



## **GENERATING INNOVATIONS THROUGH ANALOGIES**

Cornelius Herstatt

Institute for Technology and Innovation Management,  
Hamburg University of Technology

[www.tuhh.de/tim](http://www.tuhh.de/tim); [www.global-innovation.net](http://www.global-innovation.net). [www.eitim.org](http://www.eitim.org)

**2nd European Front End of Innovation Conference,  
Vienna, January 2008**

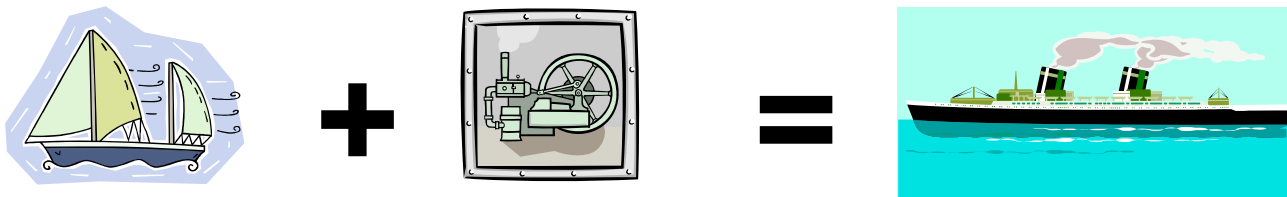
1. **Introduction – Why analogies are relevant to breakthrough Innovation**
2. The reality – Do NPD teams use analogies? Some empirical insights
3. Can analogies be used systematically for NPD?
  - a first approach
  - examples from the medical devices field
4. Summary, open questions

# Why are analogies relevant to NPD?

Generating innovations  
through analogies



**Many breakthrough innovations and new products result from recombining existing know-how and analogies**



- An analogy is a fundamental cognitive mechanism to retrieve existing knowledge and to apply it in a new context (Hargadon 2003)
- A new and creative solution usually results from the combination of pieces of knowledge that have not been connected before. (*Geschka, 1992; Geschka, Moger et al., 1994; Hargadon, 2002*)
- Empirical work by Dahl and Moreau (2002) show that
  - originality during idea generation can be enhanced by encouraging the extensive use of analogies
  - especially far analogies can lead to original designs that are valued by consumers

# Why are analogies relevant to NPD?

Generating innovations  
through analogies



## Examples from practice: NIKE-SHOX

The goal was to develop a totally new and different running shoe

- How can an optimal cushioning effect be achieved?
- Constraints: durability, weight, stability, manufacturing



Analogy



Transfer of the structure as well as material attributes of a shock absorber used in Formula 1 racing cars

## Why are analogies relevant to NPD?

### Example from practice 2: BMW iDrive

The goal was to develop a haptical tactile device to control major car functions, serving as a bridge between the driver and the car

- How can intuitive, sensitive control be realized?
- Constraints: safety, comfort, cost, manufacturing



**Analogy**  
("Touch Sense  
Technology in  
Endoscopy")



Immersion and IDEO

# Why are analogies relevant to NPD?

Generating innovations  
through analogies



## Example from practice 3: Speedo Fast Skin

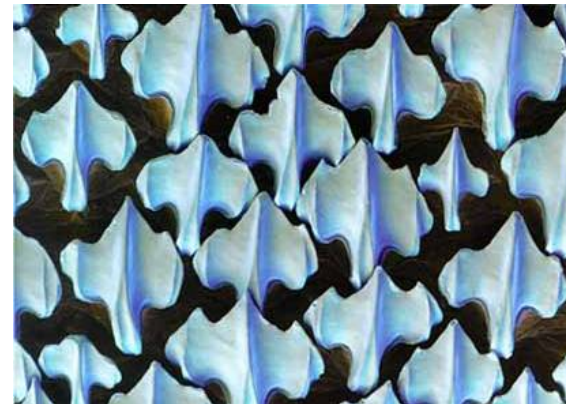
The goal was to develop a significant faster bath suit

