TRIZ，The Development And Dissemination In Industries In China

Tan Runhua

国家技术创新方法
与实施工具工程技术研究中心
National Engineering Research Center for
Technological Innovation Method and Tool

河北工業大学
HEBEI UNIVERSITY OF TECHNOLOGY

Content

- The Center
- The obstacles of innovation in industrial companies
- C-TRIZ: Development of TRIZ in China
- Dissemination of C-TRIZ/ TRIZ In China
- Conclusions

1. The center

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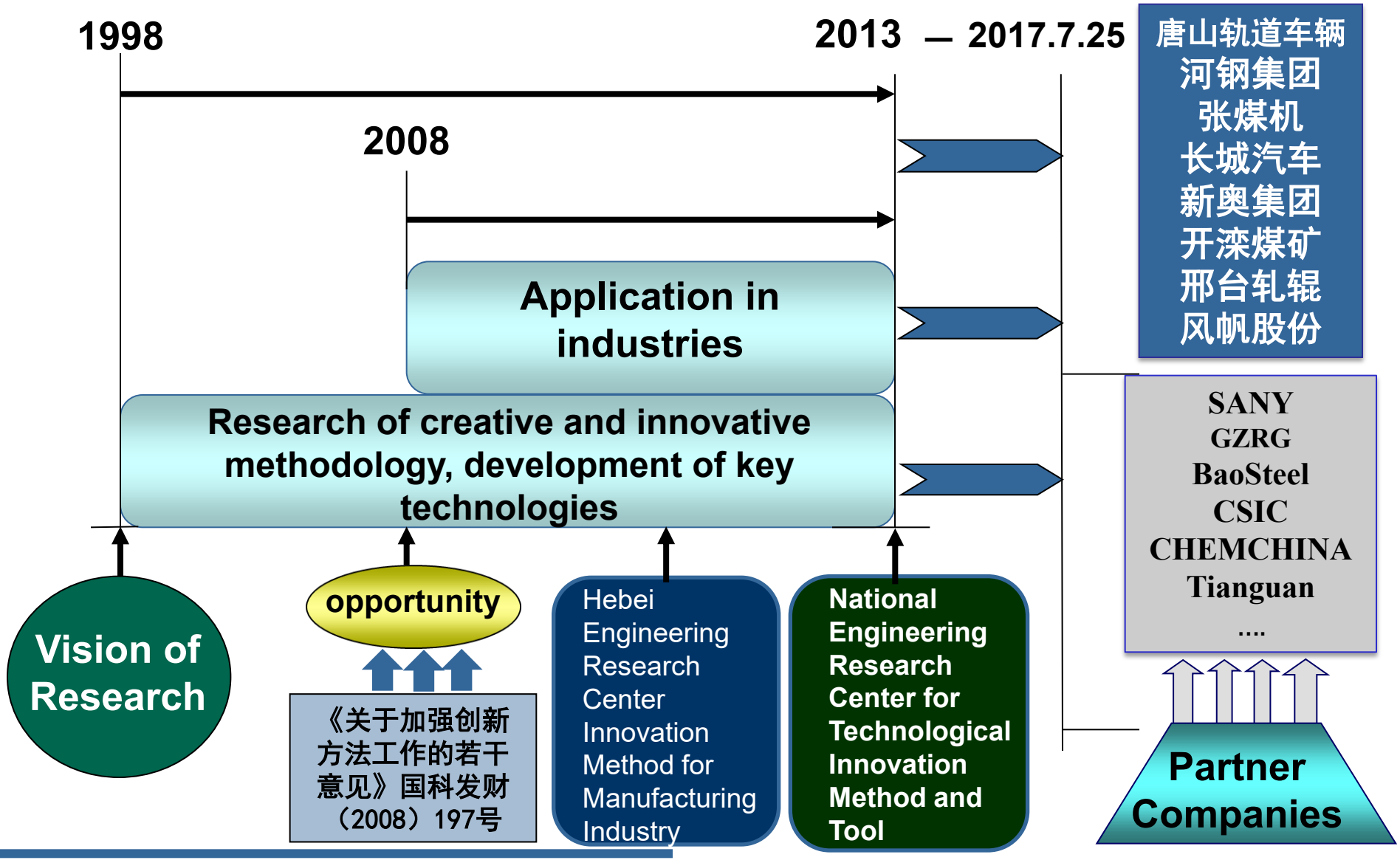

Three Kinds of Activities in the Center

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Enablers

Basic Research

- Long distance analogy method
- Function design
- Extended Effect
- Integrated path for TRIZ and design process
- Technological principle of disruptive innovation
- …

Enable Technologies:

- Incremental innovation
- Radical innovation
- Disruptive innovation
- Integrated innovation
- Patent around innovation
- Manufacturing process innovation
- Platform design and innovation
- CAI: InventionTool

Dissemination

- Service platform
- Solution provider
- Innovative engineer training
- Innovative team development
- Consulting

2. The obstacles of innovation in industrial companies

Why Do We Need Innovation?

TOP 10 Reasons Why We Need INNOVATION
by Lorraine Yapps Cohen

10. For economic growth
9. For the progression of human well-being
8. For competitive advantage
7. Because cost-cutting is not enough anymore
6. Desire for higher business revenues
5. To improve disappointing performance in the past 2 decades of U.S. firms
4. To take advantage of opportunity
3. For a more constant flow of innovation
2. For better returns
1. For business survival

For increasing completion

6 Reasons Why Innovation is a Survival Skill
by Daniel Nolan

1. Increasing Competition
2. Increasing Globalization
3. Increasing Consumer Expectations
4. Advancing Technology
5. Changing Workforce
6. Demographic Changing How We Work

The Innovation Landscape Map

When creating an innovation strategy, companies have a choice about how much to focus on technological innovation and how much to invest in business model innovation. This matrix, which considers how a potential innovation fits with a company's existing business model and technical capabilities, can assist with that decision.

	DISRUPTIVE	**ARCHITECTURAL**
REQUIRES **NEW** BUSINESS MODEL	• Open source software FOR SOFTWARE COMPANIES • Video on demand FOR DVD RENTAL SERVICES • Ride-sharing services FOR TAXI AND LIMO COMPANIES	• Personalized medicine FOR PHARMACEUTICAL COMPANIES • Digital imaging FOR POLAROID AND KODAK • Internet search FOR NEWSPAPERS
	ROUTINE	**RADICAL**
LEVERAGES **EXISTING** BUSINESS MODEL	• A next-generation 3 series FOR BMW • A new index fund FOR VANGUARD • A new 3-D animated film FOR PIXAR	• Biotechnology FOR PHARMACEUTICAL COMPANIES • Jet engines FOR AIRCRAFT MANUFACTURERS • Fiber-optic cable FOR TELECOMMUNICATIONS COMPANIES

Source: internet

Innovation = Invention + Exploitation

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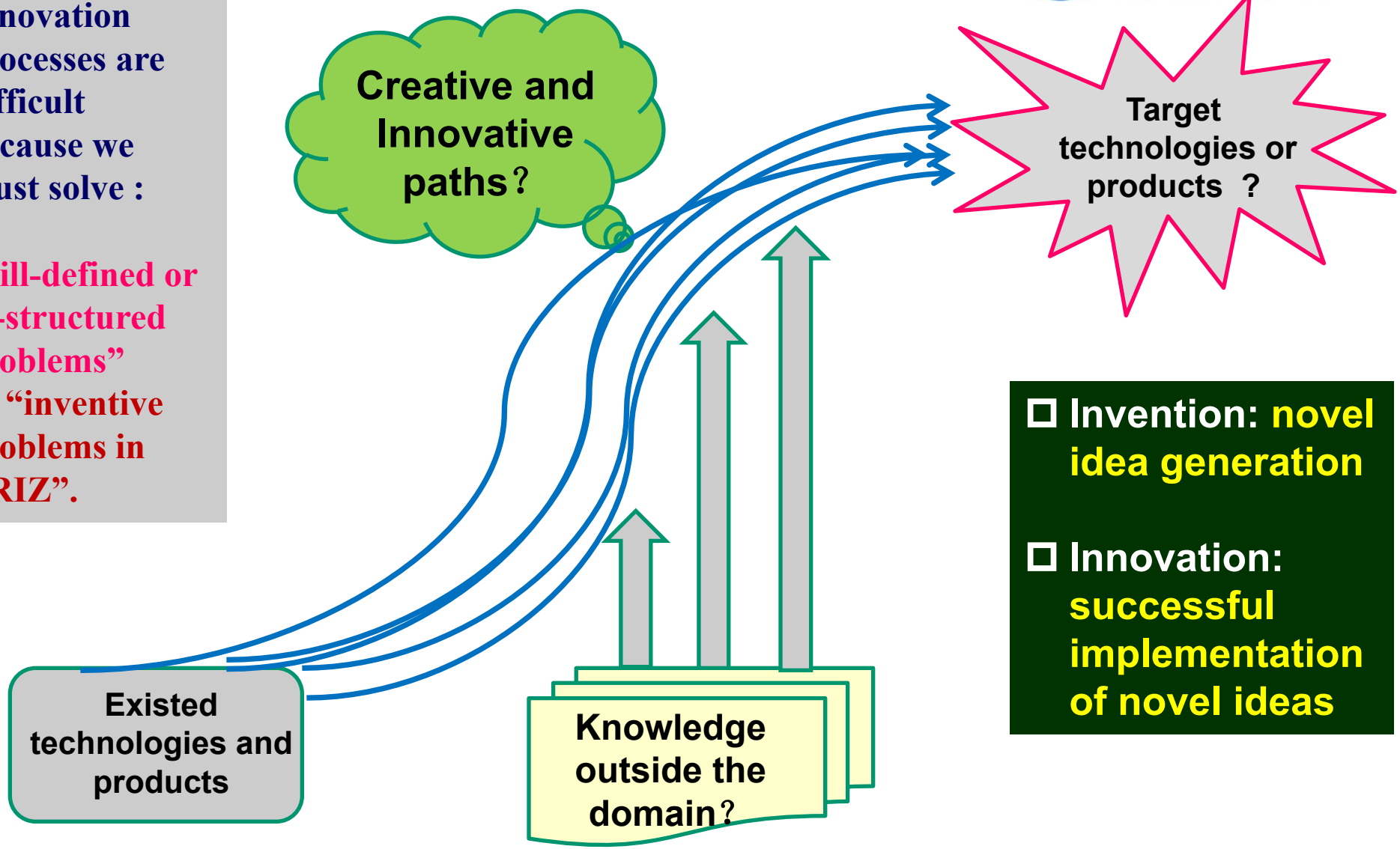
Innovation processes are difficult because we must solve :

"ill-defined or ill-structured problems" or "inventive problems in TRIZ".



- Invention: **novel idea generation**
- Innovation: **successful implementation of novel ideas**

Seven Generations of Innovation Models

1930's 1st	**Technology Push:** Simple linear sequential process, emphasis on R&D and science.
1960's 2nd	**Market Pull:** Simple linear sequential process, emphasis on marketing, the market is the source of new ideas for R&D.
1970's 3rd	**Coupling Model:** Recognising interaction between different elements and feedback loops between them, emphasis on ntegrating R&D and marketing.
1980's 4th	**Interactive Model:** Combinations of push and pull models, integration within firm, emphasis on external linkages.
1990's 5th	**Network Model:** Emphasis on knowledge accumulation and external linkages, systems integration and extensive networking.
2000's 6th	**Open Innovation:** Internal and external ideas as well as internal and external paths to market can be combined to advance the development of new technologies.
now 7th	**Extended Innovation Network:** Combining Network Models and Open Innovation. FuGle external

Fig. 1 – Evolution of different generations of innovation process models

https://zh.scribd.com/document/155958364/Innovation-Process-Models

Typical Innovative Process Models

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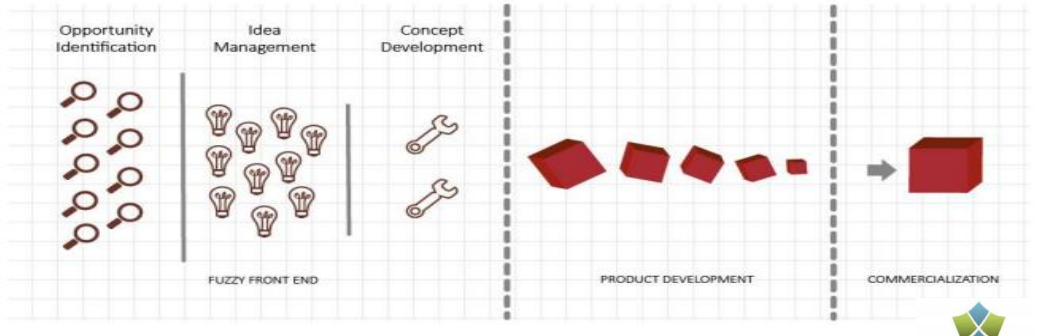
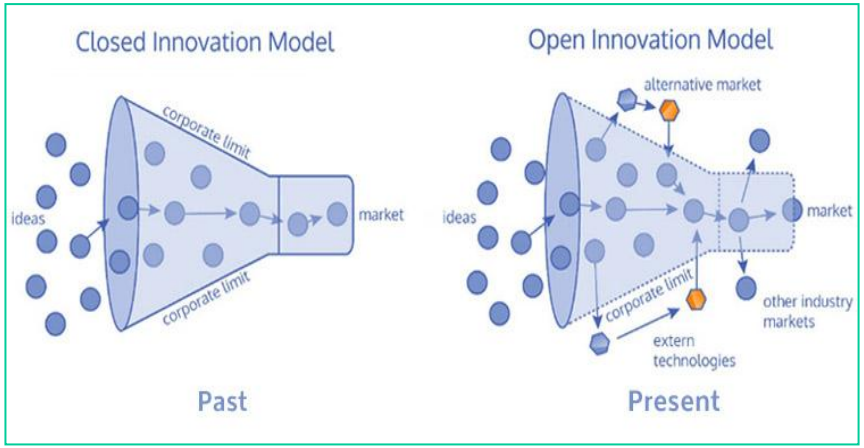
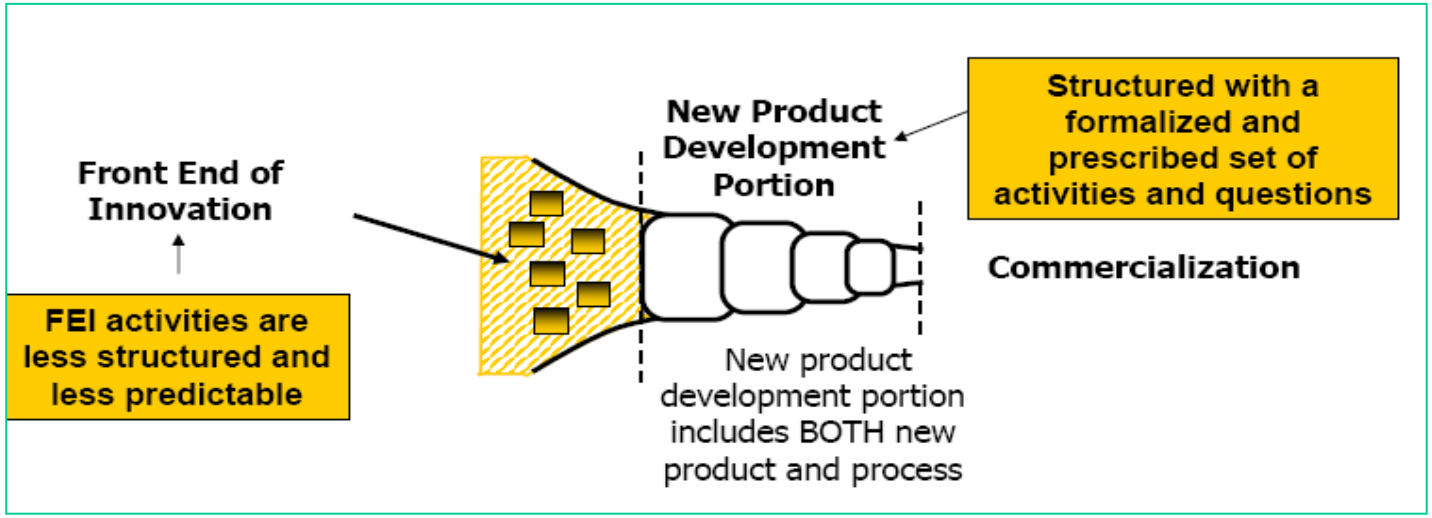
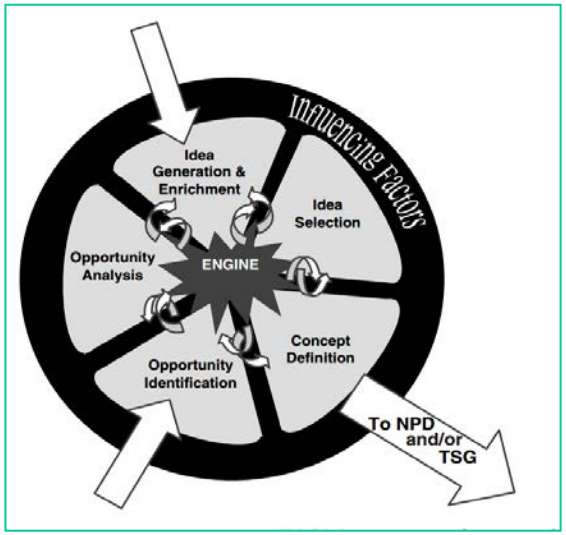


Management of the Innovation Process







Process of FFE

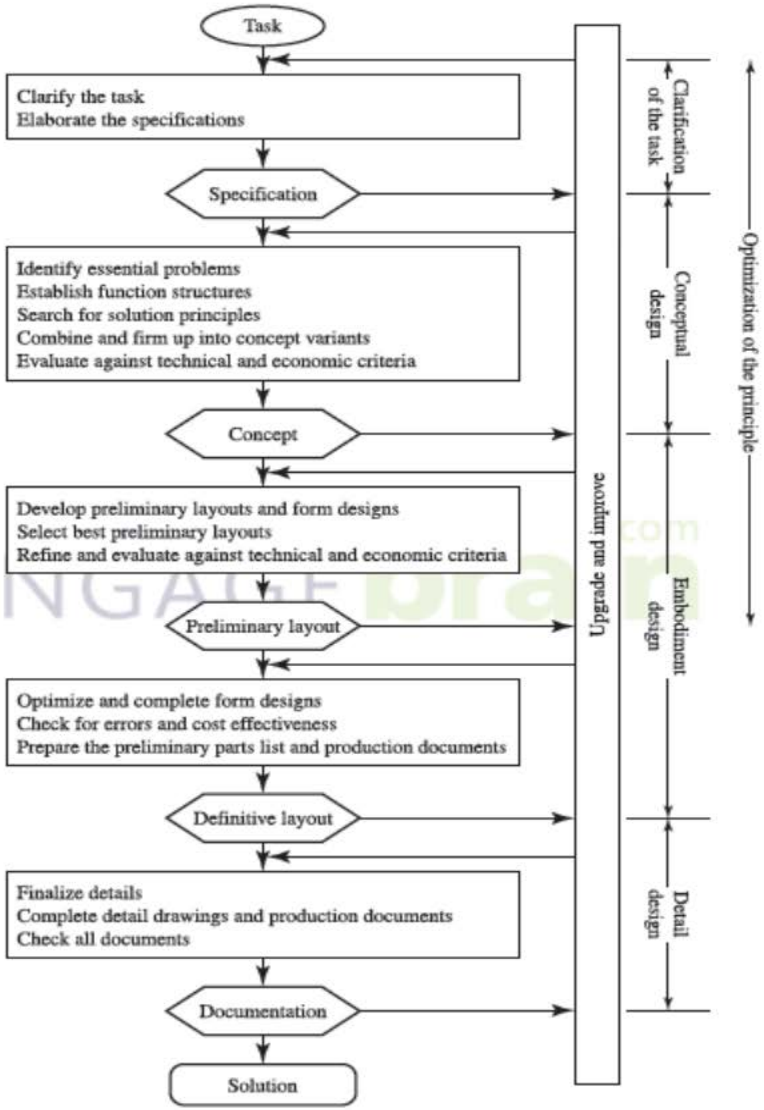


Figure 1.3 Design process map. (From ENGINEERING DESIGN: A SYSTEMATIC APPROACH by G. Pahl and W. Beitz, translated by Ken Wallace, Lucienne Blessing and Frank Bauert, Edited by Ken Wallace. Copyright © Springer-Verlag London Limited 1996. Reprinted by permission.)

