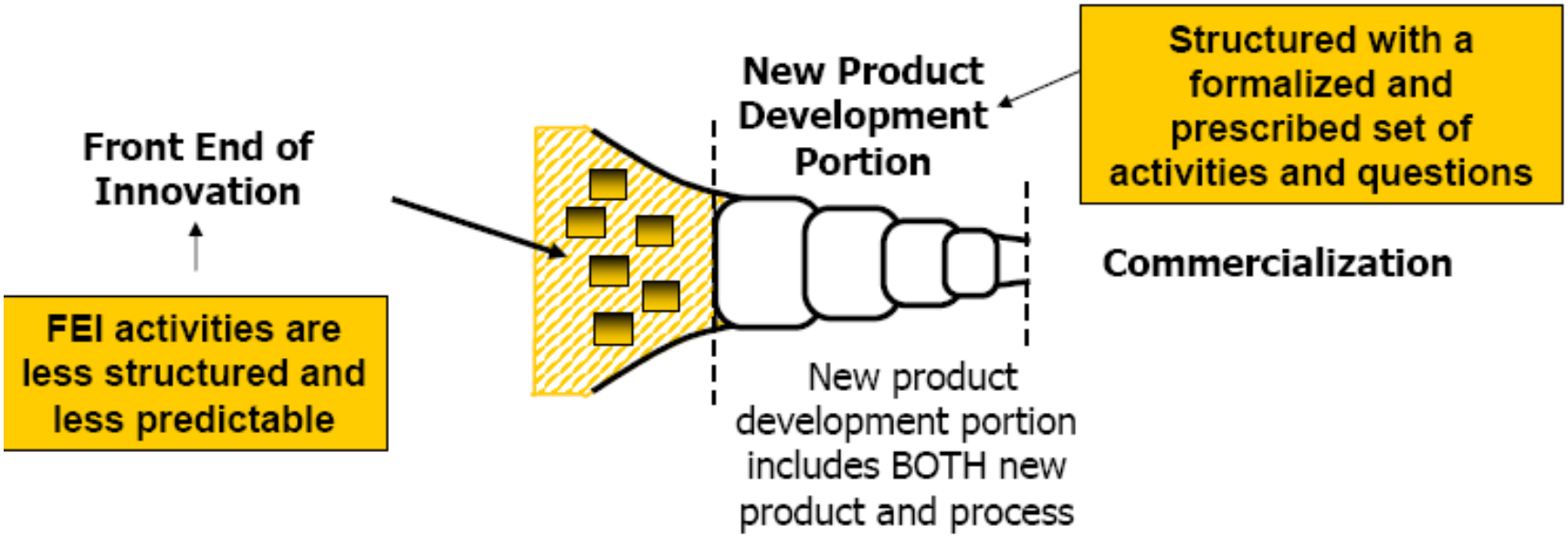
- results in product concept, including preliminary identification of customer requirements, market segments, competitive position, business opportunity and compliance with strategy

Incremental vs. radical innovations

- Koen: systematic approaches using process models can be successful in the case of incremental innovations, where both business and technical uncertainty is rather low
- whenever at least one of those uncertainties is high, we need more flexible approaches with iterations and parallelization of activities
- successful radical innovations often use rapid or virtual prototyping even in the 0-th or 1-st phase, as it allows better visualization and communication of the product concept.