- How can an optimal flu dynamic effect be achieved?
- Constraints: cost, weight, comfort, manufacturing



speedo 

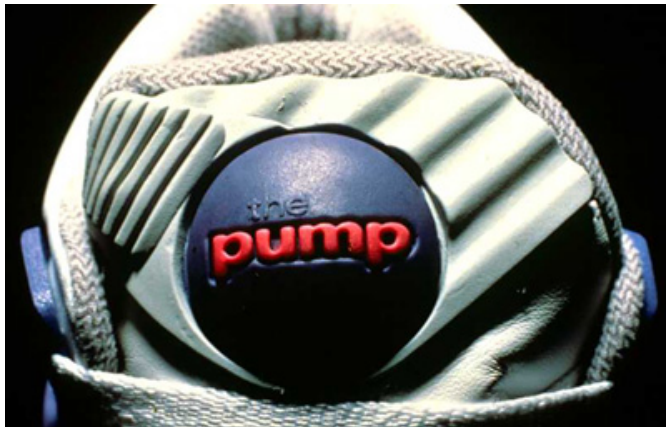
Analogy  
("Shark Skin")



## Why are analogies relevant to NPD?

Applying the idea of analogies opens a wide space of solutions; Reebok started basically with the same question like Nike but ended up with a very different solution.

### The Reebok pump:

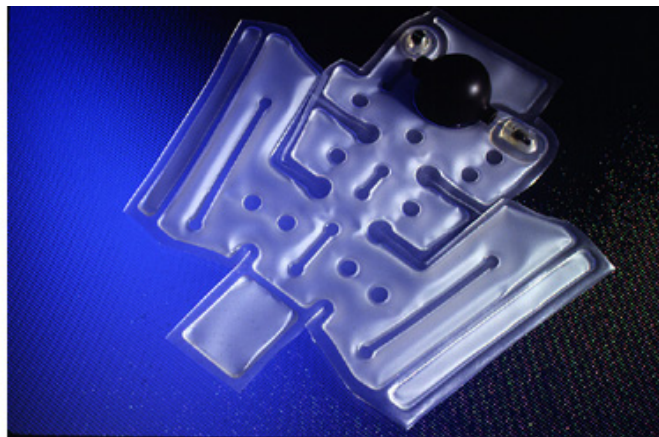


Design Continuum developed for Reebok the Pump™ sport shoe.

### Use of analogies:

- Medical technology: (1) inflatable splint to fix joints, (2) medical IV bags as an air bladder
- Diagnostic instruments: little pumps, tubing, and valve components to inflate and deflate the shoe easily

*(Hargadon 2002; 2003)*



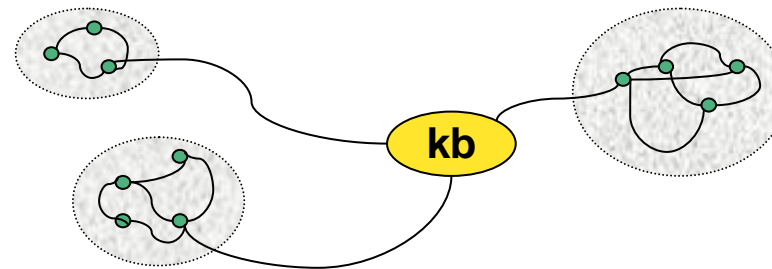
1. Introduction – Why analogies are relevant to breakthrough Innovation
- 2. The reality – Do NPD teams use analogies? Some empirical insights**
3. Can analogies be used systematically for NPD?
  - a first approach
  - examples from the medical devices field
4. Summary, open questions

## Research questions

- Are analogies systematically used in NPD? If yes, which purpose does the use of analogies serve in product development projects?
- How are design firms and knowledge brokers using analogies? How do these ensure the access to diverse knowledge domains in order to find analogous solution approaches?

“**Knowledge brokers**”, are in a special position to use analogies better than others (Hargadon 2003).

- Familiar with a wide range of knowledge domains
- Unique network position enables them to take advantage of “structural holes” (Consulting companies, design agencies and product development companies working for clients in diverse industries)