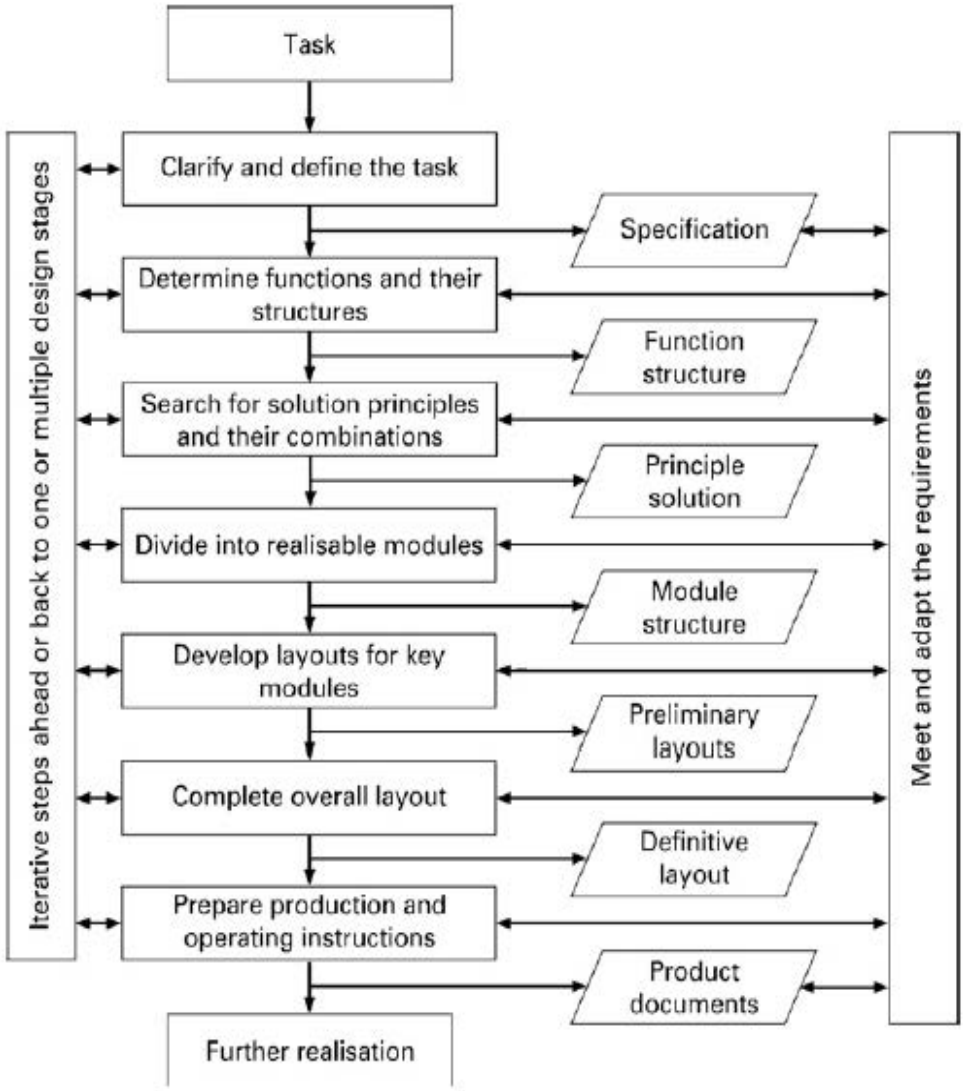


Fig. 3. Recommended design process (VDI 2221 [151]).

Creative Process = FBSD + AGE

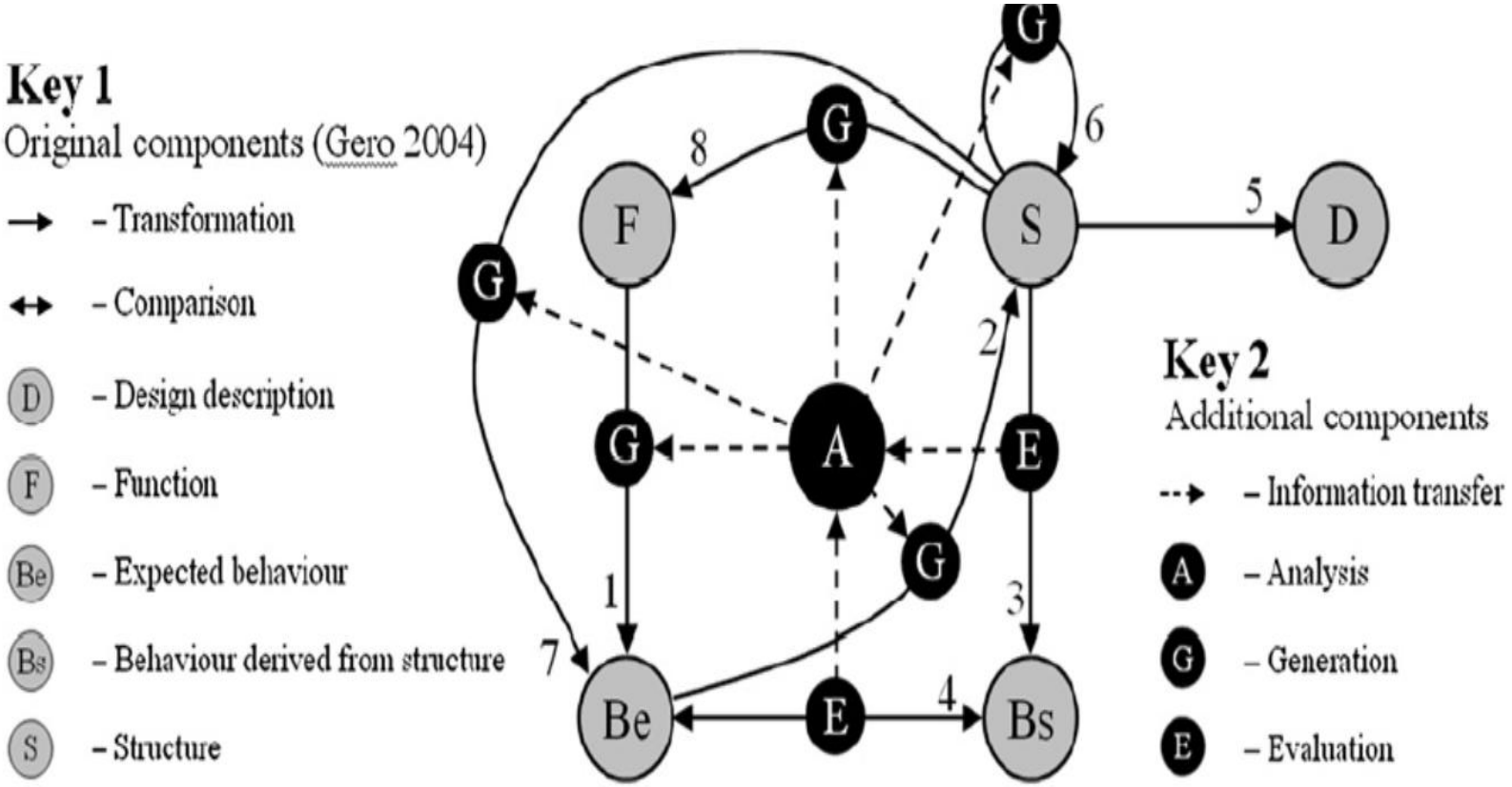


Figure 2 Integrated creative design process model

T. J. Howard, S. J. Culley and E. Dekoninck, Describing the creative design process by the integration of engineering design and cognitive psychology literature， Design Studies， 29 (2008)： 160-180

There are different types of innovation processes.

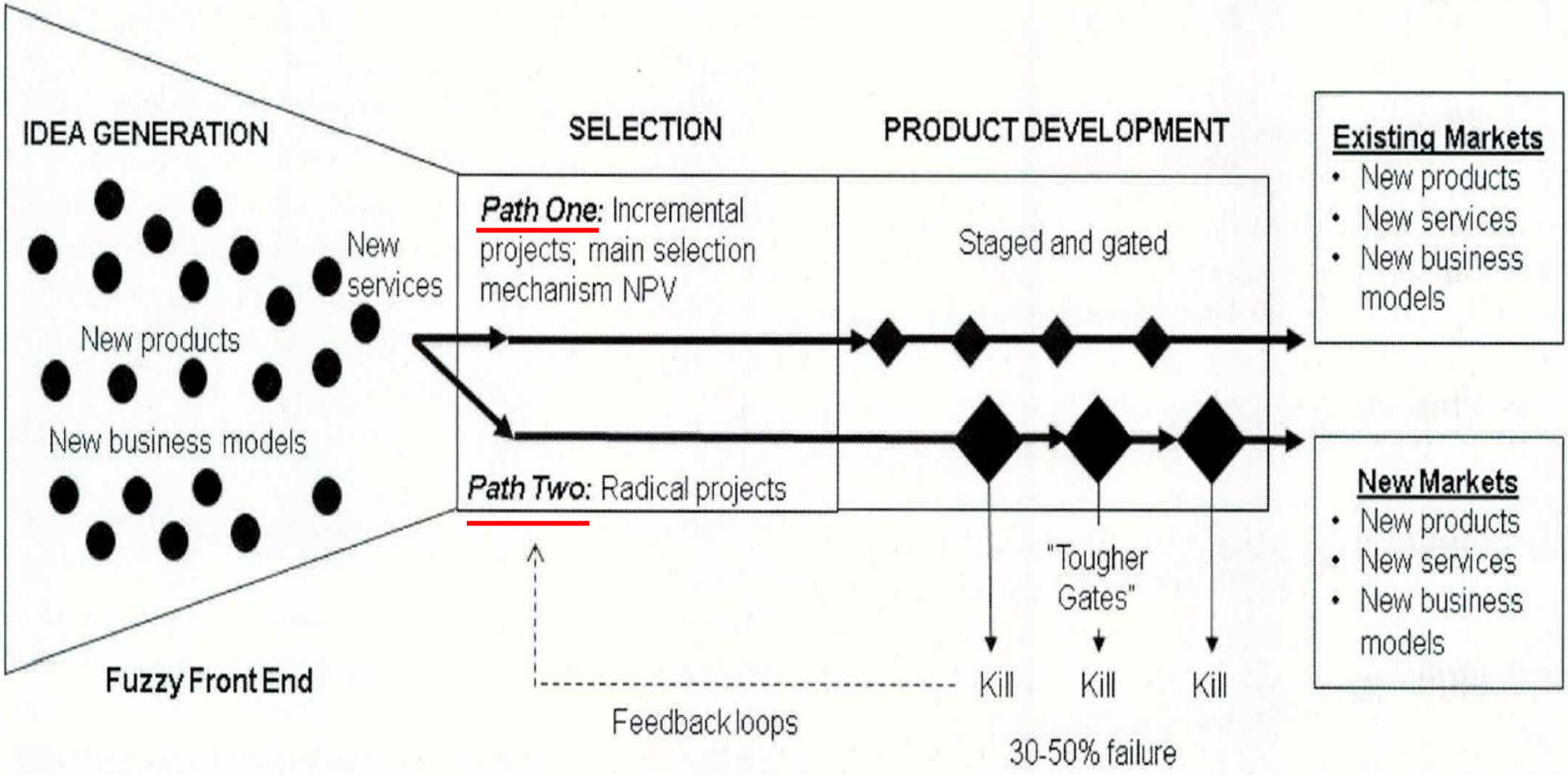


FIGURE 3. Parallel path commercialization process

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The obstacles of innovation Process

New concept : Fuzzy Front End of Company

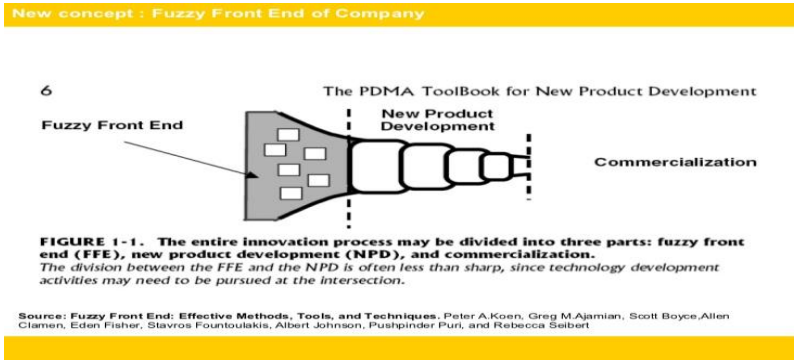
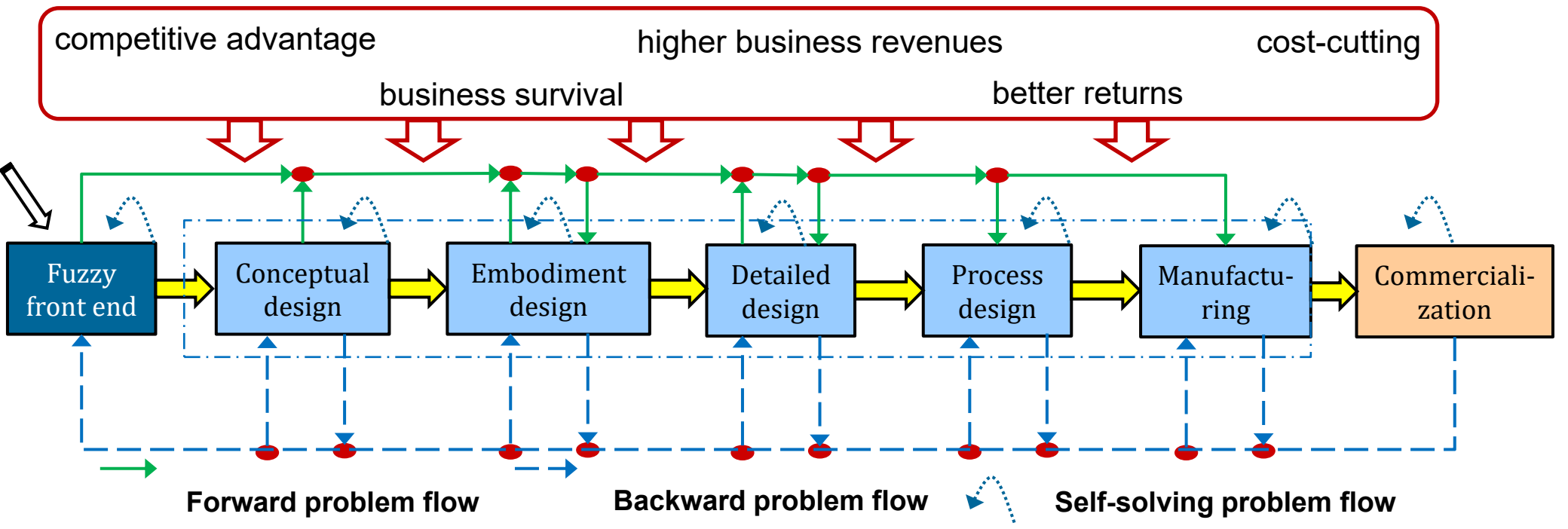


FIGURE 1-1. The entire innovation process may be divided into three parts: fuzzy front end (FFE), new product development (NPD), and commercialization.
The division between the FFE and the NPD is often less than sharp, since technology development activities may need to be pursued at the intersection.