New concept development model

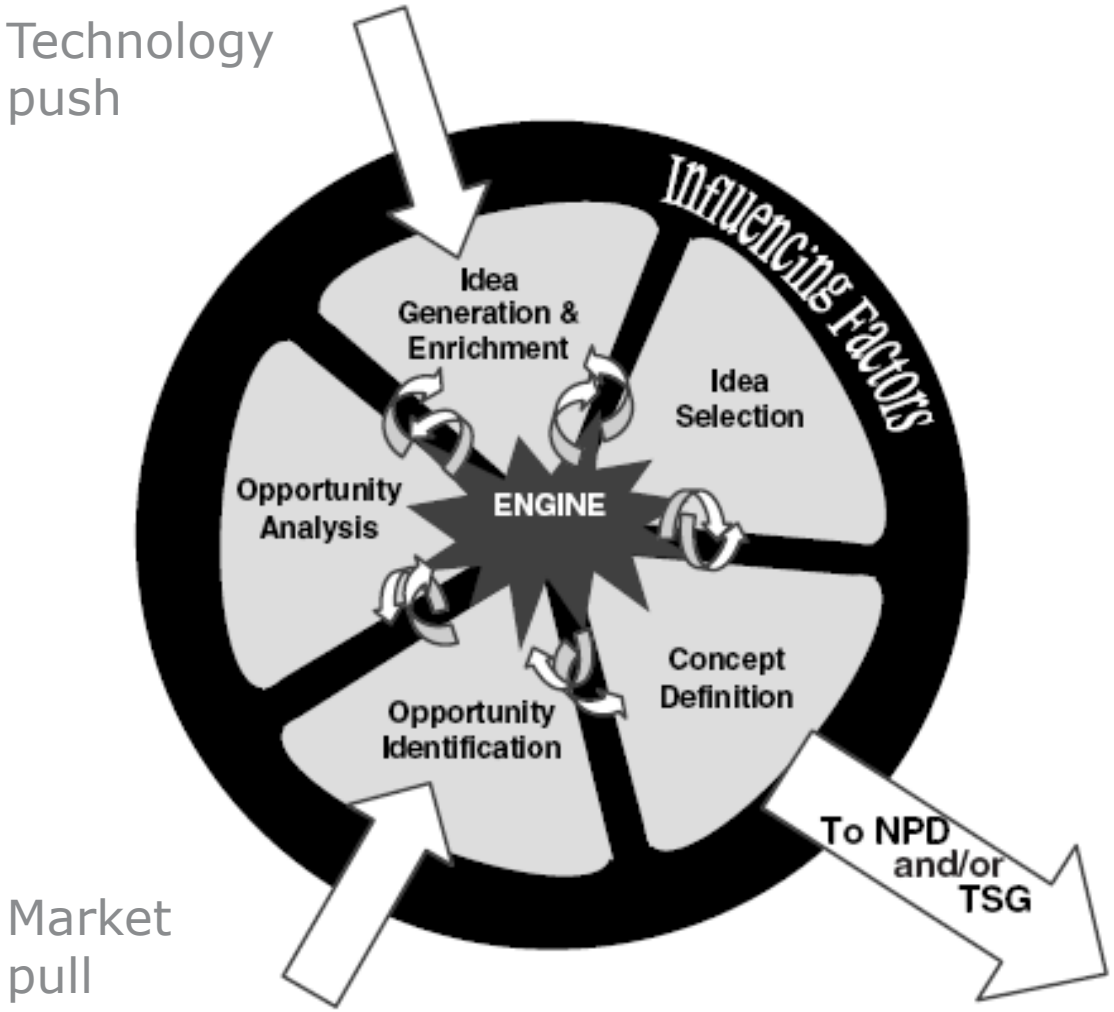
- in the early phases it is not suitable to use the same approaches as in the later, more structured process phases



Difference Between FFE and NPD

	Fuzzy Front End (FFE)	**New Product Development (NPD)**
Nature of Work	Experimental, often chaotic. "Eureka" moments. Can schedule work—but not invention.	Disciplined and goal-oriented with a project plan.
Commercialization Date	Unpredictable or uncertain.	High degree of certainty.
Funding	Variable	Budgeted.
Revenue Expectations	Often uncertain, with a great deal of speculation.	Predictable, with increasing certainty, analysis, and documentation as the product release date gets closer.
Activity	minimize risk and optimize potential	Multifunction product and/or process development team
Measures of Progress	Strengthened concepts.	Milestone achievement.