**Research method:** semi-structured interviews (mainly via telephone)

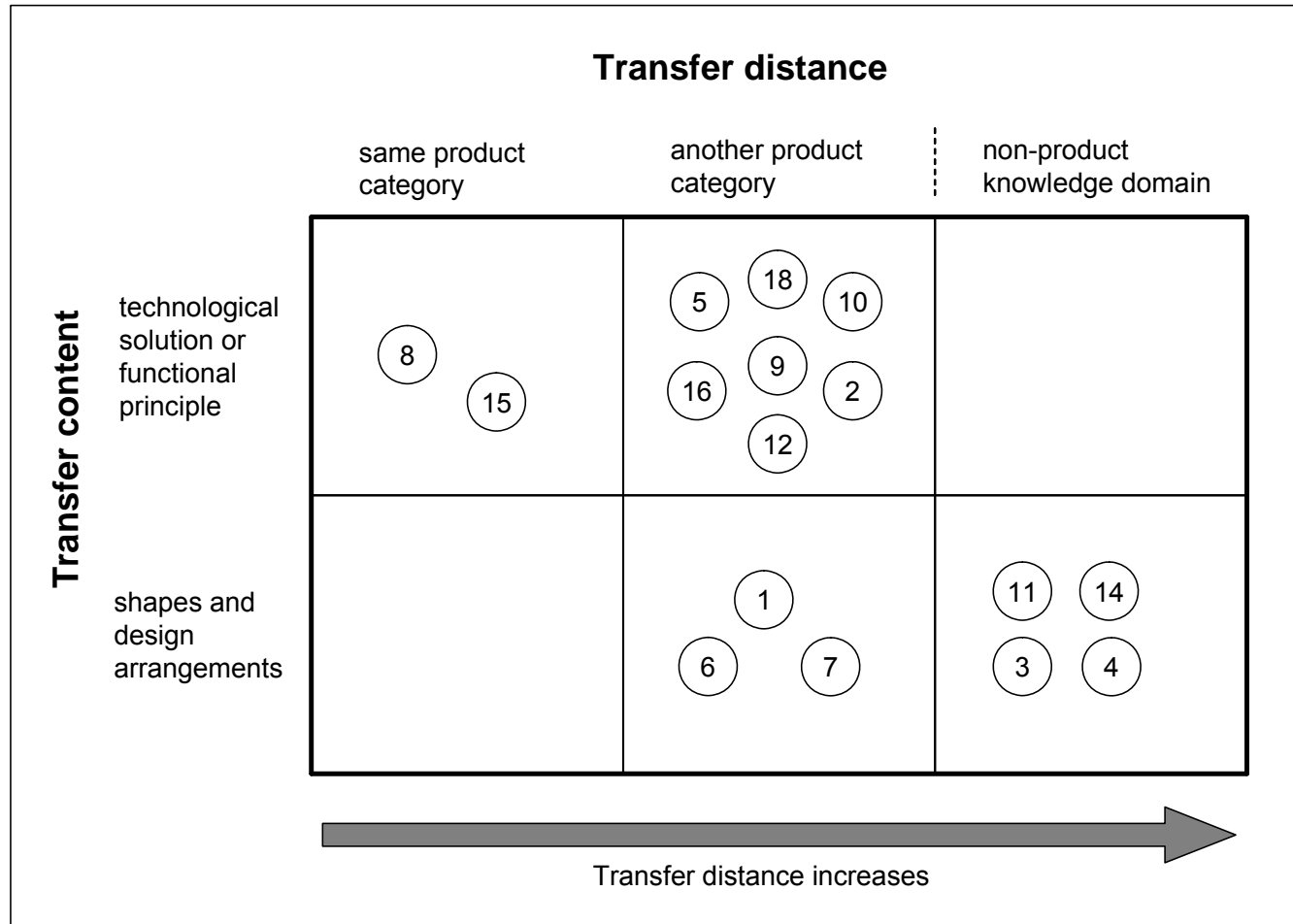
**Addressee:** managers in charge of product development projects at “knowledge broker”-companies, 18 companies offering engineering and/ or industrial design services to clients from diverse industries participated in our research.

## Interview guideline:

- General part
  - questions concerning the company (e.g. services offered, client industries) and
  - the interviewee (e.g. experience with the application of analogies in former projects)
- Project specific part
  - Description of a project in which analogies played a role for developing a new product.
  - Further questions: explanation of used analogies, formation of the team, and the way the team worked with analogies

\* Research work in progress together with K. Kalogerakis and C. Lüthje

# Typology of projects – Overview\*



\* Research work in progress together with K. Kalogerakis and C. Lüthje

Overall we found in the 18 cases:

- Analogies are regularly used in the front end of product development.
- But the interviewed companies do not follow a systematic approach in using analogies and the use of analogies is not always a conscious process.
- Analogies are used with different motivations leading to different search spaces.
- Knowledge and characteristics of the participating persons are crucial for the success of the process.
- Usage of “Local Knowledge” → knowledge and experience of team crucial for project success
- Effects: Enhanced creativity, efficiency and communication (internally and externally)
- Relation between type of analogy (distance + content) and achieved results identifiable