Source: Fuzzy Front End: Effective Methods, Tools, and Techniques. Peter A.Koen, Greg M.Ajamian, Scott Boyce,Allen Clamen, Eden Fisher, Stavros Fountoulakis, Albert Johnson, Pushpinder Puri, and Rebecca Seibert



The obstacles In innovation Process

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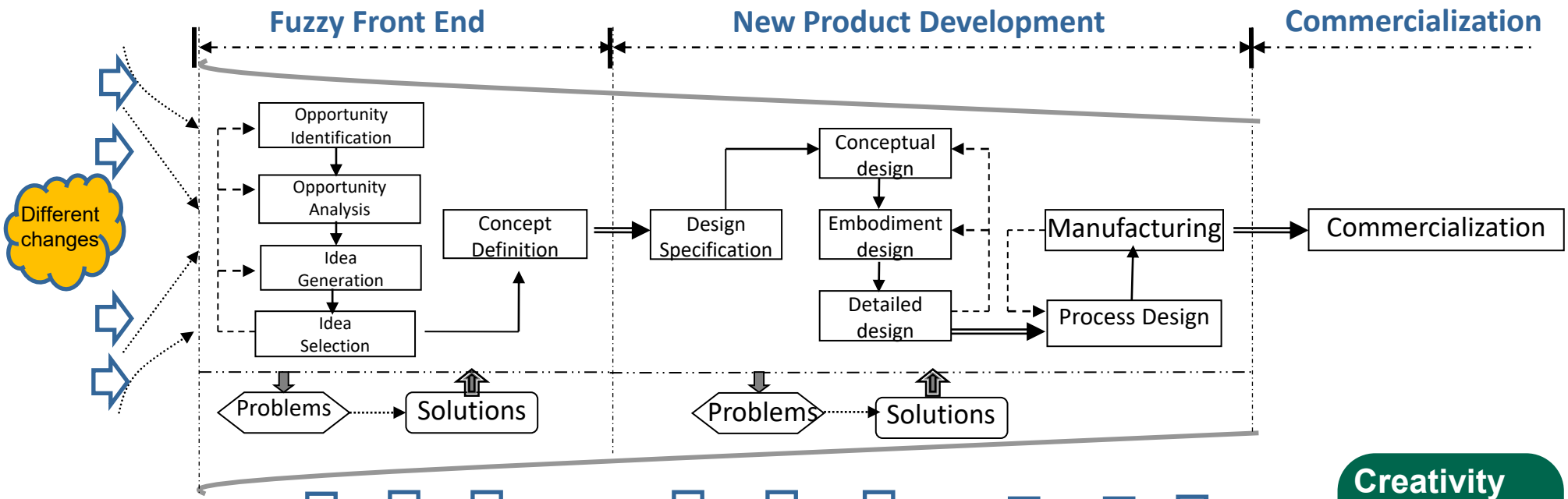

Obstacle I:

Generation of high quality ideas is difficult.

Obstacle II:

Generation of high quality new concept and new structures are difficult.

Obstacle III:

Manufacturing methods for high precisions are difficult.

Creativity and Innovation techniques:

Such as TRIZ

Category:Creativity Techniques

From Mycoted

Creativity and Innovation Techniques - an A to Z

This A to Z of Creativity and Innovation Techniques, provides an introduction to a range
most tools these techniques all have their good and bad points. I like to think of these
saw, spanner, hammer, knife and all sorts of other things in it, they are all very usefu
little guidance along with each tool to let you know whether it's best used for cutting

For the future, the aim is to also have sub-categories which will identify Techniques fo

- Problem Definition - including problem analysis, redifinition, and all aspects associ
- Idea Generation - The divergent process of coming up with ideas.
- Idea Selection - The convergent process of reducing all the many ideas into realistic
- Idea Implementation - Turning the refined ideas in reality.
- Processes - Schemes and techniques which look at the overall process from start to fi

Special thanks to the Open University for their kind permission to use material from the

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My idea:
TRIZ >>>
All other techniques!!

- Comparison tables
- Component Detailing
- Concept Fan
- Consensus Mapping
- Constrained BrainWriting
- Contradiction Analysis
- Controlling Imagery
- Crawford Slip Writing
- Creative Problem Solving - CPS
- Criteria for idea-finding potential
- Critical Path Diagrams

D

- Decision seminar
- Delphi
- Dialectical Approaches
- Dimensional Analysis
- Disney Creativity Strategy
- DO IT
- Do Nothing
- Drawing

- Listing Pros and Cons

M

- Metaplan Information Market
- Mind Mapping
- Morphological Analysis
- Morphological Forced Connections
- Multiple Redefinition

N

- NAF
- Negative Brainstorming
- NLP
- Nominal Group Technique
- Nominal-Interacting Technique
- Notebook

O

- Observer and Merged Viewpoints
- Osborn's Checklist
- Other Peoples Definitions
- Other Peoples Viewpoints

- SuperGroup
- SuperHeroes
- SWOT Analysis
- Synectics
- Systematic Inventive Thinking

T

- Talking Pictures
- Technology Monitoring
- Think Tank
- *Thinkx*
- Thril
- TILMAG
- Transactional Planning
- Trigger Method
- Trigger Sessions
- TRIZ
- Tug of War

U

- Unified Structured Inventive Thinking

Day 3 - 28.10.2015 TRIZ Future Conference 2015 - Agenda 15092015.xlsx

16.15		Problem solving methods of Standard Solutions under the analogy thinking. WANG, Qiuyue; YANG, Bojun; DUAN, Xiuling	User in engineering innovative design and contradiction identification*. HOUSSIN, Remy; SUN, Xiaoguang; RENAUD, Jean; GARDONI, Mickael	-
16.40	**Coffee Break**			
17.00	**Workshops**	The Workshop topics will be selected by the participants and announced at the conference		
	Workshop topics	1. Corporate TRIZ: How to implement TRIZ into the innovation process 2. TRIZ for Services: How TRIZ supports service design 3. TRIZ education: Cooperation of industry and universities 4. Extending TRIZ: Combination with other systematic methodologies for product development 5. TRIZ future: Middle and long term perspectives 6. TRIZ markets: Building business models and discovering "Blue Oceans"		
18.00	End of the conference day			

TRIZ And The Development

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Father of TRIZ : Altshuller

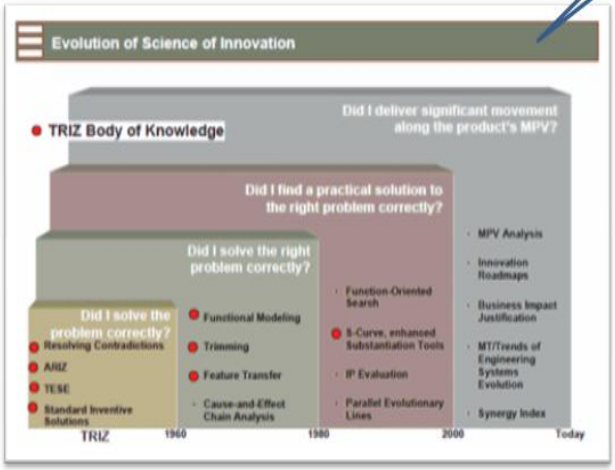
The year of 2016 was celebrated as first, the 60th anniversary of foundation of TRIZ since the first paper on TRIZ "*About Psychology of Inventive Thinking*" was published by Genrich Altshuller [Altshuller 1956].

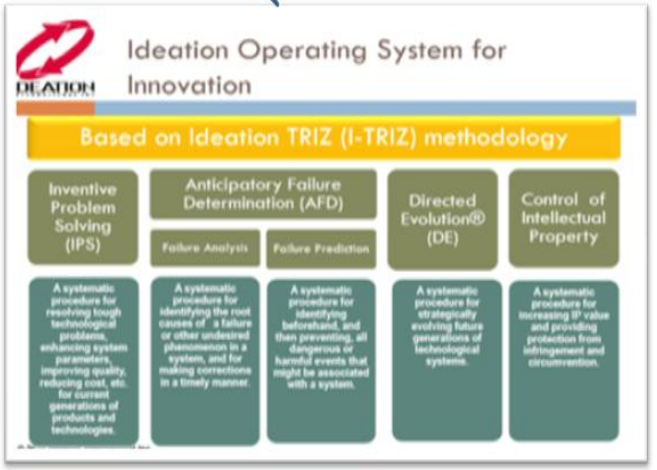
The development of TRIZ after 1998

TRIZ Consulting, Inc. | PQR | TRIZ-RI Group | TRIZ® engineeringsolutions | OXFORD CREATIVITY | TRIZ Consulting Group

ai | ICG | GEN3 PARTNERS | DEATION Where innovation begins | Process Innovation

*TRIZ | xTRIZ | 现代-TRIZ | I-TRIZ | P-TRIZ





At some point, there was an impression was that every engineer in South Korea had to know TRIZ to get a job.

3. C-TRIZ: development of TRIZ in China

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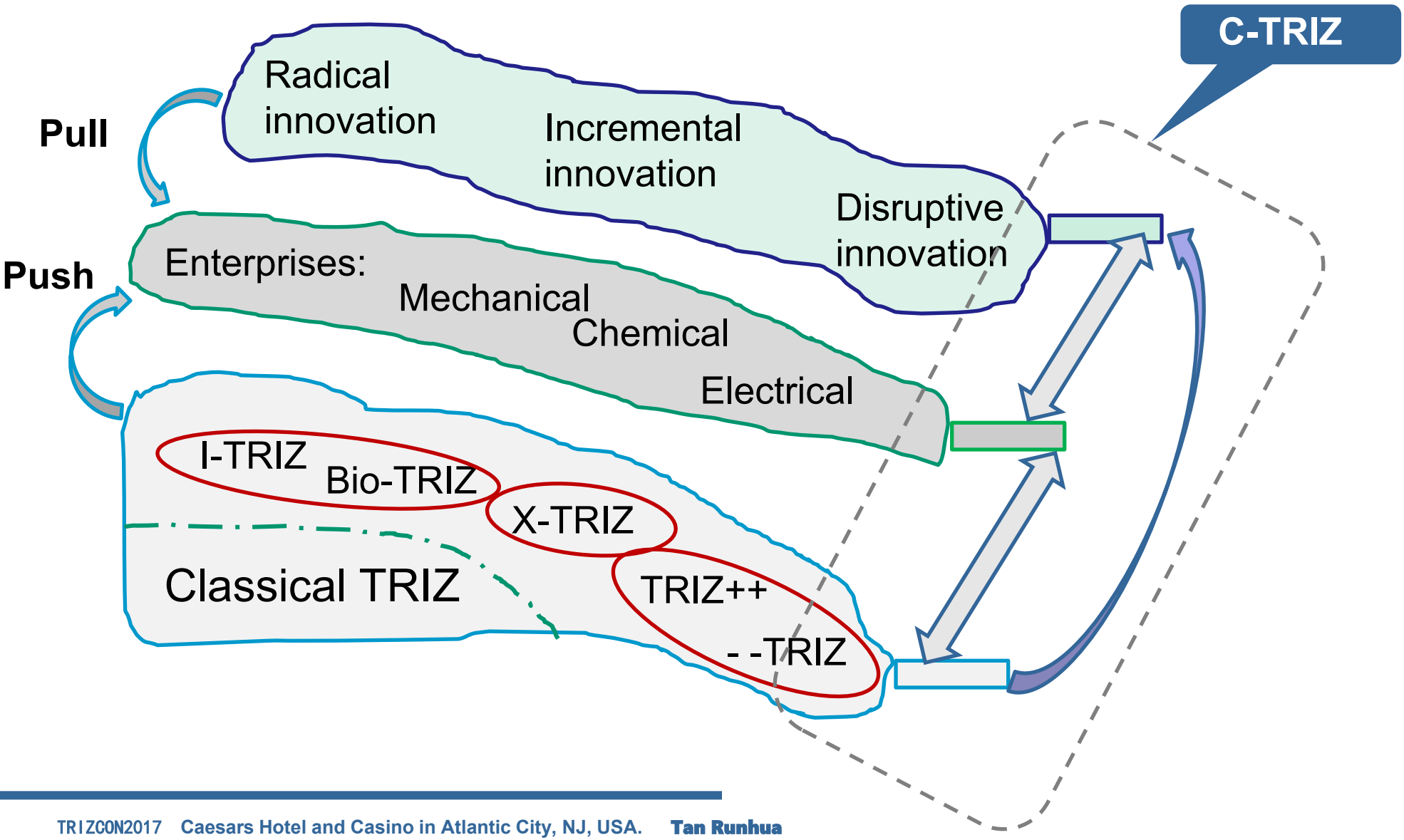

C-TRIZ: Four levels of methods

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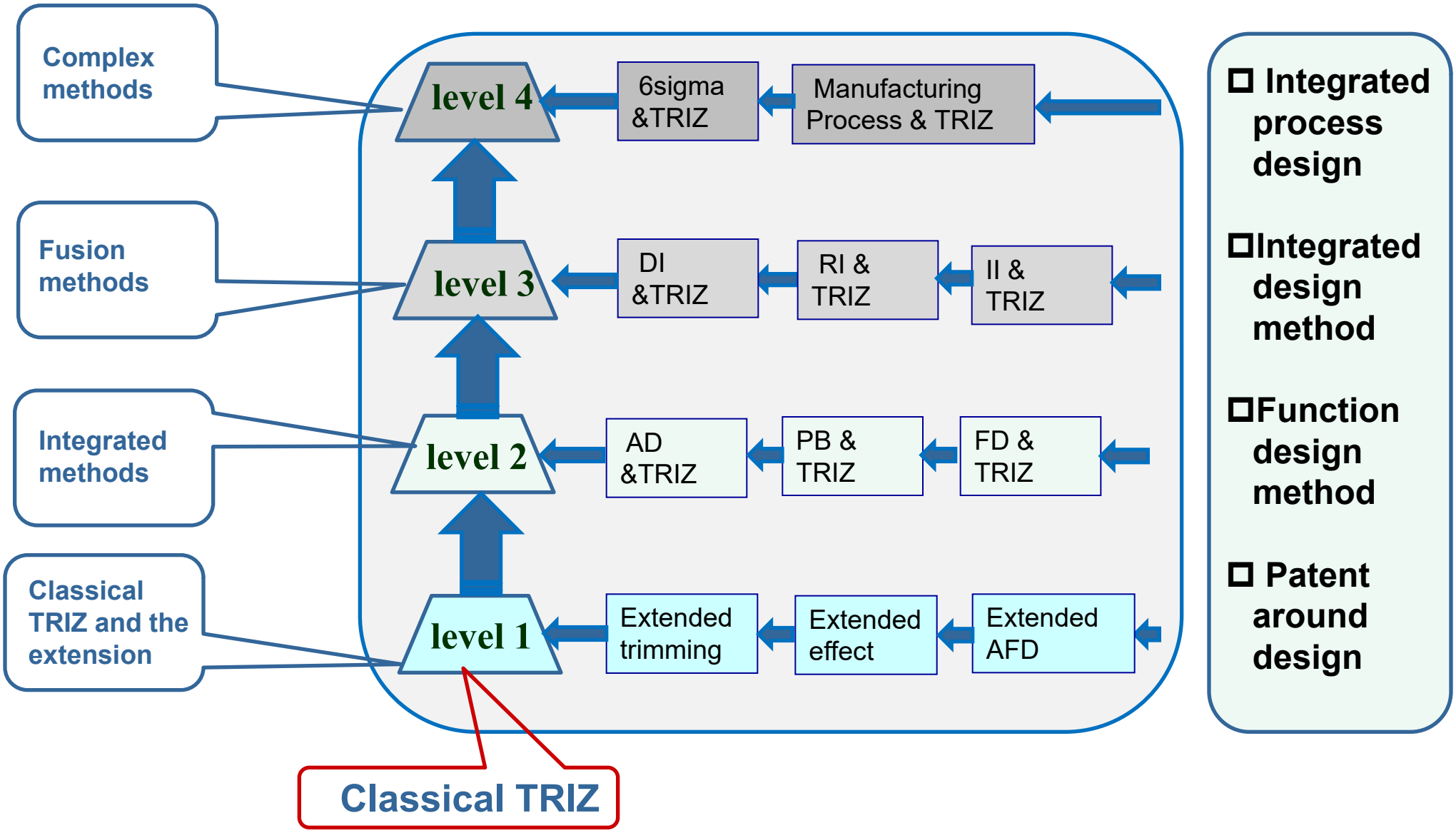


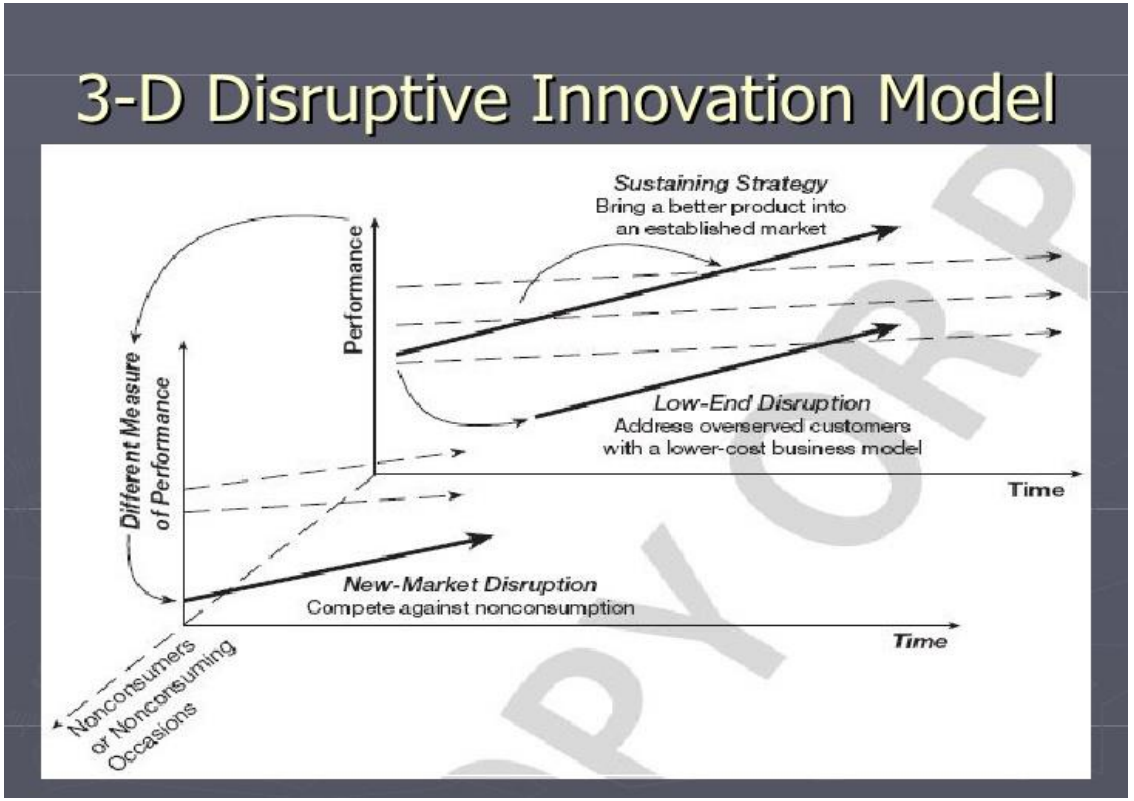
- Integrated process design
- Integrated design method
- Function design method
- Patent around design

Topic 1: Disruptive innovation supported by TRIZ (level 3)