New concept development model (NCD)



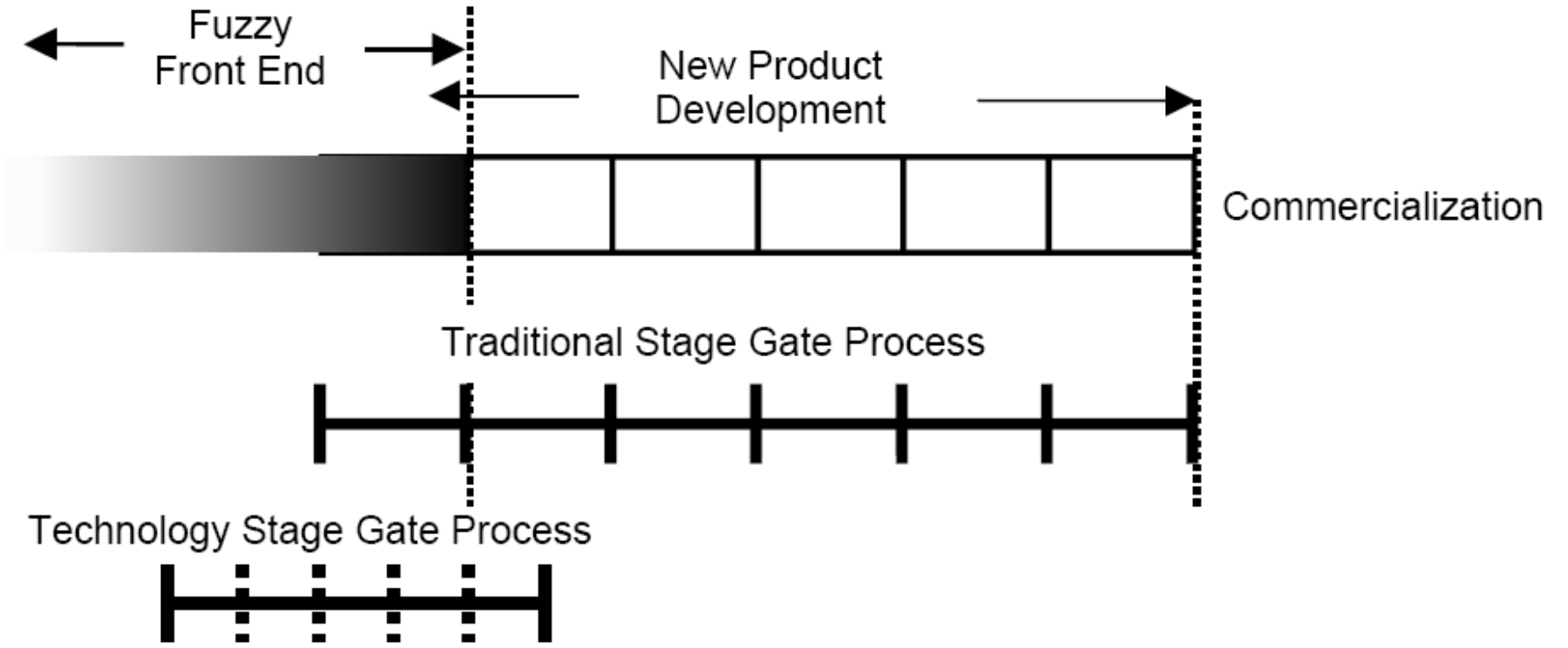
NCD components

- Engine: represents management support
- Engine powers the five elements of the NCD model
- The engine and the five elements are placed on top of the influencing factors.