# Functions of analogies in new product development\*

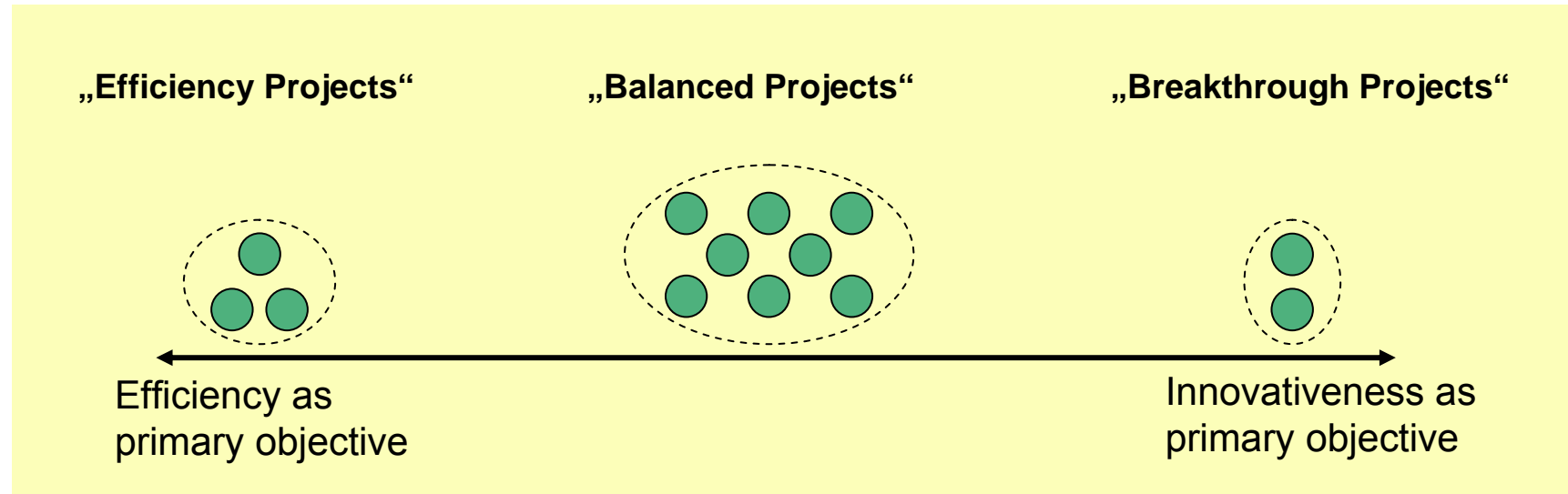
Generating innovations through analogies



The function of analogies in product development processes we observed can be characterized along an efficiency / innovativeness dimension.

**Efficiency:** Fulfilling given demands in the shortest possible time  
→ Nearer search space for analogies

**Innovativeness:** Aiming at a high degree of innovation  
→ Wide search space and focus on far analogies



\* Research work in progress together with K. Kalogerakis and C. Lüthje

## Example: Breakthrough Projects

Target of project	Analogy	Characteristic of analogy based transfer
Design study of a fork-lift truck	An egg as an archetype form to provide protection	Transfer of basic ideas and shapes from very distant areas. Use of very far analogies.
Design study of a mini cordless electric screwdriver	A hand-axe (/ hand-wedge) from the Stone Age	

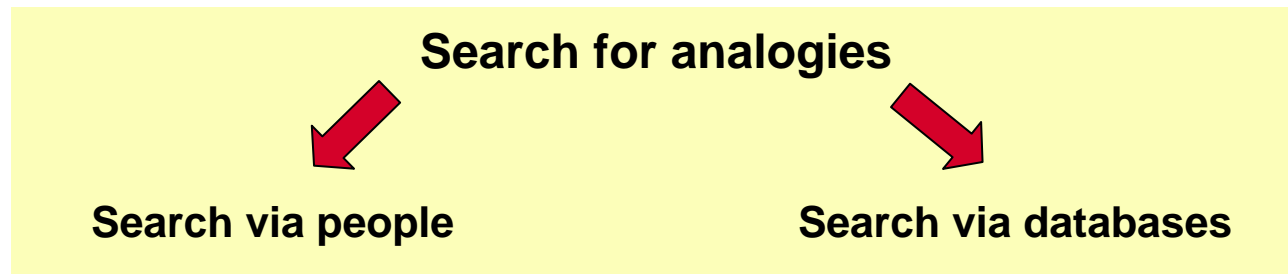
In these cases innovativeness was the predominant objective– almost totally neglecting project efficiency

The intention was to develop a design study for imaginary product lines of the future not having the restriction to be directly marketable. However, these studies inspired the development of products being successfully brought onto the market.

The scope of analogies was broader than in the other two clusters – basic ideas are transferred from really different areas like for example nature or Stone Age habits.