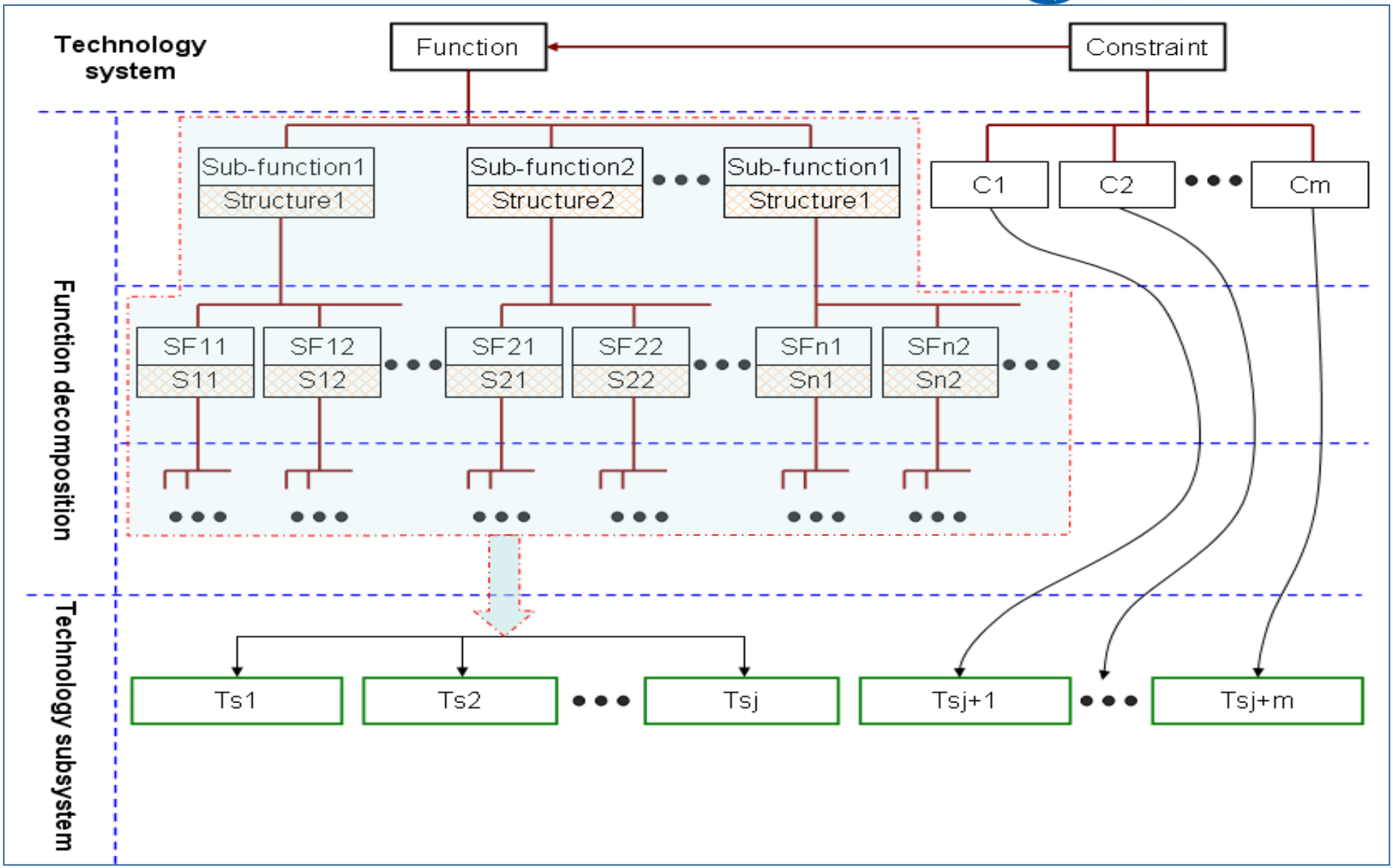
Question?

What are the basic principles of disruptive innovation For engineer applications ?

by Clayton M. Christensen



Disruptive innovation(DI) refers to a technology, process, or business model that brings to a market, a much more affordable product or service that is much simpler to use. When these products are getting stable gradually in the low-end market and in the new market by development, they can take the place of the products in the mainstream market.


Technology system
Function
Constraint
Sub-function1
Structure1
Sub-function2
Structure2
Sub-function1
Structure1
C1
C2
Cm
SF11
S11
SF12
S12
SF21
S21
SF22
S22
SFn1
Sn1
SFn2
Sn2
Function decomposition
Technology subsystem
Ts1
Ts2
Tsj
Tsj+1
Tsj+m

A standard radar map configurations of technology system

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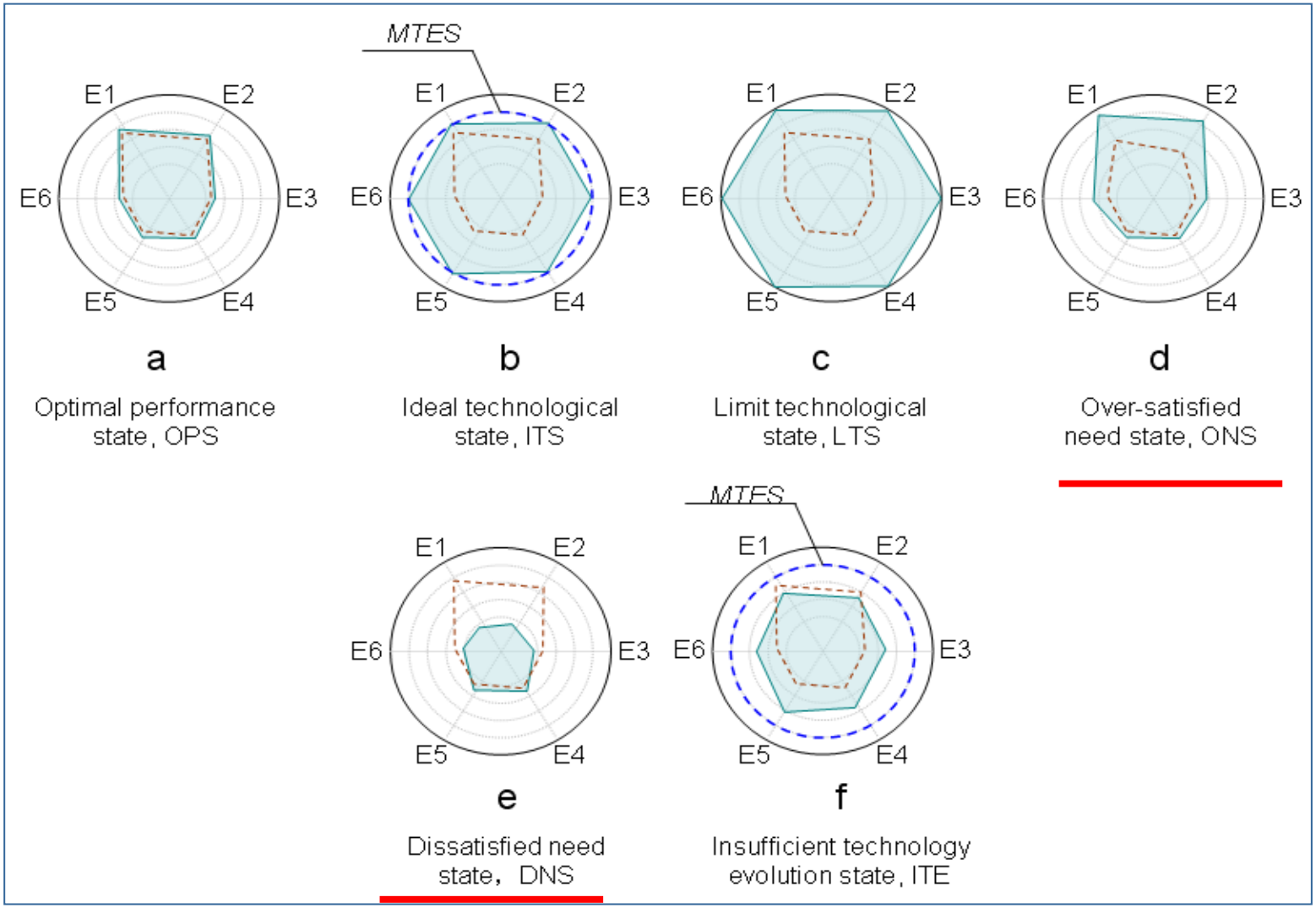
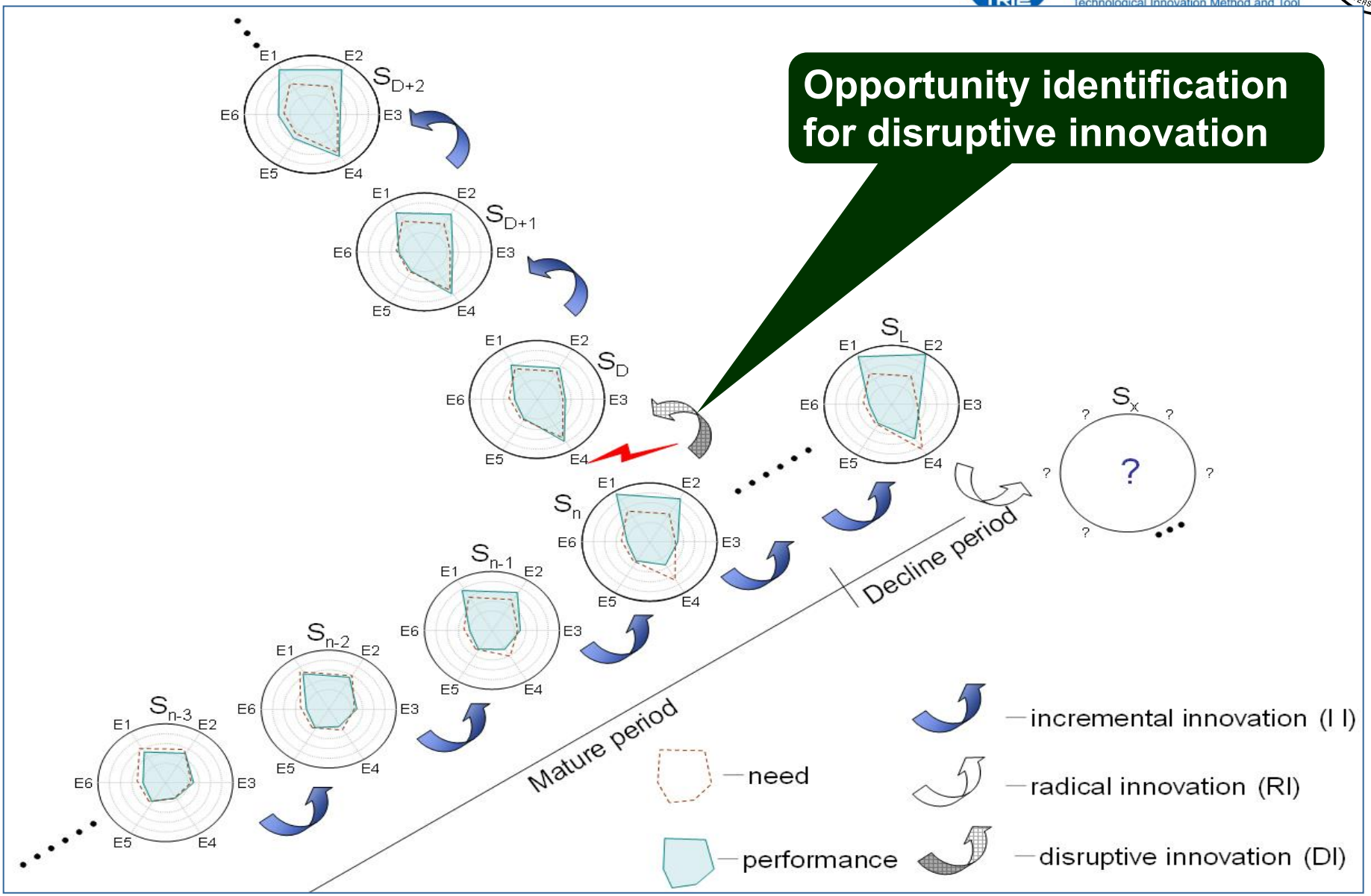


Source: Sun & Tan

Technological system evolution and innovation model



The model is for ideation in process of FFE

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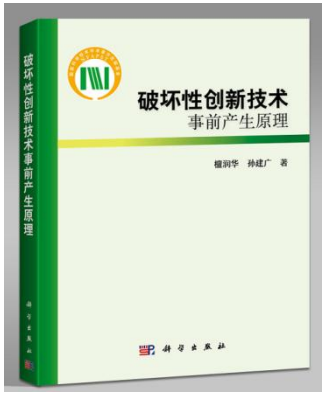
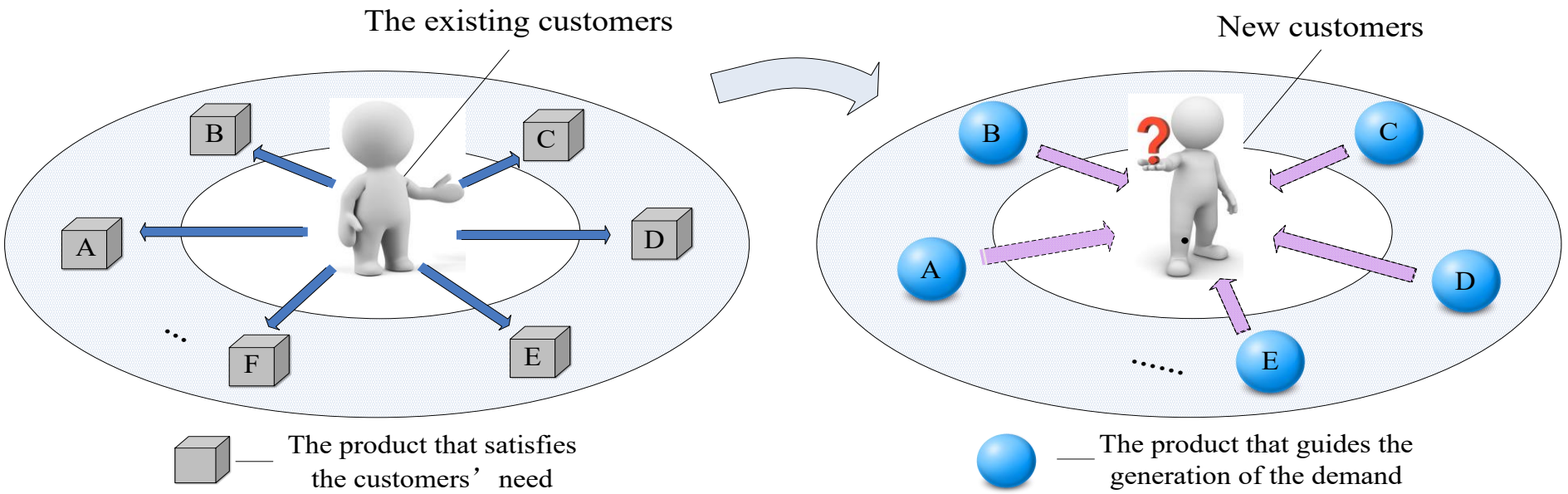


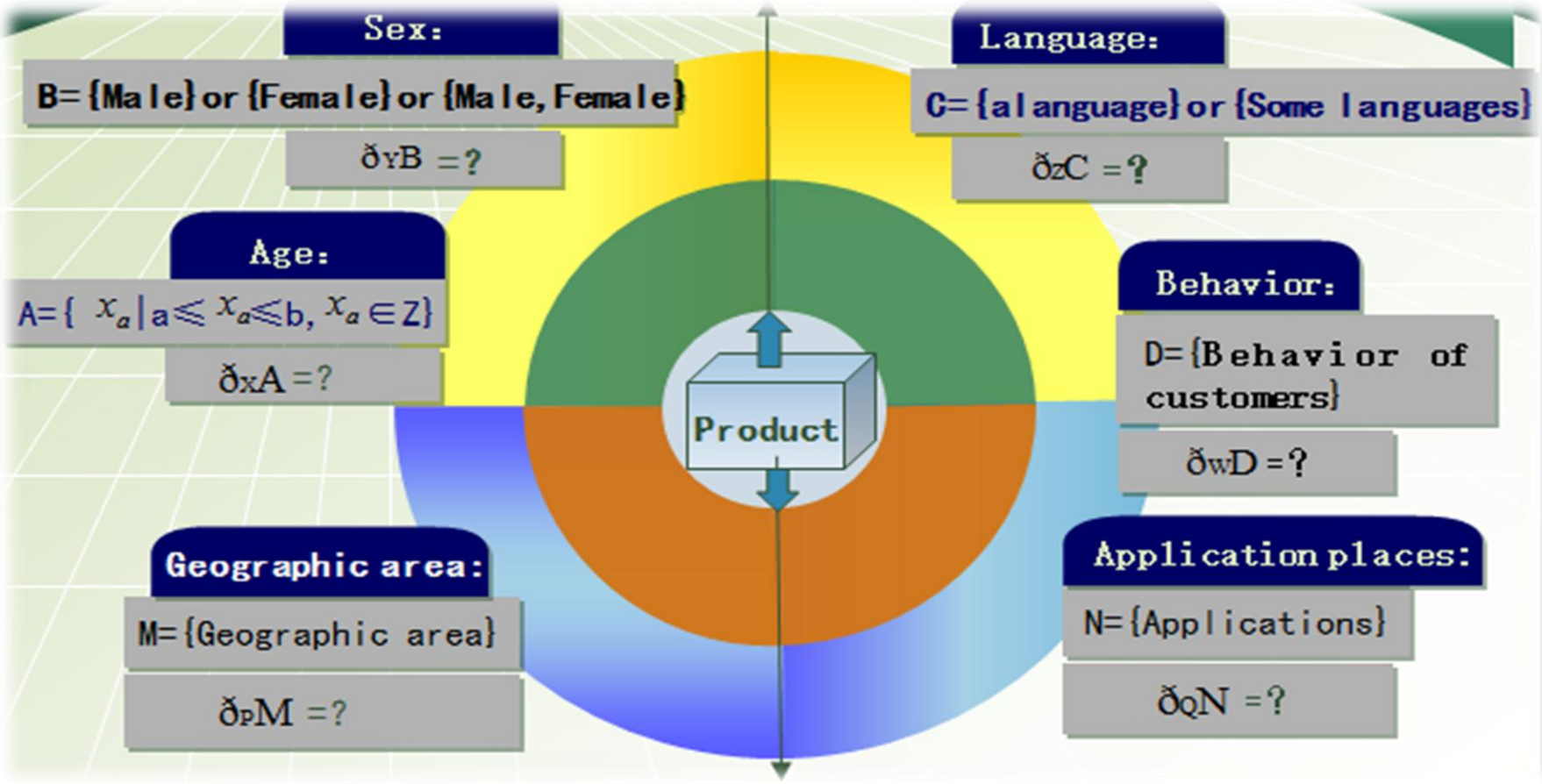
The flowchart of DI based on technological system evolution

