Improving the Management of Innovation Risks - R&D risk assessment for large technology projects

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Abstract

Global network structures of products and services are important value creators in many companies. Complex business models include a variety of relationships and interrelationships within and across different systems, especially in innovation processes. This leads to lower predictability and higher behavioral deviations or, in other words, increases innovation risks. Risk management is becoming more and more important and is crucial for the German Machinery and Plant Engineering Industry (MPEI). Many companies are medium-sized and are using standard static risk management methods.

Use of these methods often means that critical situations are detected late, they do not help in the understanding of problem characteristics and their interdependencies and, therefore, lead to erroneous decisions. With the industry focusing on its core competence in innovation, companies have complex success factors and complex risk clusters. Therefore, the modelling of cause-and-effect structures of innovation risks in the German MPEI facilitates the exploration and understanding of the behavioral dynamic of risk clusters. In a comparison of standard risk assessment with the Causal Loop Diagram and the System Dynamics Model of Innovation Risks, the potential of System Dynamics for systemic and multi-dimensional risk management is demonstrated.

1. Introduction: Interconnection of Innovation Risks

Risk Definition (Common Sense)
"Chance or Danger, arising from tasks and decisions, to deviate from set targets."

Risk Nets

Dynamic and multi-causal systems are typical attributes to describe the current environment. In reference to risks this complexity could also be recognized having a look to theirs causes and effects.
Many challenges arise from this which are highly interconnected and turn innovation risk management into multi-dimensional risk management (see figure 1) which is both complex and dynamic.

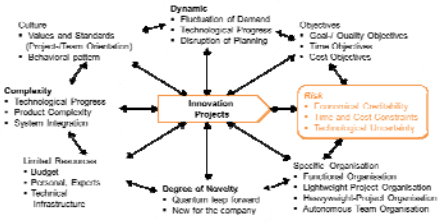
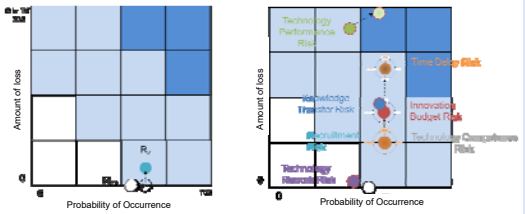


Fig.: Aspects and Interconnection of innovation risks *(Gassmann 2006b S.9)*

2. Problem: Current Methods applied don't deal with complexity sufficient and holistic



3. Objective: Generic SD-Model for Risk Analysis

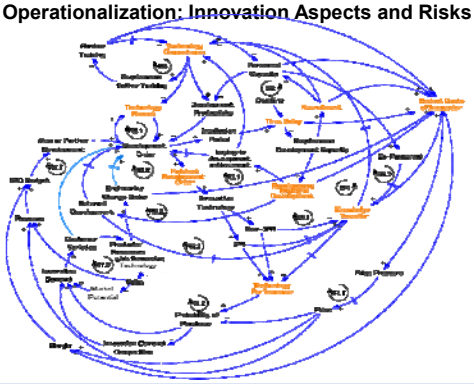
Research question

a) How can the innovation risks in the machinery and plant engineering be defined?
b) What does the structure of the relevant innovation risks look like?
c) How do they affect each other?
d) Is there a need for adjusting single risks depending on the results of the simulation?

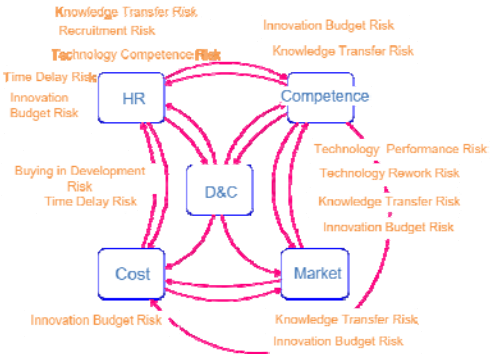
4. Research Methodology: "Standard Cases: Standard Structures"