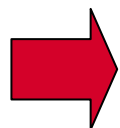
\* Research work in progress together with K. Kalogerakis and C. Lüthje

According to the interviews the search for analogies is not the outcome of an explicit and conscious decision, but emerges in the context of general creativity sessions held in the early phase of the development projects.



**None of the examined companies used databases to find analogies.**

- Effort to initialise and maintain such a database is too big
  - Solutions in pattern matching are still not sufficient
  - Lack of time to execute search
  - Only explicit knowledge can be transferred
- ⇒ Database search for analogies seems to be inefficient



**Knowledge access while searching for analogies has to concentrate on the participating persons.**

## The project development team:

- Characteristics of the team members seem to be decisive for the outcome of the processes.
- However, from the interviews there is little indication that the consideration of increasing the success of analogical thinking strongly influences the team composition.
  - General project management considerations predominated.
- Individual characteristics of all employees should foster the use of analogies
  - Certain amount of experience to rely upon
    - Only if people have knowledge from different areas are they able to make transfers based on analogies.
  - Communicative habits
  - Curiosity, diverse hobbies ...
- Interdisciplinarity of teams can have positive effects

## Detecting relevant analogies

**Experience and knowledge of the team members that is used to search for analogies can stem from diverse sources:**

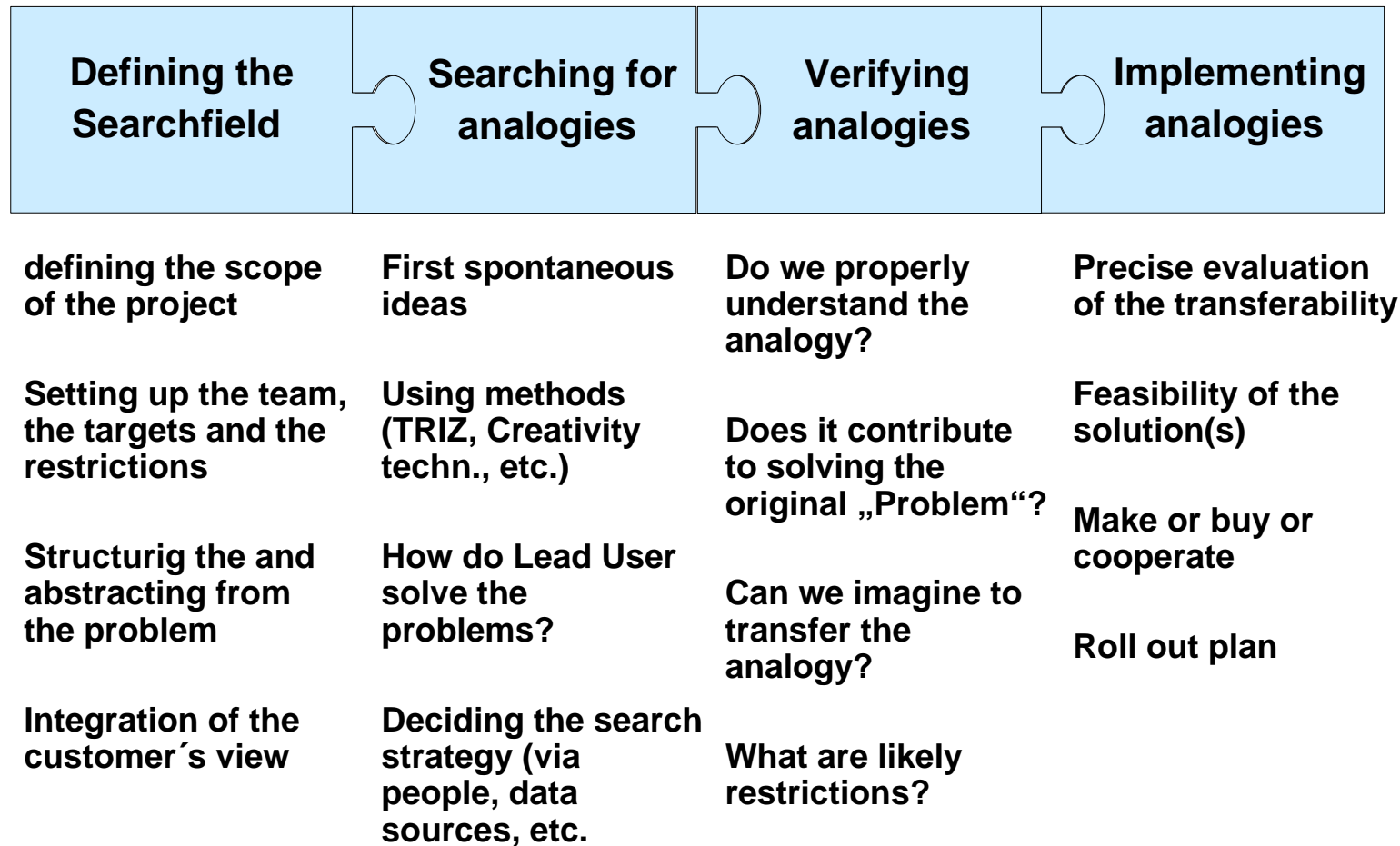
- Former development projects are an important source.
  - especially relevant in the “efficiency projects” and in most “balanced projects”
- Other knowledge sources: Hobbies of the team members, their general education or an inspiration of the direct environment of the developers.
- In addition to applying personal knowledge, the team members can also make use of their personal networks.
  - experts within or outside the company