2.2.1 Process of Generating New Market Disruptive Innovative Ideas

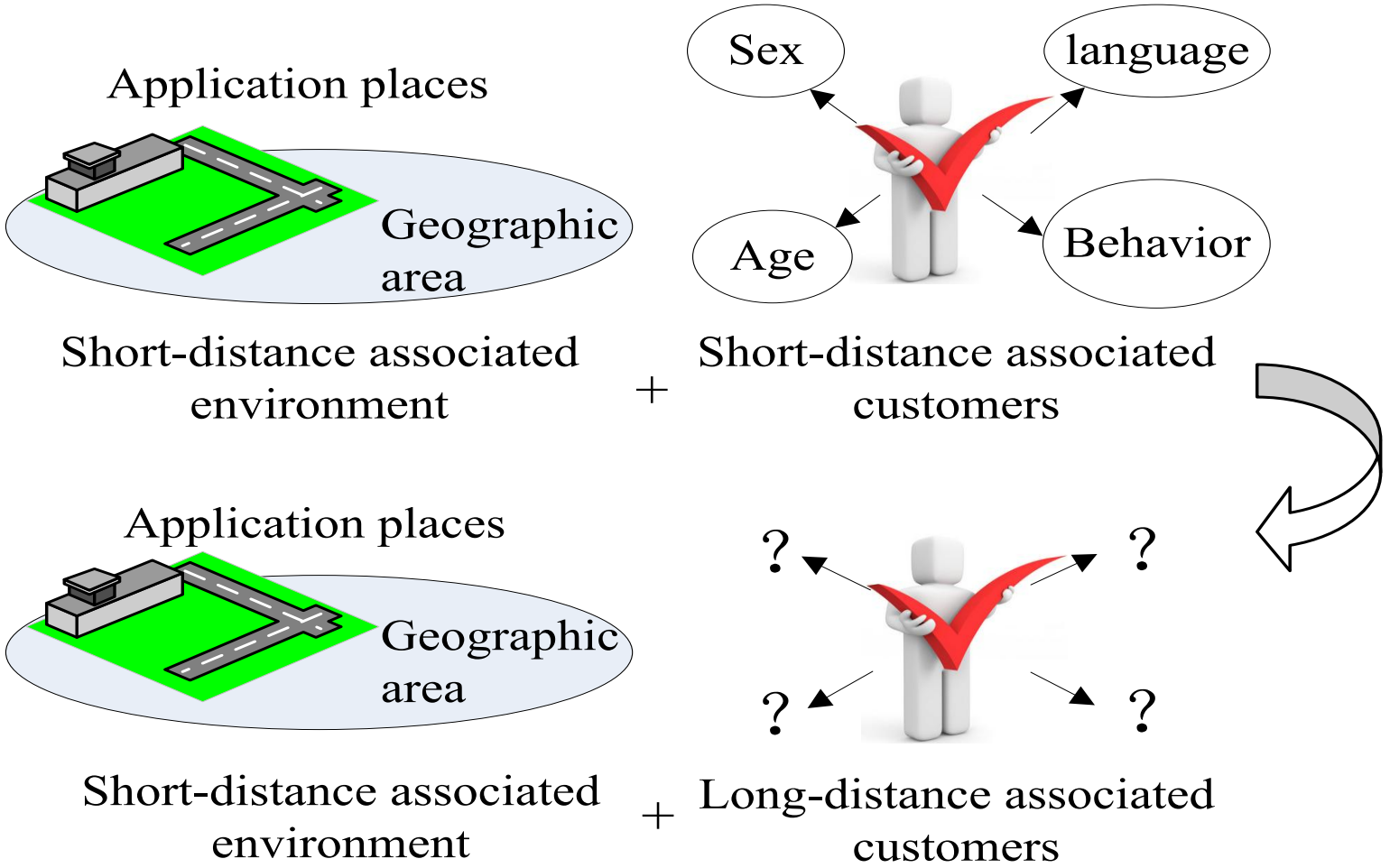
Design-driven theory

Passive design → **Active design**



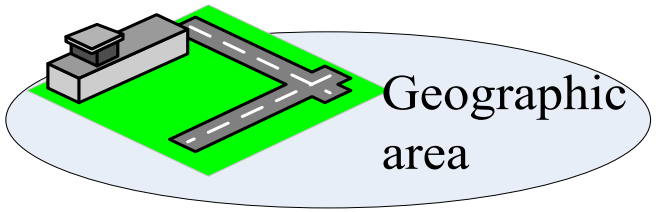

Sex:
B={Male}or{Female}or{Male,Female}
δYB =?
Language:
C={a language}or{Some languages}
δzC =?
Age:
A={ x_a | a≤ x_a ≤b, x_a ∈Z}
δxA =?
Behavior:
D={Behavior of customers}
δwD =?
Product
Geographic area:
M={Geographic area}
δPM =?
Application places:
N={Applications}
δQN =?

❖ Driven Mode 1 of Generating NDI Ideas



❖ Driven Mode 2 of Generating NDI Ideas

Application places



Short-distance associated environment

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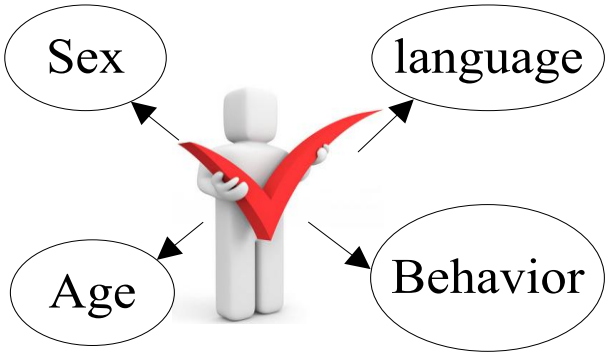
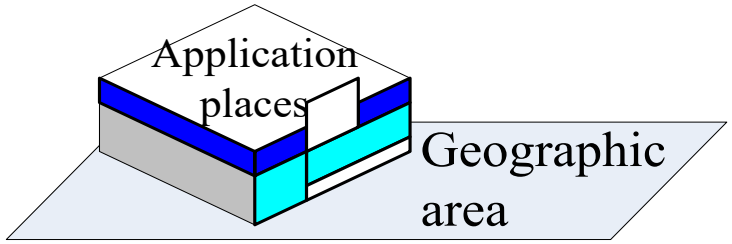
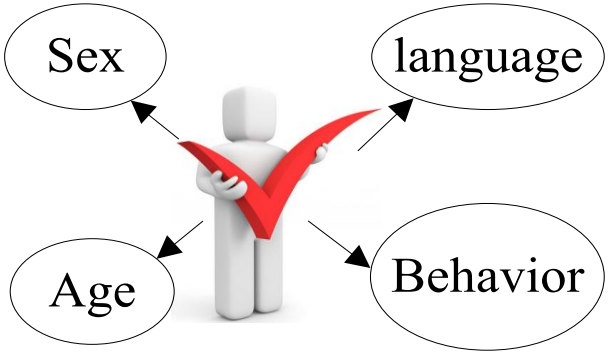


Short-distance associated customers



Long -distance associated environment

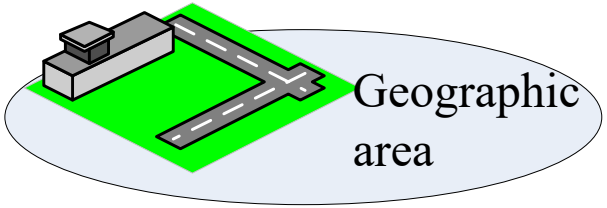
+

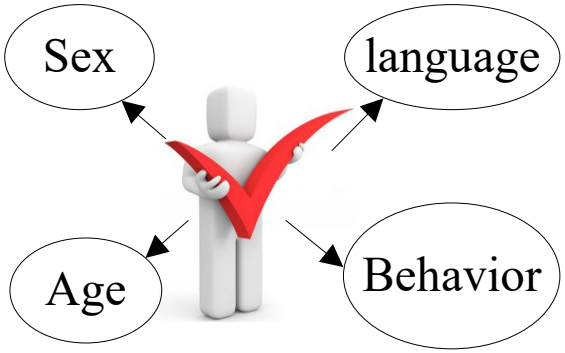


Short-distance associated customers

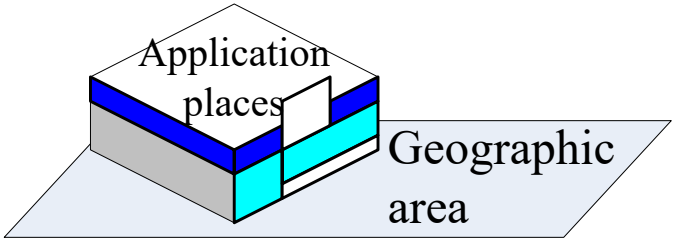
❖ Driven Mode 3 of Generating NDI Ideas

Application places



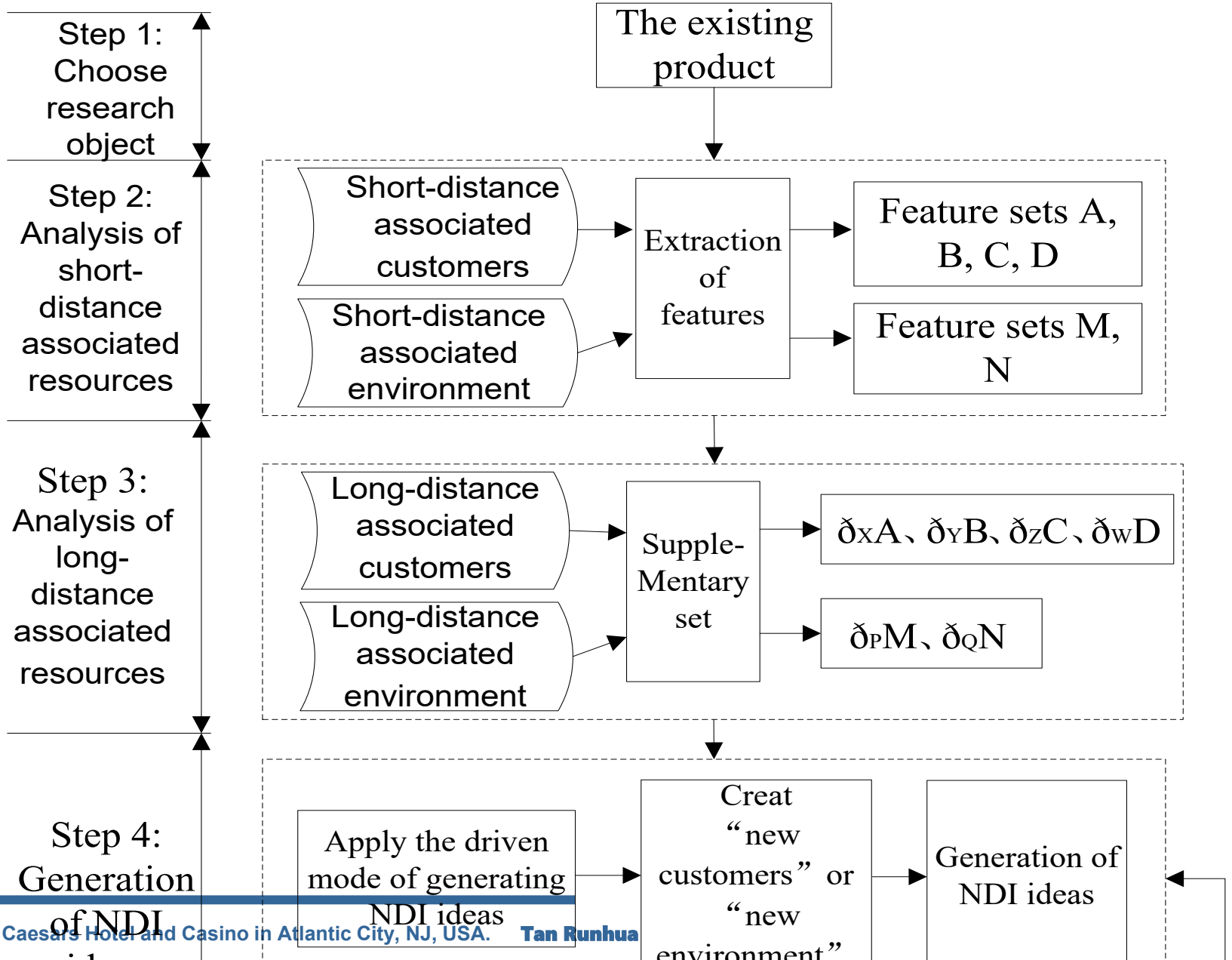


Short-distance associated environment + Short-distance associated customers

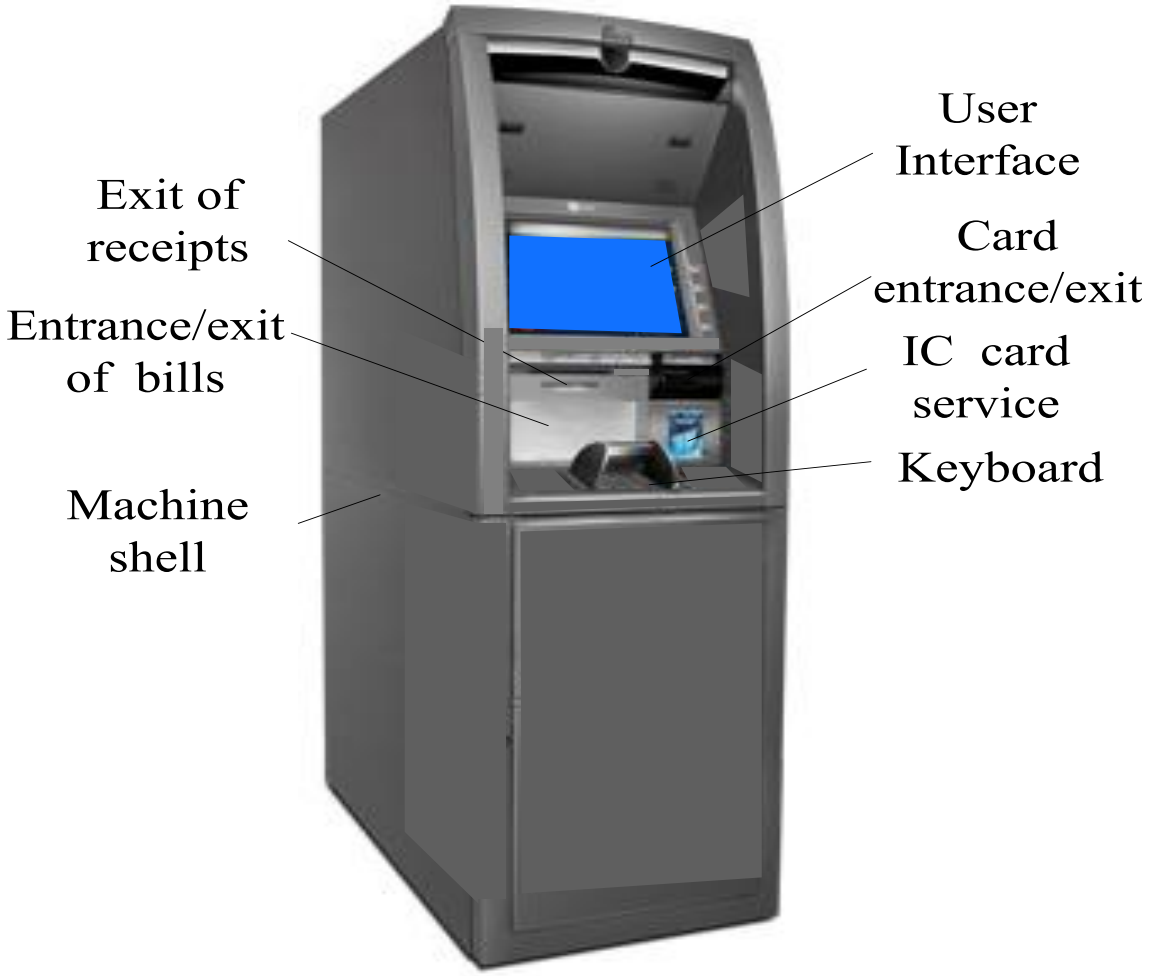


Long-distance associated environment + Long-distance associated customers

The process model



Case study



The hardware structure of cash recycling system（CRS, not include the control unit）is chosen as the research object of new market disrupive innovative design.