Technology stage-gate process (TSG)

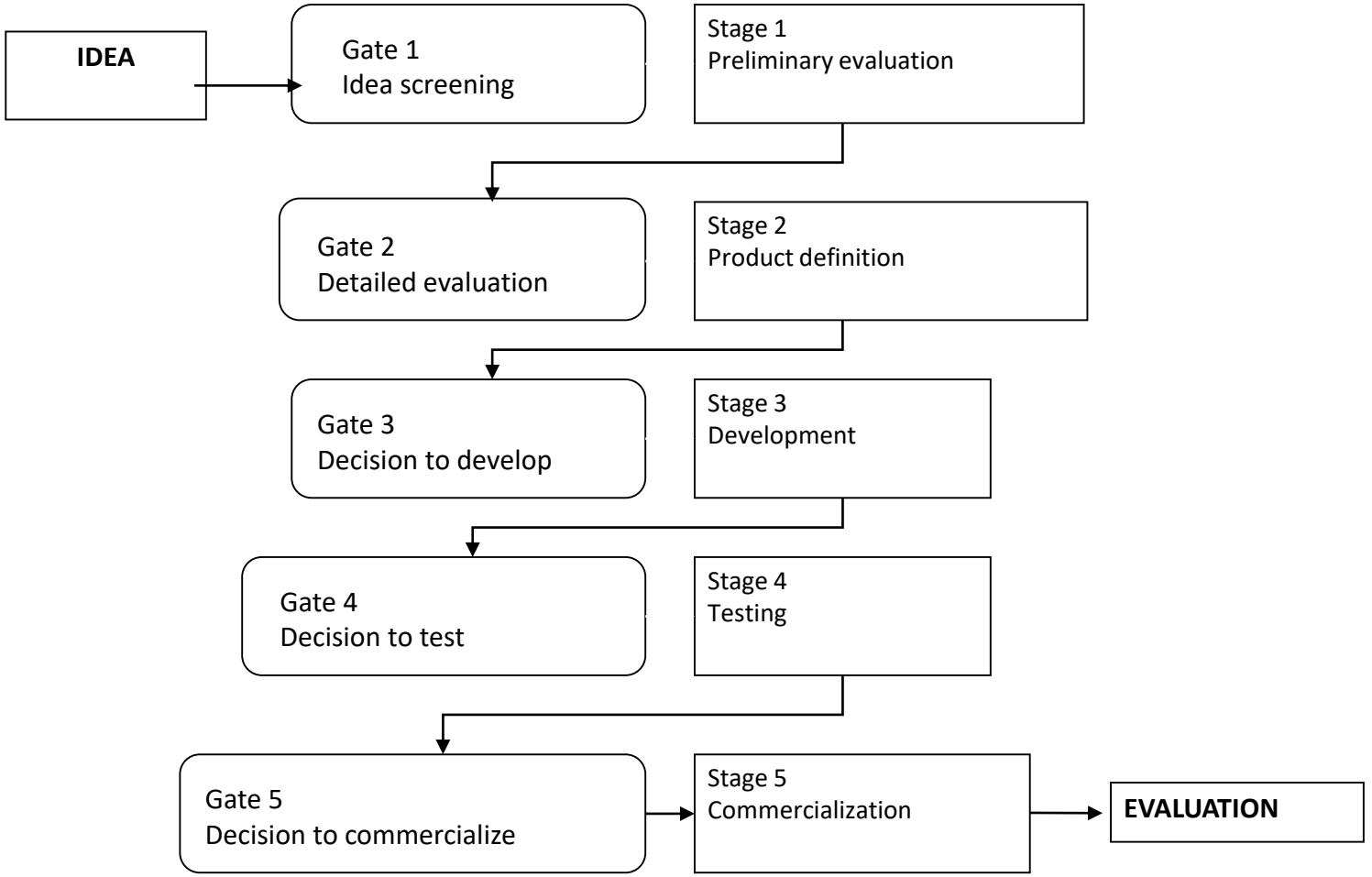
- Management of high-risk projects within and at the transition between the fuzzy front end and new product development
- traditional SG: gates are transparent, the product development team can "see" all the deliverables at the gates
- TSG: gates are opaque, the team can only "see" to the next gate and understands that the deliverable may change as the technology is developed

Traditional and technology stage-gate processes



EVALUATION OF THE NEW PRODUCT DEVELOPMENT AND R&D PROJECTS

Stage-gate process



Project feasibility

- The stage-gate model divides the innovation process into five stages with gates, in which evaluators decide if to continue or kill the project.
- Each phase has its cost, duration and probability of success. Usually only the last stage generate profits.
- To justify the project development cost, we should prove at the very beginning its feasibility. Traditionally we have to show that the project net present value is greater than zero, i.e. that the whole project, taking into account the time value of the money, will generate net profit.