1. Technology Leadership: **Maier (1998)**; Milling (1996) auf Basis von Bass (1969); Dillerup (1999); Milling (2002); Morecroft (2008); Warren (2008).
2. Price Competitiveness: **Maier (1998); Bossel (2004)**; Milling (2002).
3. Quality: **Lyneis & Ford (2007); Rahmandad & Weiss (2009); Rahmandad & Hu (2010)**; Ford & Sterman (1998); Lyneis et al. (2001); Love et al. (2002).
4. Time for Development: **Rodrigues & Williams (1998)**; Lyneis et al. (2001); Love et al. (2002); Lyneis & Ford (2007); Richardson (2014).
5.1 Internal Capacity Expansion: **Lyneis & Ford (2007)**; Rodrigues & Bowers (1996); **Ford & Sterman (1998)**; Rodrigues & Williams (1998); McGray & Clark (1999); Lyneis et al. (2001); Morecroft (2008).
5.2 External Capacity Expansion: **Ford & Sterman (1998)**
6. Technical Qualification: **McGray & Clark (1999); Lyneis & Ford (2007); Warren (2008)**; Lyneis et al. (2001); Rodrigues & Williams (1998).
7. Knowledge Transfer: **Georgantzas & Katsamakas (2008); Warren (2008)**; McGray & Clark (1999); Luna-Reyes et al. (2008); Rahmandad & Weiss (2009).

5. Operationalization: Innovation Aspects and Risks in the Innovation-Risk-System

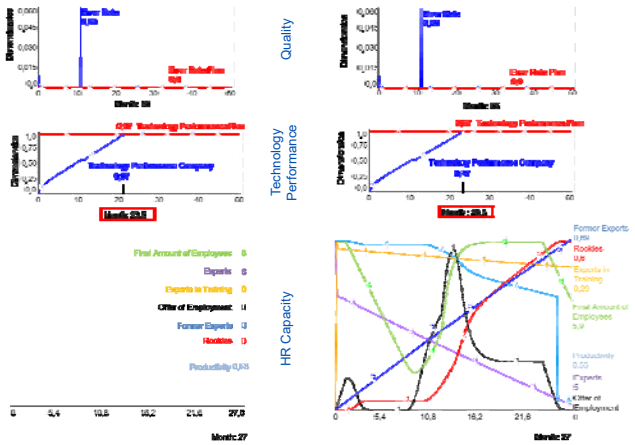


Continuous and iterative Validation



6.1 Simulation Case - Standard Base Run

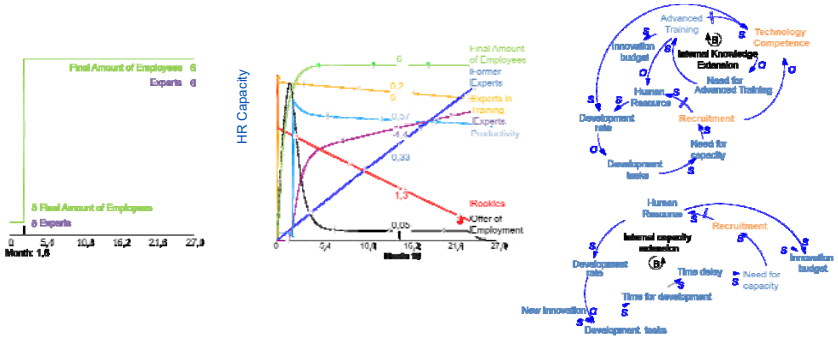
CLASSICAL PLANING PERSPEKTIVE | SYSTEM DYNAMICS PERSPEKTIVE



Market	Result	Standard Base Run		
		Plan	System	Risk (Deviation in %)
Company's Situation	Market launch	49,5	51,5	+ 4,0
	Quality (Funktional) in %	100	100	0
	Technology Performance	97	97	0
	Costs in T€	2.413	2.412	- 0,05 + Time Delay Risk
	Actual Margin **without penalty in %**	0,6	0,7	+ 16,6 + Time Delay Risk
Market Situation after 121,5 Month	Customer Amount	41	38	- 7,3
	Competitor Customer	6,9	7,3	+ 5,8

6.2 Standard Base Run Risk - Shortages in skilled workers – 1 expert

CLASSICAL PLANING PERSPEKTIVE | SYSTEM DYNAMICS PERSPEKTIVE | CAUSAL EXPLANATION



	Result	Standard Base Run	Risk Run		
		Deviation%	Plan	System	Risk (Deviation in %)
Company's Situation	Market launch	+ 4,0	49,9	54,1	+ 8,4
	Costs in T€ in T€	- Time Delay Risk	2.412	2.445	+ 1,4 + Time Delay Risk
	Actual Margin **without penalty in %**	+ 16,6	0,7	-0,7	- 200 + Time Delay Risk
Market Situation after 121,5 Month	Customer Amount	- 7,3	41	33	- 19,5
	Competitor Customer	+ 5,8	6,9	7,8	+ 13,0

References (Full reference in the paper)

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