### **Activation of knowledge:**

- Mostly brainstorming or other creativity techniques (e.g. 6-3-5 method) under a given time frame
- A discussion of diverse ideas within the team seems to always be important

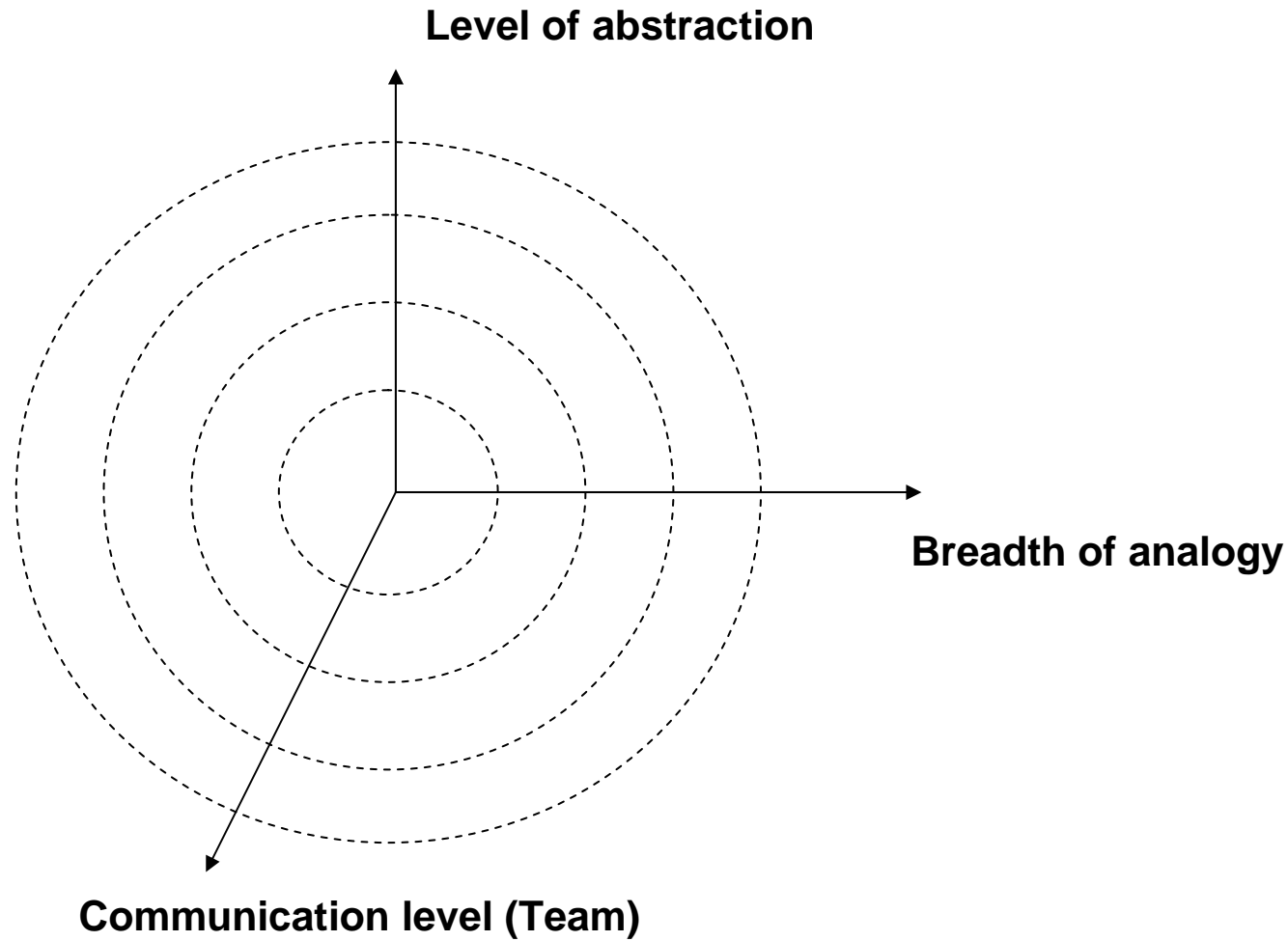
1. Introduction – Why analogies are relevant to breakthrough Innovation
2. The reality – Do NPD teams use analogies?  
Some empirical insights
3. **Can analogies be used systematically for NPD?**
  - a first approach
  - **examples from the medical devices field**
4. Summary, open questions