DCF methods

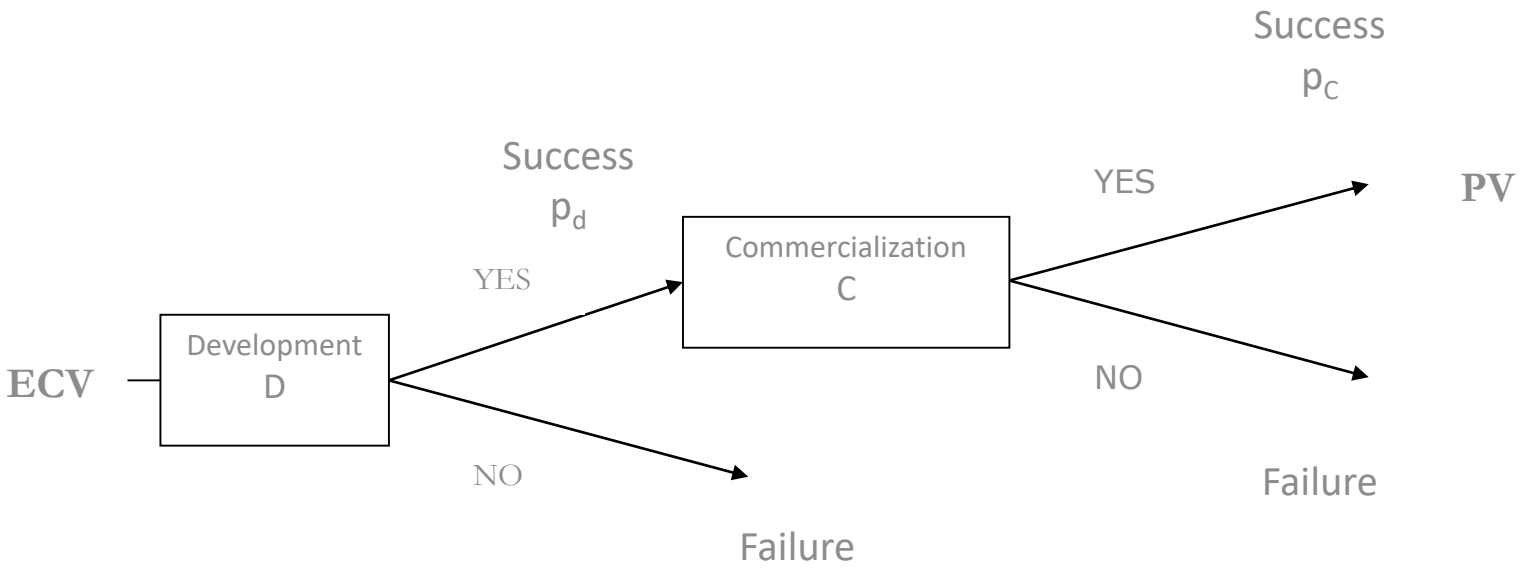
- The generally accepted method of evaluation of investment, is based on discounted cash flows (DCF).
- The method is successfully used for investment projects with low level of uncertainty and duration from several months up to few years.
- In many cases it is not suited to long-term NPD and R&D projects, as it penalizes projects with high risk and potentially valuable projects can be rejected or terminated.