Generation of NDI ideas for CRS

- Analysis of short-distance associated resources

Resources	Extraction of resource features	Feature sets
Short-distance associated customers	Age	A= $\{x_a \mid 18 \le x_a \le 60, x_a \in N^*\}$
	Sex	B={Male, Female}
	Language	C={A certain language}
	Behavior	D={operate by vision, operate by right hand}
Short-distance associated environment	Geographic area	M={Many countries and regions in the world}
	Application places	N={Halls of bank branches, Outside the bank branch, shopping malls, etc.}

Generation of NDI ideas for CRS

❖ Analysis of short-distance associated resources

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Generation of NDI ideas for CRS

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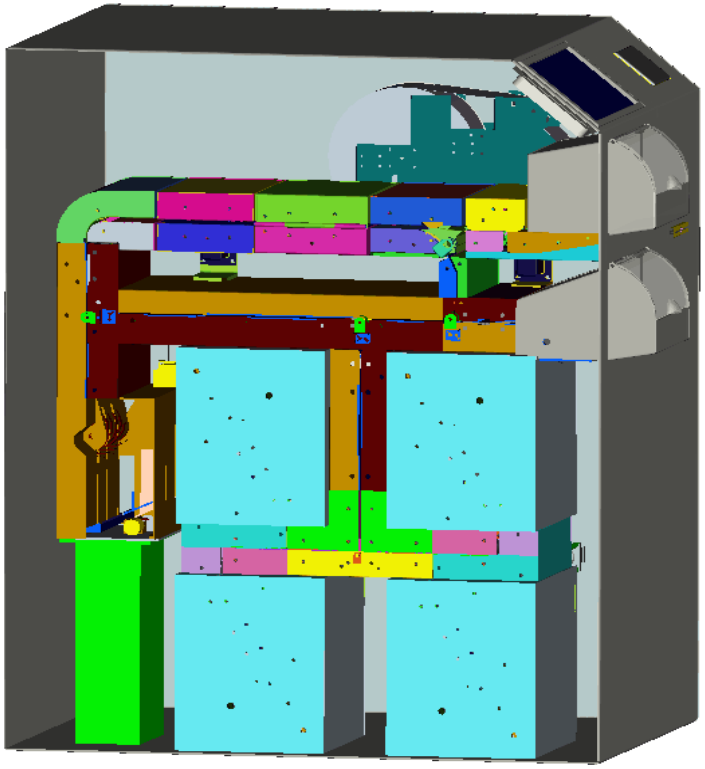
❖ Generation of NDI ideas

Driven mode	Idea	Targeting customers	Evaluation indicator: Implementation value	Design circle	Cost	Total points
Mode 1	Idea 1	$\eth_X A=\{x_a \mid 0<x_a<18, x_a \in N^*\}$	8			24
	Idea 2	$\eth_Z C=$ {Foreigners who do not speak the local language}	7			23
	Idea 3	$\eth_W D=$ {People with visual disabilities}	6			17
Mode 2	Idea 4	Drivers	9			26
	Idea 5	Cashier	9			25
	Idea 6	Ticket seller	9			21
Mode 3	Idea 7	$\eth_P M=$ {Rural or remote areas}	8			24

- **A cash recycling system for minors(FM-CRS)**



Topic 2: Transformation of opportunities by training process (level 4)

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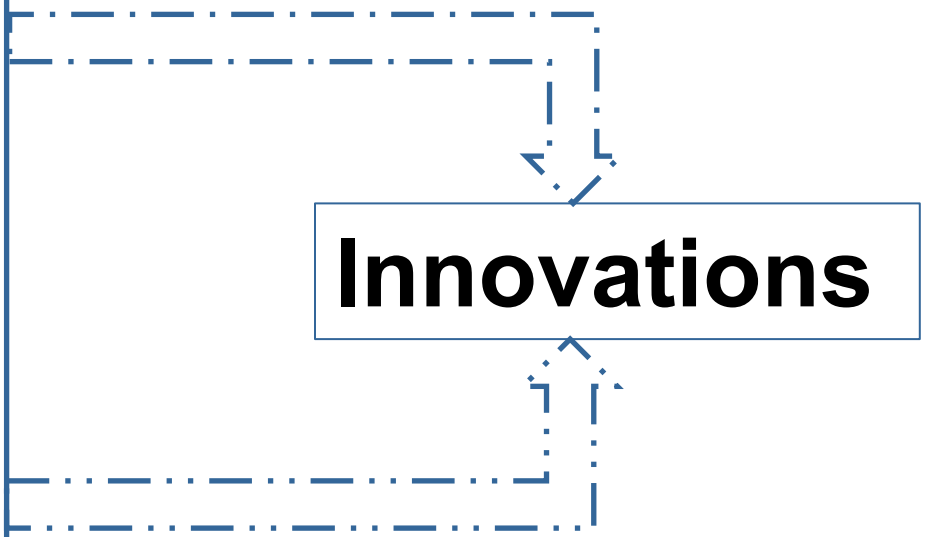
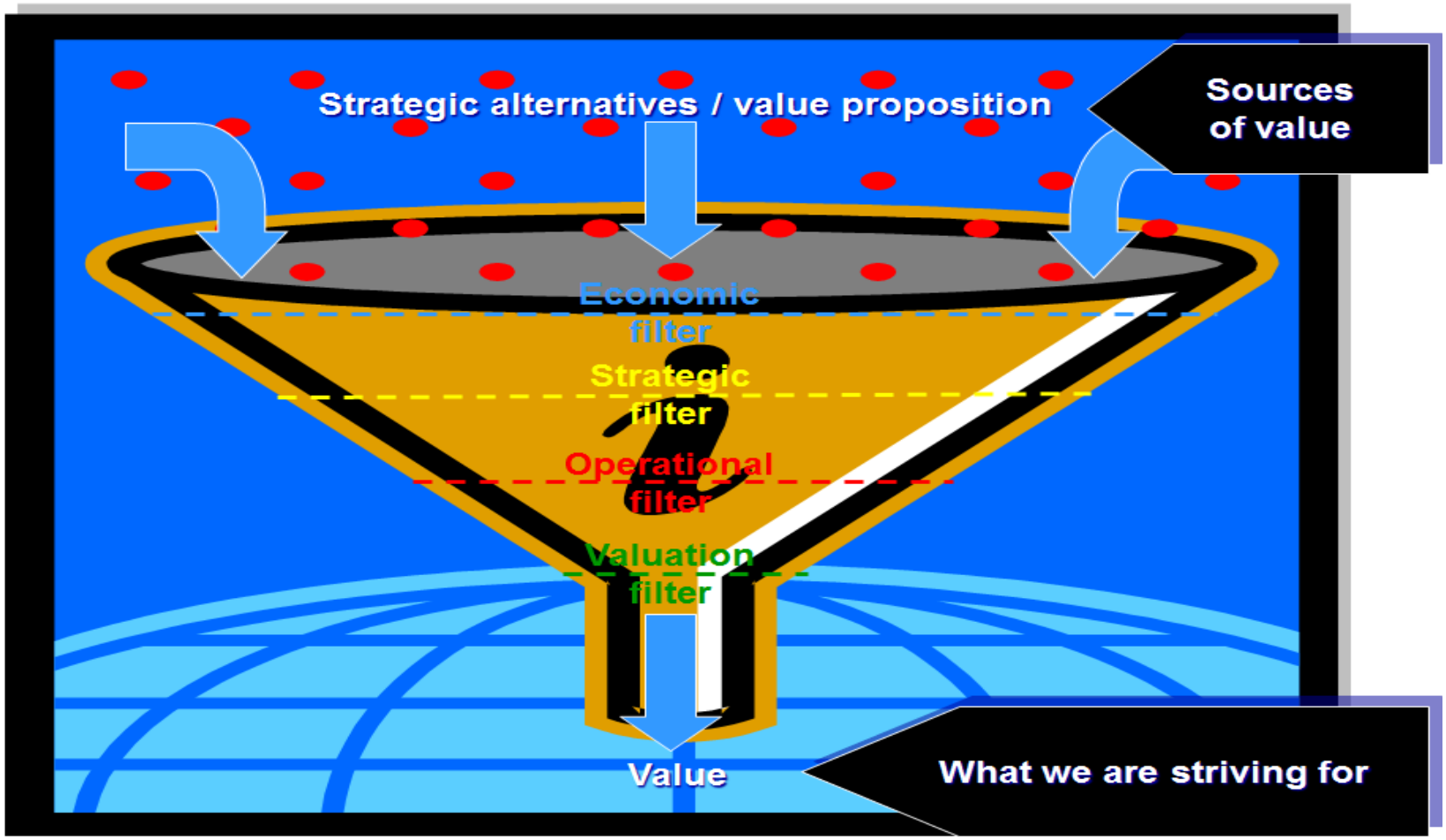
Opportunities Identified

A. Unexpected Successes
B. Unexpected Failures
C. Unexpected External Events
D. Process Weaknesses
E. Industry / Market Structure Changes
F. High-Growth Areas
G. Converging Technologies
H. Demographic Changes
I. Perception Changes
J. New Knowledge



Evaluate Strategic Alternatives



Source: By Dr. Iain Sanders

(Design for Innovation Ltd.)

Opportunity driven training process

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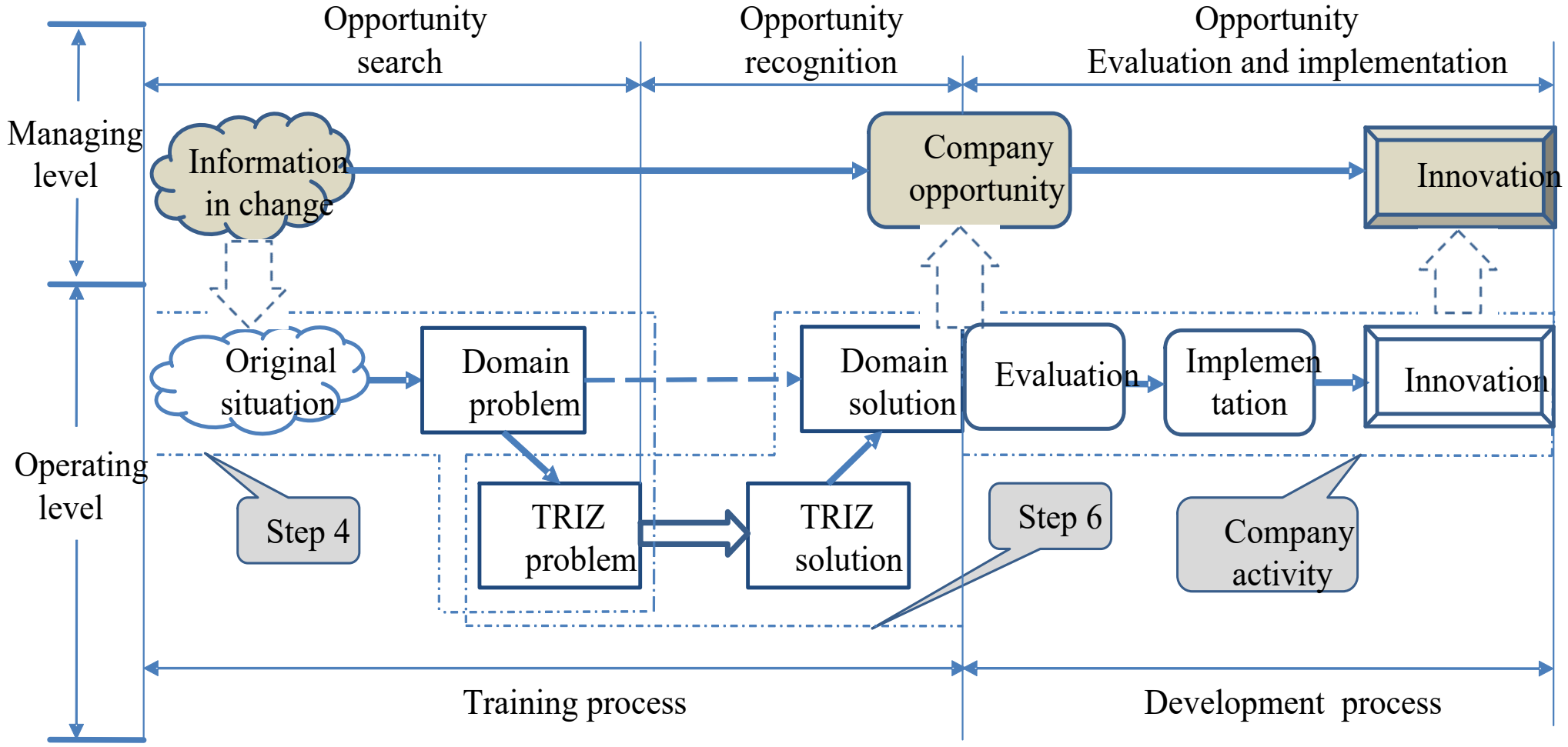
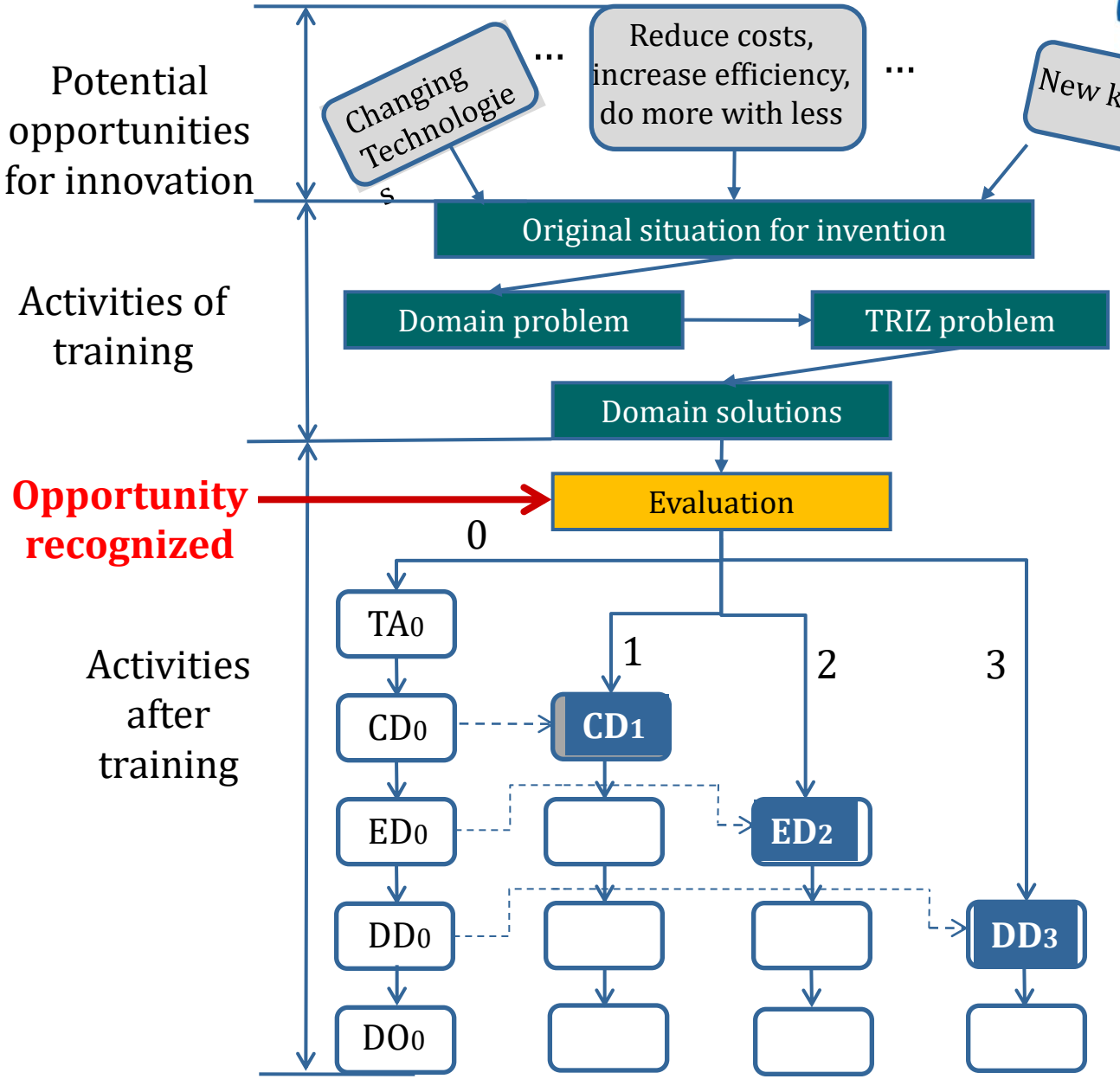


Source: Tan 2017



New Model For Redesign

TA: Task

CD: conceptual Design

ED: Embodiment Design

DO: Detailed Design

New Model For Redesign

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Training process

Output of training:

New technologies

New processes

EVALUATION

Redesign path

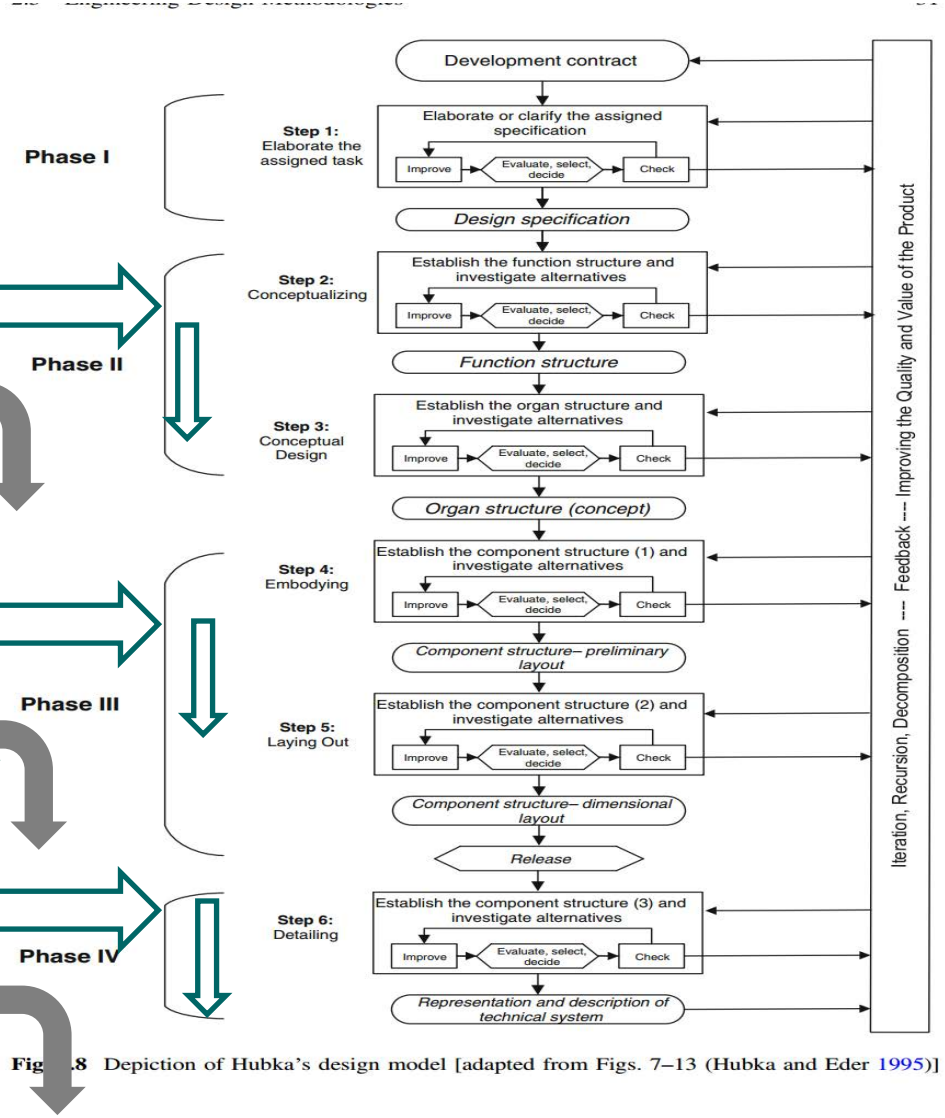
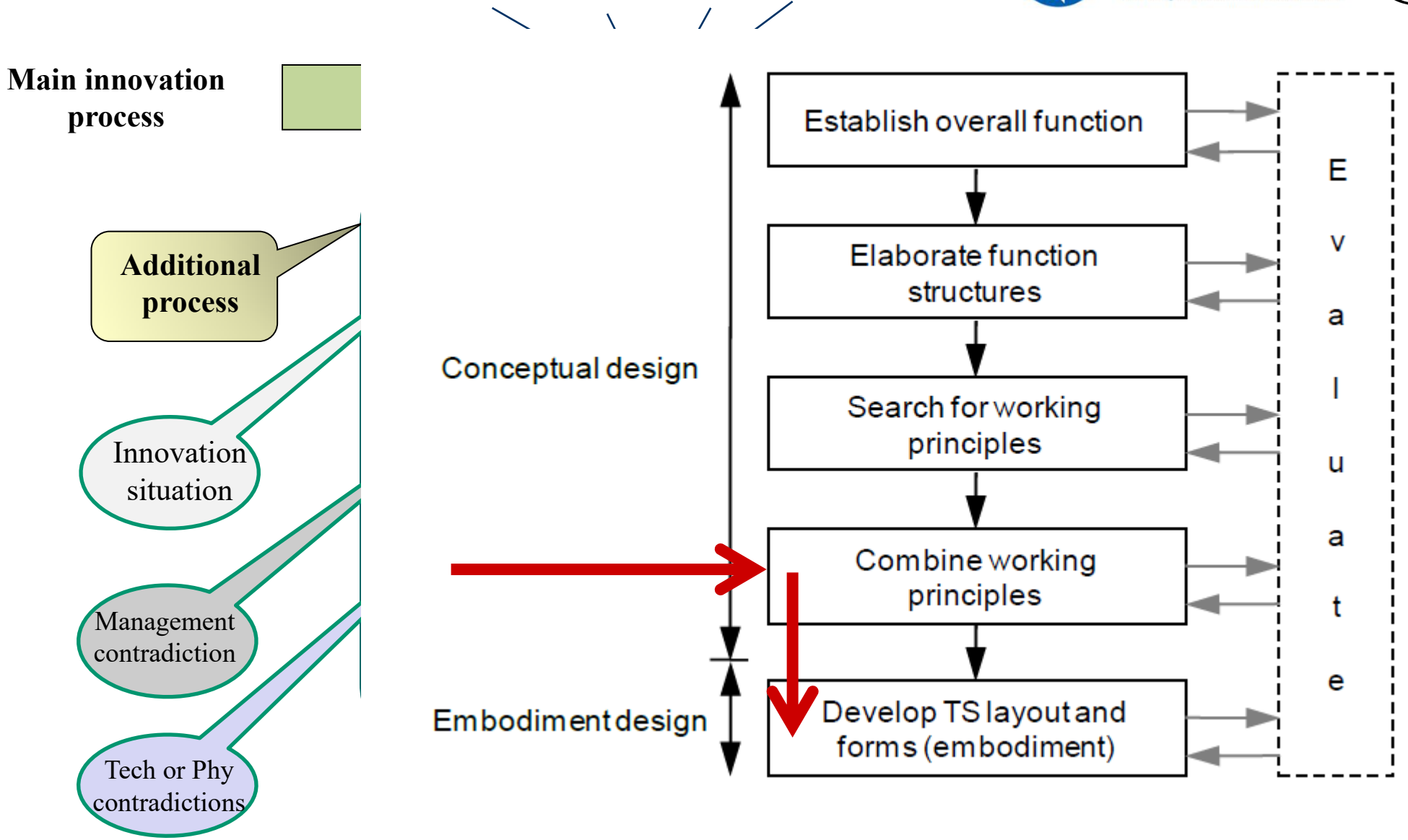


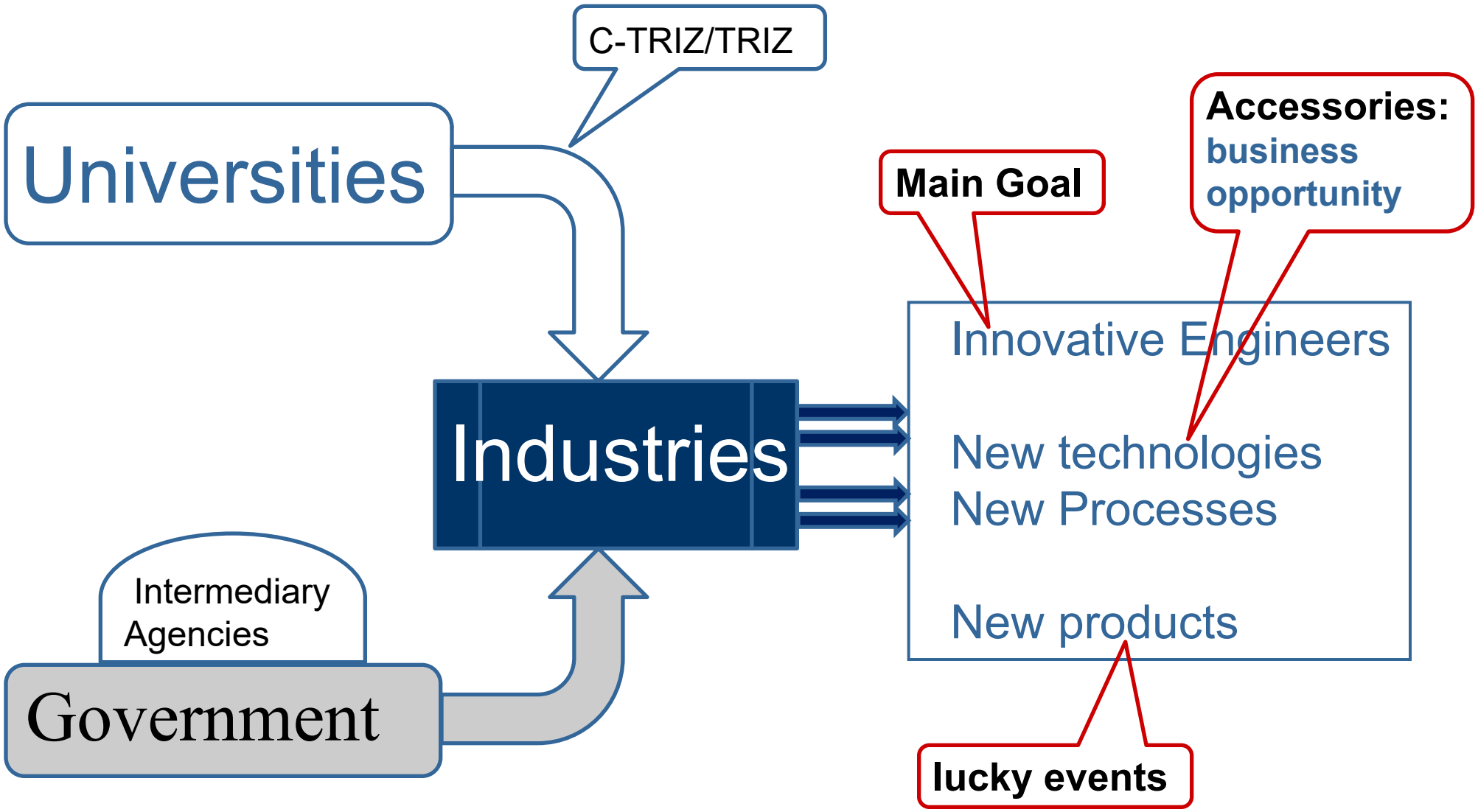
Fig. 8 Depiction of Hubka's design model [adapted from Figs. 7–13 (Hubka and Eder 1995)]

Design process inside a company

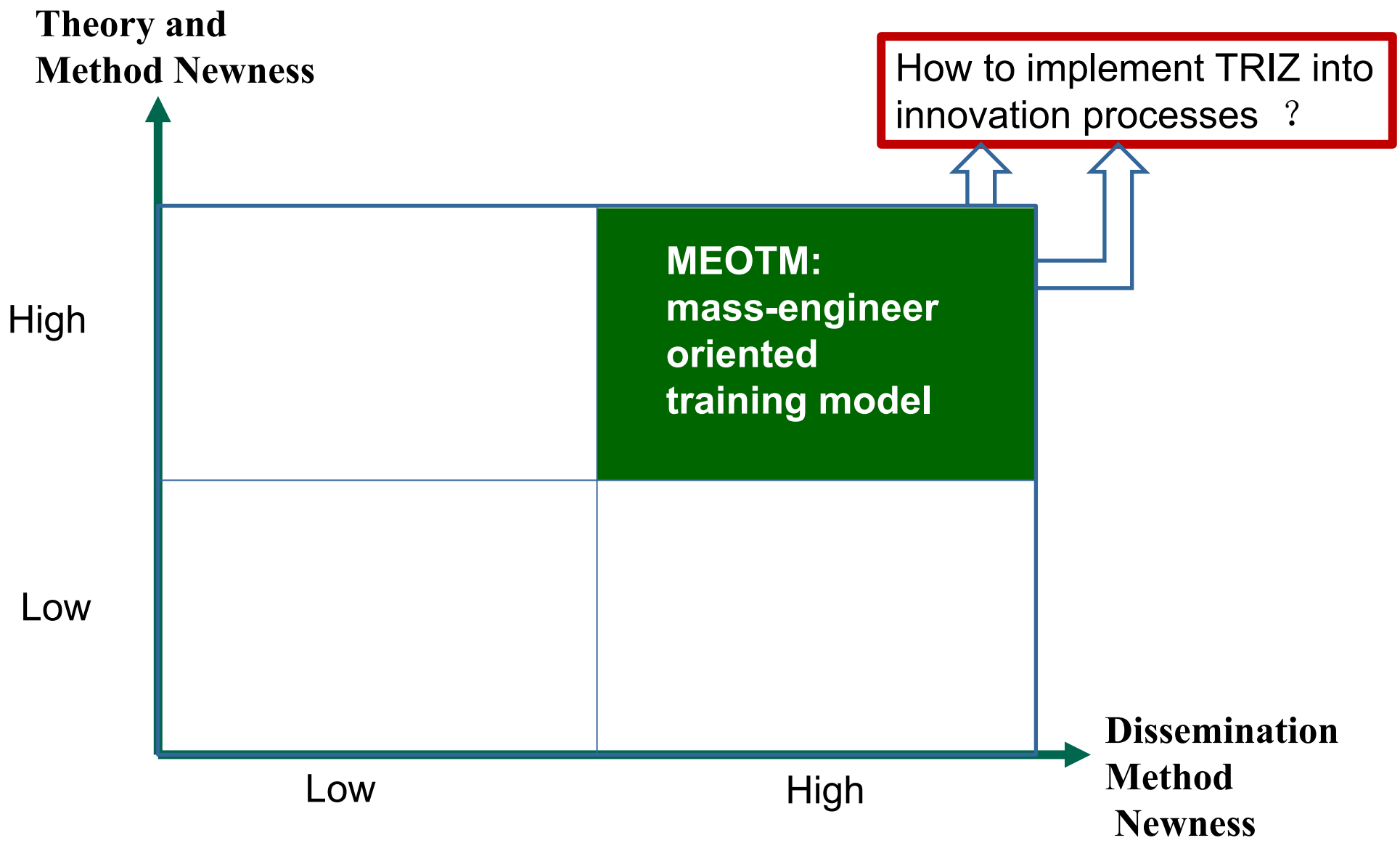
Case: A New process model for redesign



4. Dissemination of C-TRIZ/TRIZ



The position of different training models across the theory newness and dissemination method newness dimensions



Network for dissemination

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The Center (University)

Regional Bases

1. 河北科技厅
2. 浙江科技厅
3. 内蒙科技厅
4. 青海科技厅

1. 天津高开区
2. 天津北辰区
3. 天津西青区
4. 河北承德市

Company Bases

1. 中车-唐车公司
2. 广州无线电集团
3. 上海东方九乐公司

Company Alliance

1. 扬中研究院
2. 任丘企业联盟

Co-companies

1. 承德苏垦银河连杆股份有限公司
2. 北京卓奥世鹏科技有限公司
3. 河北德胜农林科技集团有限公司

Every sub-system does have bigger space !

The path of Dissemination

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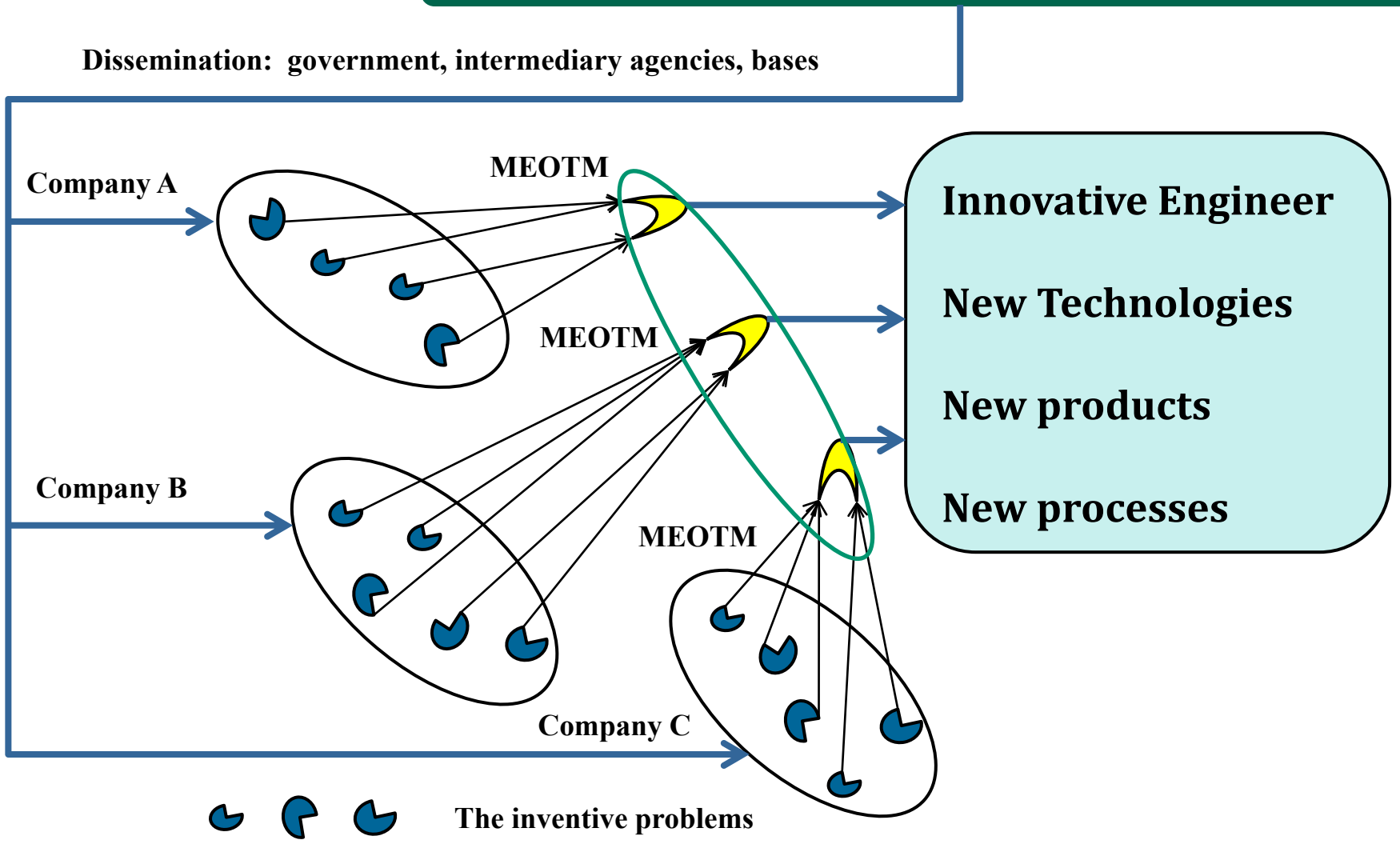
Enabling Technologies for Innovation : C-TRIZ/TRIZ