## Elements of getting the „puzzle“ together (the analogy process)



# Components of search strategy

Generating innovations  
through analogies



## Example: A new suture

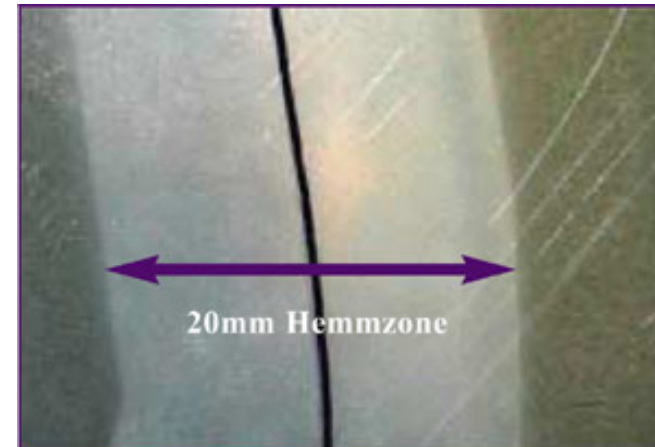
Problem: infection of wounds by using traditional sutures

How do other industries handle bacteria?

➔ **Manufacturers of cleaning agents possess a long standing experience on how to clean even badly contaminated surfaces with comparatively harmless disinfectants.**

Combining disinfectants with traditional sutures resulted in a new antibacterial suture.

Advantage: Cleaning agent was cost-saving, proven to be totally innocuous and not bound to any patents.



VICRYL Plus in a petri dish with staphylococcus aureus. (Source: [www.ethicon.de](http://www.ethicon.de))

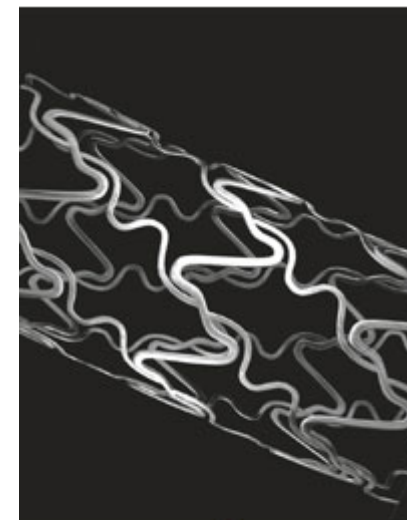
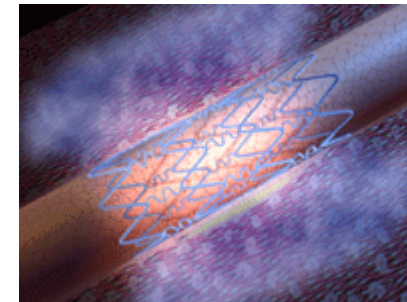
## Example: A new stent

Problem: Many patients relapsed just a few years after stent implantation, because their organism rejected the stent as foreign matter.

How can one prevent that growing tissue closes the stent in the artery?

→ **Medications used for transplantations could repress such rejections and were already available at the market.**

The new product was realized in a cooperation with the pharmaceutical company that possessed the patent on the medication and other companies with knowledge concerning the coating of stents



cypher  
Stentless-elastic Coronary Stent

(Source: [www.jnjgateway.com](http://www.jnjgateway.com))

## Example: A new mesh for the repair of hernias

Problem: Traditional hernia implants cause chronic discomfort for a number of patients

Which way of solution do other industries follow?

➔ **Automotive cushions have to fulfill similar standards as hernia implants: They have to be lightweight, flexible and at the same time forming.**

Idea originating in the automotive supply industry:  
A fabric with two textile outer surfaces is connected and at the same time hold at distance by a spanning thread.