Weakness of DCF methods

- Do not take into account the typical nature of the NPD and R&D projects that can be divided into stages separated by gates, deciding about project continuation or termination.
- Financial models assume that the decision about the project realization is done at its very beginning and is irreversible. However, investments into NPD or R&D projects are incremental and the evaluators at the gates decides about the project fate on the basis of changing situation.

Project Expected Commercial Value (ECV)

- Takes into consideration all three important characteristics of each phase – its cost, duration and probability of success
- The project is modeled by the probability tree.
- The stage duration, together with the discount rate, is reflected in the net present value calculation.
- Illustration: project with only two stages – development and commercialization



ECV = project expected commercial value
p_d = probability of successful development
p_c = probability of successful commercialization
D = development costs
C = commercialization costs
PV = net present value of expected project earnings

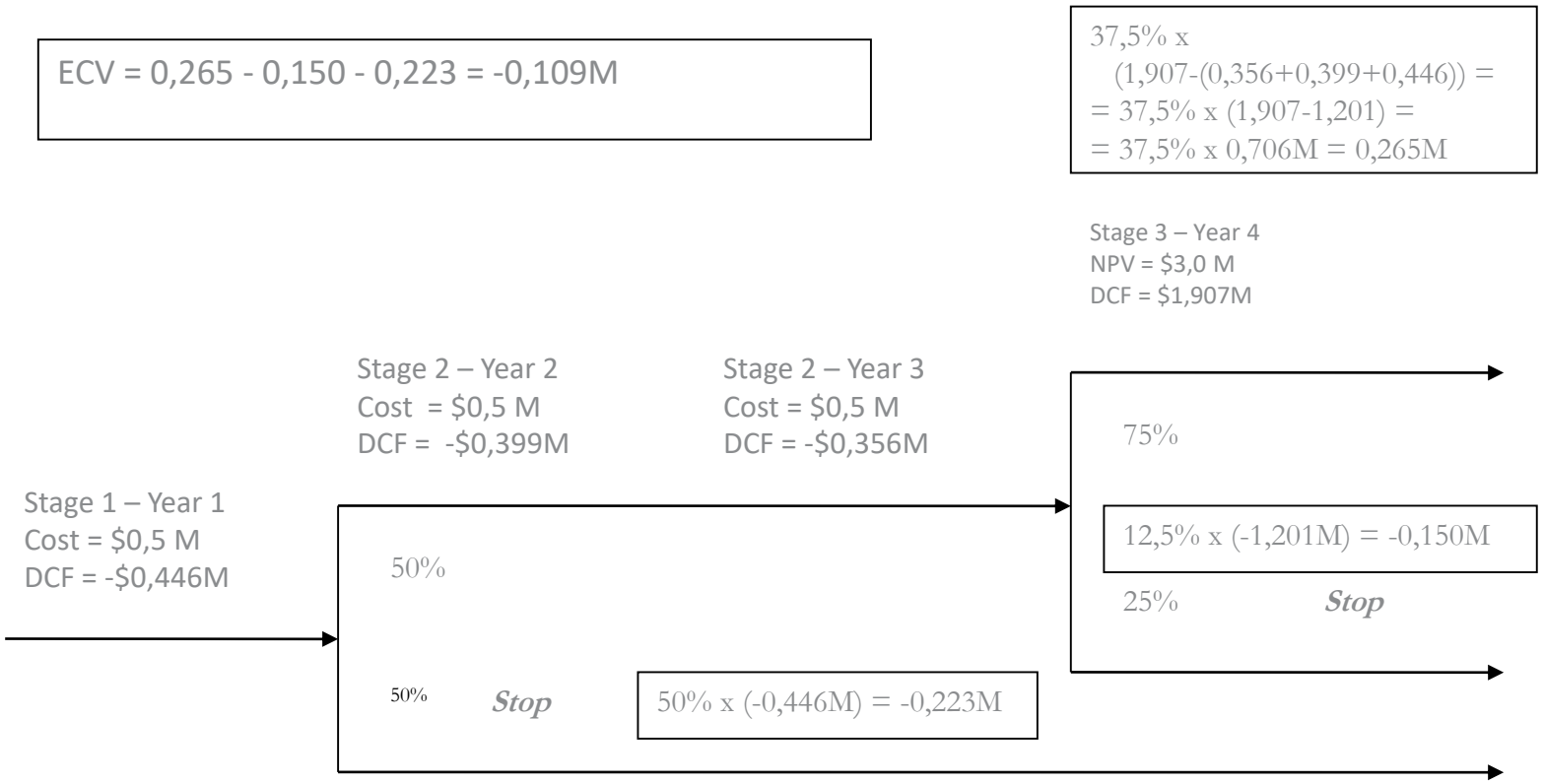
$ECV = [(PV * p_c - C) * p_d] - D$

according to [Cooper 2001]

Example

- The first stage (1 year): laboratory tests; success probability 50%.
- The second stage (2 years): field tests; success probability 75%.
- If tests are successful, the necessary investment into the technology is $5M, expected earnings $8M ⇨ project net present value $3M.
- Financial data are discounted, assuming the weighted capital costs WACC = 12%, risk-free discount rate 5%.
- Development costs and specific project risk are high ⇨resulting ECV negative (-$109 000)
- according to this criterion, project should be rejected.

Probability tree in project evaluation



áccording to [Boer 2003]

Real options

- The concept of real options is closely related to financial options that found their place in financial markets in recent decades. Real options relate to company opportunities and emphasize the basic idea that risk can bring the competitive advantage and as such it should be rewarded.
- The application of the real options theory is briefly described in [Boer 2003], the related website contains further information and references to more detailed resources. Here we will give only a brief account of basic concepts and terminology.

Two kinds of risks

- **specific risk**
- **market risk**

Specific risk

- Specific for the partial situation
- At lest partly under your control (e.g. risk of a fire or risk of project failure)
- Can be diversified - we can use insurance to share fire risk and maintain the diversified project portfolio to protect against the risk of project failure