Dissemination Model

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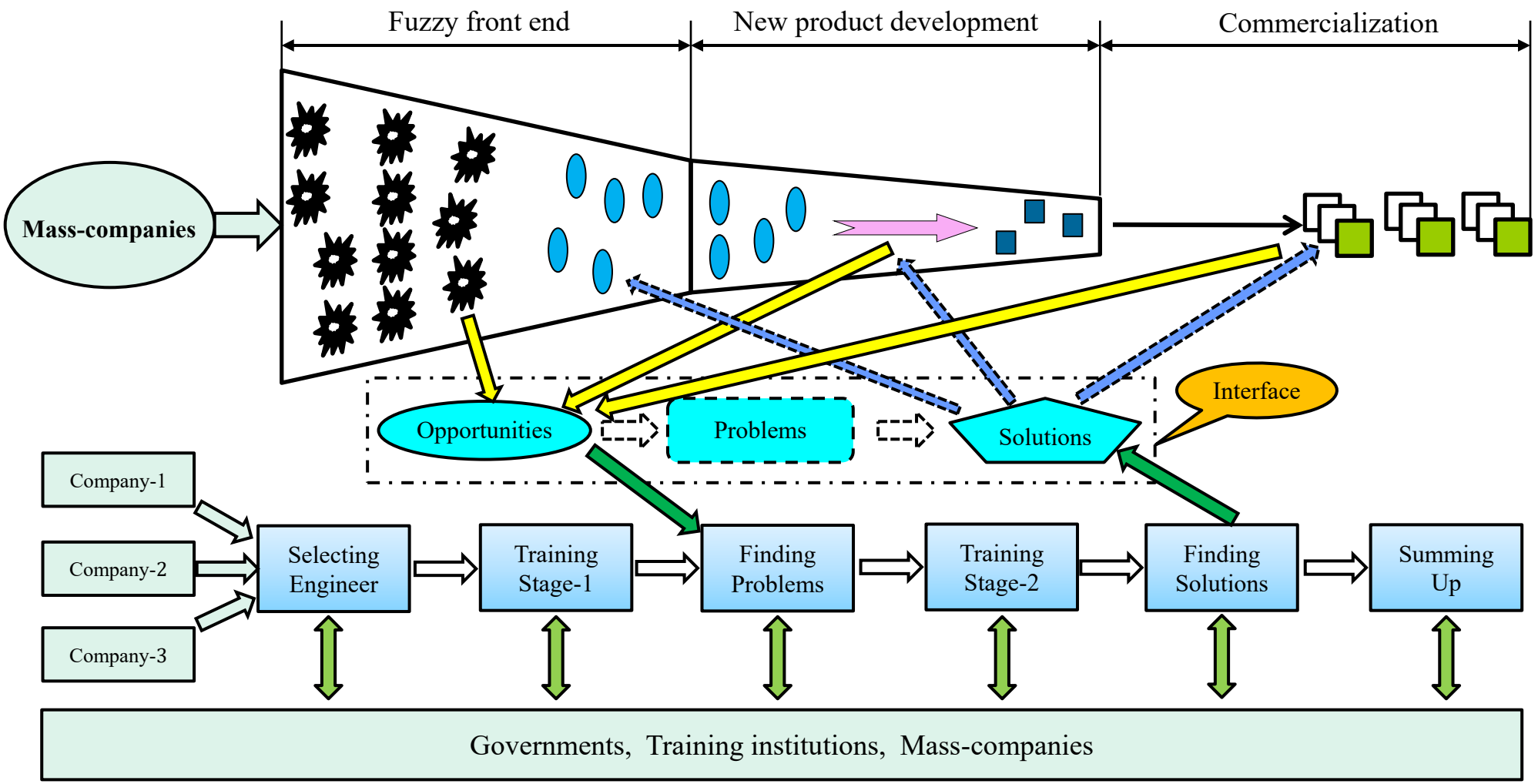
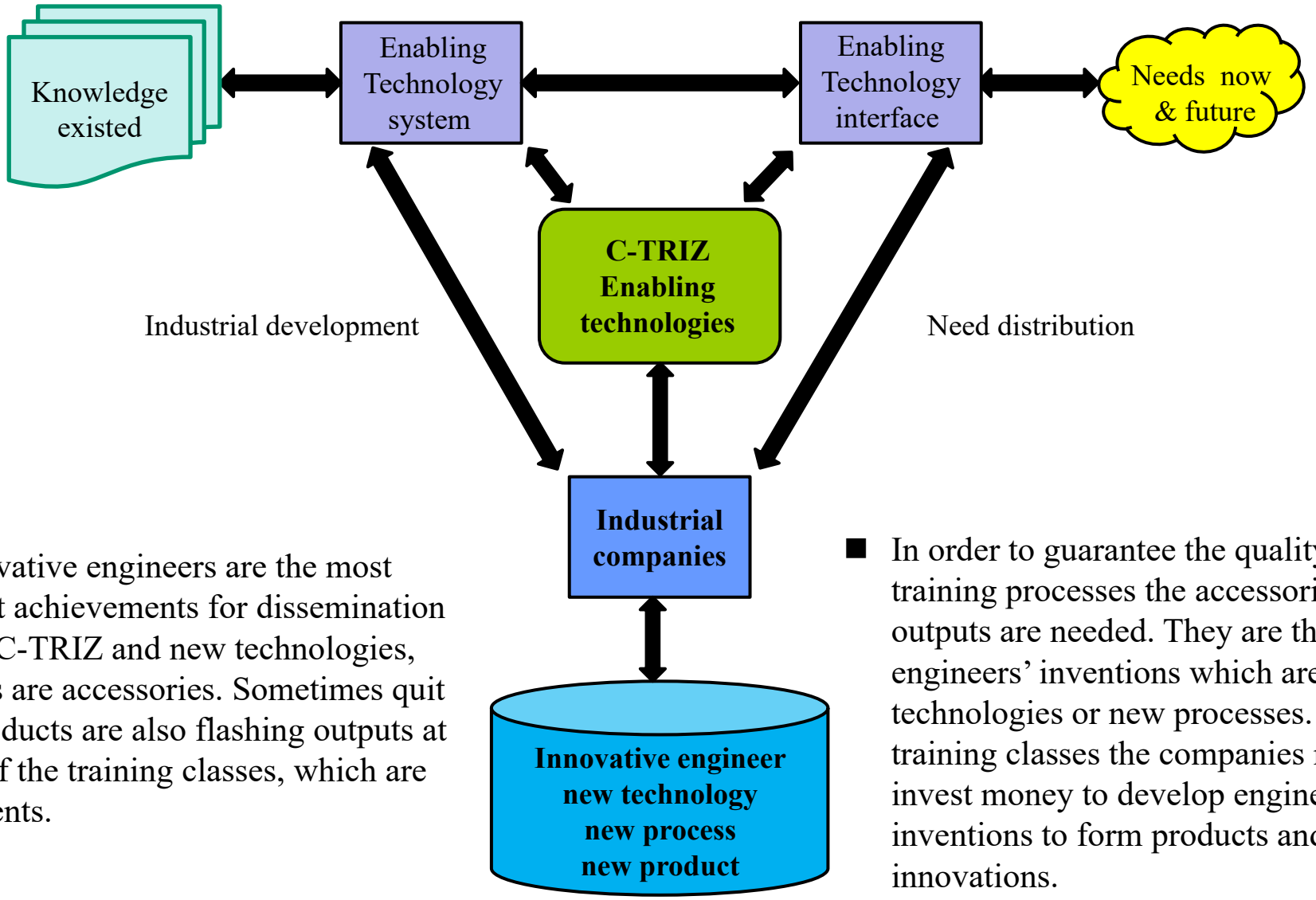


MEOTM: mass-engineer oriented training model

Relationship of partners



- The innovative engineers are the most important achievements for dissemination of TRIZ/C-TRIZ and new technologies, processes are accessories. Sometimes quit a few products are also flashing outputs at the end of the training classes, which are lucky events.

- In order to guarantee the quality of the training processes the accessories as outputs are needed. They are the engineers' inventions which are new technologies or new processes. After the training classes the companies may invest money to develop engineers' inventions to form products and innovations.

The Gates for Dissemination

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- **The training process itself should be controlled jointly by the companies in which some engineers are sent to the classes. Some managers of companies also need to make an evaluation for making decision and discussion with our team.**

Gate -1:
Some manager make an evaluation about the appropriateness of every engineer selected to attend the training classes.

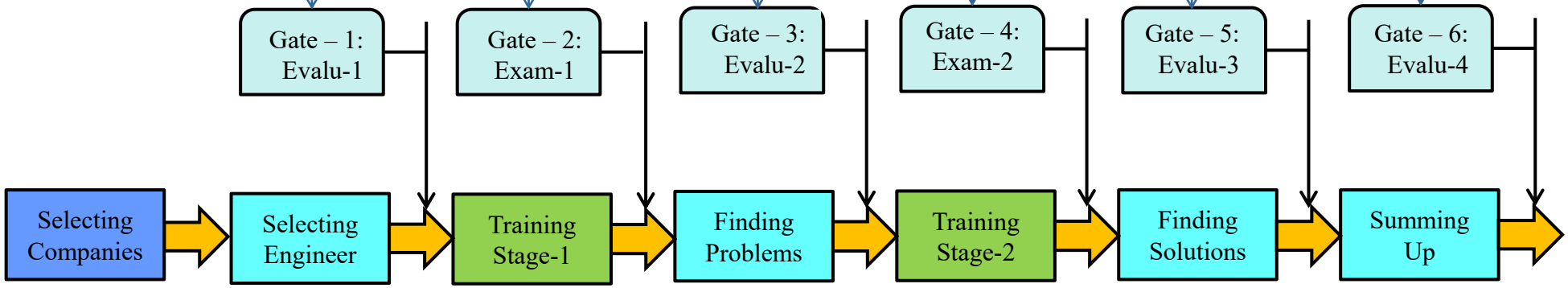
Gate -2:
The trainers make examination to evaluate the knowledge level studied for all the engineers in classes.

Gate -3:
The engineers to attend the class find inventive problems, which are domain problems, and the solutions of the problems are inventions.

Gate -4:
The trainers make examination to evaluate the knowledge level studied for all the engineers.

Gate -5:
Some manager and trainers make evaluations whether the problems are really solved or not and recognition that there are some opportunities for innovation or not..

Gate -6:
Every engineer in a class must make an open reply for his or her projects. The trainers make decisions about their level. Some manager makes decisions whether the inventions are opportunities of possible investment for following innovations of the company.



The innovative engineers trained in this center From 2013 to 2016

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Needs of Companies

- Innovative Engineers
- New Technologies
- New products
- New processes

Numbers of engineers to attend training program

Numbers of certificated engineers : 1692

Numbers of Patent applied : 1218

Output: 8.8 hundred million RMB/per year for companies

专利：1218；发明专利：648
论文：82；新产品：62；新技术：206
新工艺：135；经济效益：8.8亿元

721
3331
1692

企业总数
培训人数
证书总数
学员成果

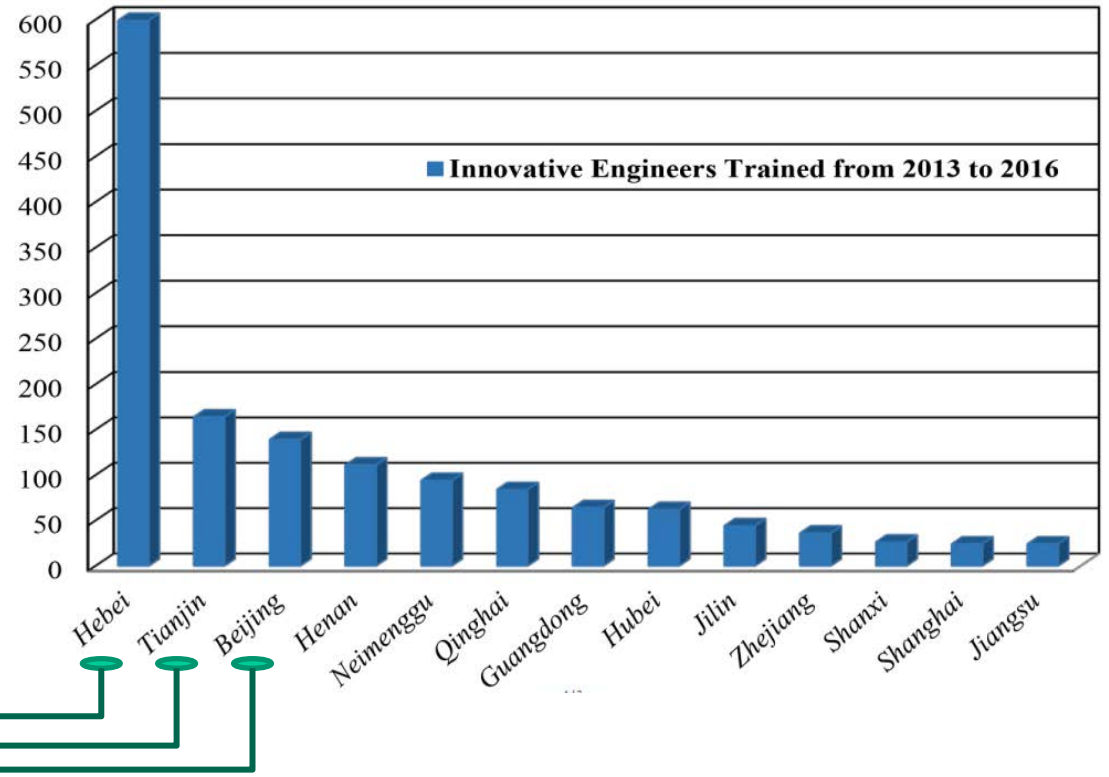
2013–2016年，创新工程师成果

TRIZ

Numbers of enterprises to attend training program

- The numbers of Hebei is the first which shows that the center servers the province first. The reason is that the university is belong to the province.
- The number of Tianjin is the second which shows that the center pays more attention to the city located in.
- The third is Beijing which is near to Tianjin.

Certification numbers 1602



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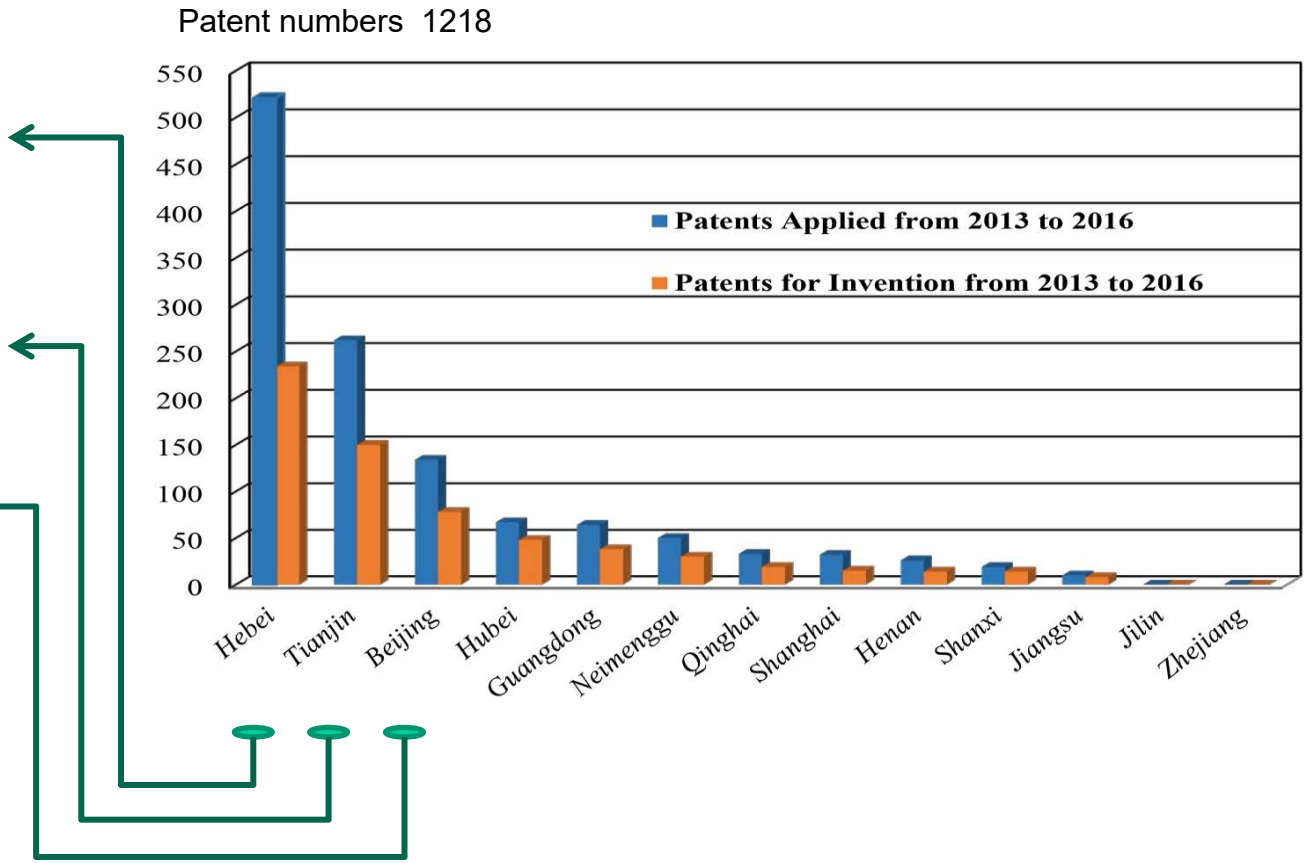

Case 1: RenQiu, Hebei Province
（2015.5.16 - 2015.12.6）

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More than 1000 peoples

Popularization

Beginning of middle level class

lecturing

Case training

Consulting in workplaces

Debating

Final ceremery

35 in 60 engineers have passed the final debating.

They have made applications of patents of 20. A few new processes were also developed.

Case 7: New sawing machine design

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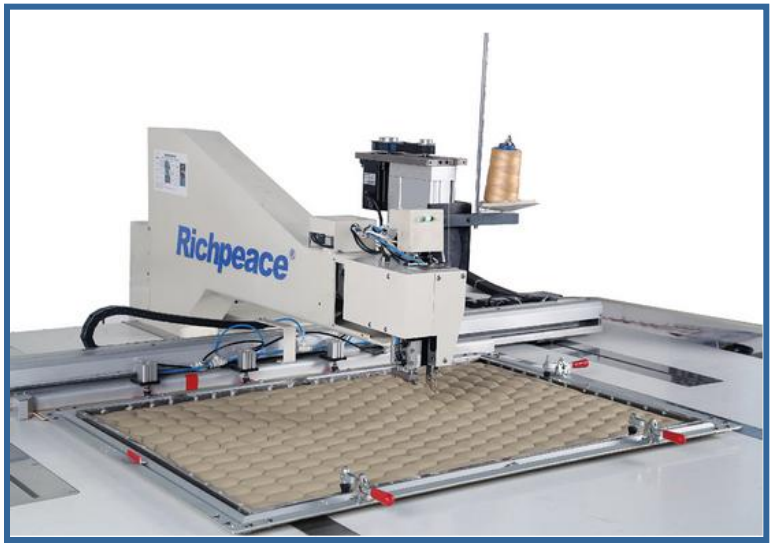

Original Problem:

There are some creases on the surface of down jackets.

How to make the surface smooth ?

Inventive problem:

One technical contradiction

No.1 inventive principle is used to solve the problem.

4 patent application

共申报4项专利，两项实用新型已获授权。另两项发明专利

1、一种增强羽绒制品缝纫强度的负压台板，专利号：201410408602.0

2、一种缝制羽绒制品的全自动模板缝纫机，专利号：201410414402.6

在知识产权局审核中。

创新培训师证书

王 彬 于2015年04月完成创新培训师培训，修完全部规定课程，熟练运用技术创新方法分析解决工程问题，具备技术创新方法培训能力，经考核与答辩，成绩合格，特授予创新培训师一 级资格证书。

姓 名:王 彬
身份证号:120224197311194836
工作单位:天津宝盈电脑机械有限公司
证书编号:2015MC027

主 任 颁证日期：2015 年 04 月 17 日

№ 1520027 国家技术创新方法与实施工具工程技术研究中心
National Engineering Research Center for Technological Innovation Method and Tool

6. Conclusions

- C-TRIZ has been being developed.
- MOETM has a feature of mass engineer-oriented from different companies at same time and long training period.
- The general evaluation for our dissemination is positive.
- More industrial companies begin to pay attention to the training program and a bigger market is being formed in China.
- China is an opportunity to disseminate TRIZ for the international TRIZ world.
- My center is certainly a best cooperator for the international TRIZ world.

Thank You!

rhtan@hebut.edu.cn
http://www.triz.com.cn