PROCEED®mesh

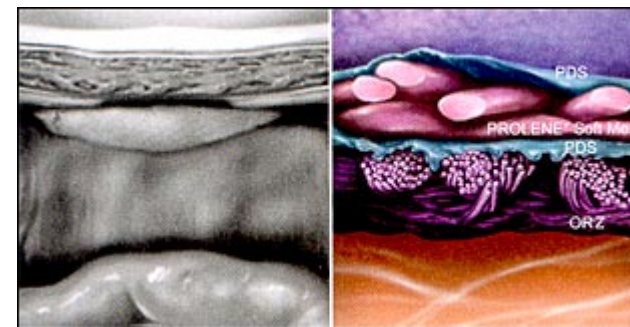


Fig. 1: Day of implantation

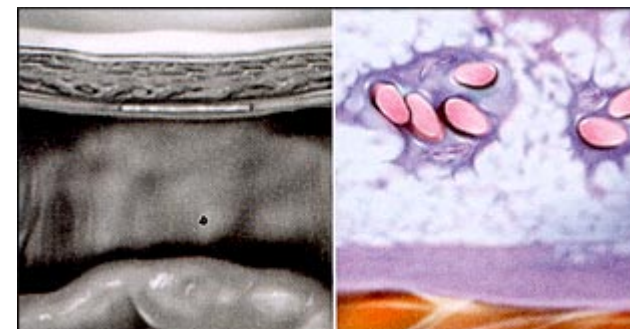


Fig. 2: Total integration  
(Source: [www.ethicon.de](http://www.ethicon.de))

- The use of analogies in product development can lead to innovative, valuable solutions – designers as well as engineers confirm this.
- Today, analogies are mostly used in a very pragmatic way, if at all. Looking at our research on knowledge brokers, we can differentiate between efficiency projects, balanced projects and breakthrough projects.
- But. the search for analogies is mostly based on the knowledge of the participating persons in the team and very rarely organized. This limits the scope (breadth and depth) of possible solutions.
- Our action research-based approach shows that the search for and use of analogies can be actively and systematically organized (ex ante). This has led to successful and innovative solutions in all three reported projects.
- Much more research has to be done, of course! (The process as such, the motivation to use analogies, efficient and effective search procedures, evaluation procedures and techniques, etc.)
- Human resource management seem to play a crucial role (configuration of teams, etc.)



Additional slides not used  
in the presentation

## Efficiency Projects

Target of project	Analogy	Characteristic of analogy based transfer
Mobile phone appliance for tunnels	Transfer of a processor used in a control board of an amplifier for a mobile phone mast	Transfer of an existing technological solution that was already used in a former project
Facility to rearrange allocation of train wagons	Transfer of a solution of consistent time measurement in shared systems	
Electronics for a medical device to create high voltage in very small dimensions	Transfer of a technological solution from light electronics	

All three cases belong to engineering companies that reported to use analogies mainly to meet time and cost constraints set by their clients.

In order to succeed the engineers built upon their experiences from former projects and transferred existing technological solutions.

## Balanced Projects (2)

Target of project	Analogy	Characteristic of analogy based transfer
Purifier for dental tools (e.g. bur, polisher)	Transfer of technical solutions from high-pressure-cleaners and premium car-doors	Transfer of technical solutions from other industries. Ideas are based on former projects, but not directly transferable without building up new competences.
High-quality baby stroller	Transfer of disc brakes from mountain biking and single wheel suspension from vehicle construction	
Design of a steering lawn mower	Transfer of solution principles from vehicle construction	
High-quality backrest of an office chair	Transfer of technical solutions from sports and medical technology	
Original promotion item with long lasting value	Transfer of material and movement of a piece of ship yard waste	Transfer of design elements based on direct contact to the environment of the designer

## Balanced Projects

### Goals:

- Compliance with given time and cost frame to develop marketable solution
- Developing a really new solution to differentiate the innovation from existing products in the market

Slight differences can be identified in-between the cases concerning their approach of making a transfer based on an analogy

Target of project	Analogy	Characteristic of analogy based transfer
“Baton” for the Common Wealth Games	Transfer of form and technical ideas from an antenna for digital radio	Transfer of design elements or principles from former projects.
Design a mixer for audio engineering	Transfer of solution principles from an ergonomic study of the interior of cars	
Design of a cockpit of a big passenger aircraft	Transfer of ergonomic principles from vehicle construction and chairs in general	

... (see next page)