- Therefore the market does not pay any premium for specific risks
- Specific risk can be often characterized by its probability.
- Better management of specific risk can help us to achieve the competitive advantage.

Market risk

- Is not under your control
- Cannot be diversified. The pharmaceutical company, as a part of health care sector, can do little to diversify the market risk.
- Traditionally, market risk increases the capital expenses and therefore decreases the project value.
- However, the situation is different with options: here the higher market risk, expressed as volatility, increases the option value, which can be quantified using the Black-Scholes algorithm, well known from financial options.

Volatility

- Quantifies the rate of change of market value of the ***underlying asset,*** i.e. the asset to its ownership we are entitled by buying the option (technology, database of customers …).
- Is usually specific for the industry and can be estimated on the basis of information available from e.g. stock market, industry statistics, etc.
- The higher the volatility, the more advantageous is to hold the respective option.
- The higher volatility means the higher potential of both the increase and decrease of the related asset price. As the option holder we can fully exploit the increase, while in the case of decrease we do not realize the option and the maximum loss is limited by the option cost.

Application

- Boer [Boer 2003] applies the real option model (OPT) with volatility equal to 50% to the example from Fig. 3
- He shows that using this method the project value is $0,171M, i.e. it is positive and the project is ***feasible***.
- The difference in project value assessed by ECV and OPT models is $0,279M, what is enough to justify the project. The difference is caused by market volatility.
- Boer also proves that in case of the zero market risk, i.e. the zero volatility, both methods give the same result.
- The method of real options brings the most significant effect to **projects with high level of risk having slightly negative net present value** determined by ECV or other models based on the discounted cash flow.

Conclusion

- Illustration of the often neglected side of the new product development and R&D projects.
- The researchers, engineers, designers must work together with investors to determine before the project launch and in the gates how efficiently the capital invested into the effort is used.
- It is not an easy task; however, we hope that we succeeded to persuade the auditorium that this important task cannot be avoided.

Reference and source

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