Business Process Management & Innovation (P-TRIZ)

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London, March 2006
Ten years on, CSC has a new process agenda
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<th>Third wave</th>
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<td>Sharing data</td>
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</tr>
<tr>
<td>Data aware applications</td>
<td>Distributed applications</td>
<td>Distributed processes</td>
</tr>
</tbody>
</table>
Latest report: BPM case studies and history

From CIO to CPO via BPM:

The Next Generation of Enterprise Automation

Value = invention + scale
1900 - Frederick W. Taylor

Carl Barth
Computers: glorified adding machines?

“Don’t let that Mr. Skinner hear you say that. He says a computer is an instrument of the imagination. He says that with another computer, me and Miss Glazier he could run Credit and Settlement single-handed.”

– Miss Prothero, from Alan Bennett’s, Office Suite

“Out of this collection of tools can be built virtually any office application system”

-Michael Hammer et al, MIT Office Automation Group, 1981

[www.recordare.com/good/oa81.html](http://www.recordare.com/good/oa81.html)
2000 - The rise of knowledge work

- Objects did change the world
- Processes are going to change it again

Knowledge worker costs are now 50% of all corporate costs
Not call centre worker robots
“Knowledge” workers
A process tool is needed

Work with processes and work in processes
Who remembers these?

When was the last time you used one?

Tacky cardboard sleeve

*When was the last time you used one?*
We still draw them, what’s stopping us using them?
Process work is pervasive but **terminology** varies

- G2000 organizations are almost universally embarking on multiple process improvement exercises to increase organizational efficiency or effectiveness.
- These efforts go by many names, including industrial engineering, ISO certification, Six Sigma, Sarbanes Oxley, enterprise business architecture (EBA), business process improvement (BPI), business process re-engineering (BPR), Audit and Compliance, Rummler-Brache, Integrated Definition Function Modeling (IDFM) and Lean Thinking, to name a few.

Process work is pervasive but **semantics** varies

- Entity relationship diagrams
- ANSI standard flowcharts
- Process models, various
- Data flow diagrams
- Unified Modeling Language (UML/MDA) diagrams (activity, class, etc.)
- Catalyst, LOVEM
- Network diagrams
- CRUD (create, read, update, and delete) matrices
- IDEF charts (0 through 9)
- EPCs (event chains)
The connection to reengineering

CSC 1993 + Drilling Machine = BPM Definition

CSC 2003
Fast forward Post-ERP
To BPML and BPMS
1999 to 2003
Towards a process virtual machine

Source: CSC EAI Practice
Distributed concurrent processing can be unified

Business processes

BPML

BPML foundations
Pi calculus, Join calculus, XPath

Middleware services

Message queue
Asynchronous, Peer-Peer

Pub/sub
Asynchronous, Federated

RPC/ORB
Synchronous, Distributed

TP monitor
Transactions, Co-ordination
When complexity mounts and becomes unmanageable, it’s time for action.
How business people think, really …
The power of unification

Fusion of procedural, functional, and rule-based programming metaphors
Business Process Management Initiative (BPMI.org)
Process unifies computation and communication
“For over two decades the Process Calculus community has sought to combine two things: the way you define and analyze mobile distributed processes and the way you program them. We believe we’ve found the basic maths to meet this challenge, and it is heartening to hear that it is being applied to the management and automation of a company’s most basic economic assets, its core processes …”

Robin Milner, Professor of Computer Science, Cambridge University, UK

— ACM Turing Award Winner, 1991
Since $A \sim B$ there is $B'$ such that $B \not\rightarrow B' \not\downarrow_s$ does not hold. The only way this is possible is

$$B' \equiv (\nu \tilde{z}) \left( Q_j \mid \Sigma_{i \in I}^j \right)$$

for some $j \in I$. We now exploit the inductive hypothesis. We have

$$A' \not\rightarrow A_j'' \equiv (\nu \tilde{z}) (P') |$$

Since $A' \sim B'$ there is $B_j''$ such that $B' \not\rightarrow B_j'' \not\downarrow_s$. The only possibility is

$$B_j'' \equiv (\nu \tilde{z}) \left( Q_j \mid (M) \right).$$

But $A_j'' \not\equiv B_j''$ by (2.2), a contradiction. Hence (2.2) is true.

**Case 2** Suppose that $\alpha$ is $\bar{x}y$. Let $s_i (i \in I)$ and $t$ and $w$ be fresh names, and set

$$M \equiv x(w). (\Sigma_{h=1}^k [w = a_h] t + \Sigma)$$

The argument is then similar.

**Case 3** Suppose that $\alpha$ is $\bar{x}(z)$. Suppose $\text{fn}(P)$ and $t$ and $w$ be fresh names, and set

$$M \equiv x(w). (\Sigma_{h=1}^k [w = a_h] t + \Sigma)$$

The argument is then similar. In this case, we have

$$A' \equiv (\nu \tilde{z}) (P' \mid (\Sigma_{h=1}^k [z = a_h] t + \Sigma)$$

and not $A' \not\downarrow_s$ and not $A' \not\downarrow_t$. It follows that the process $O$ of performing a bound variable substitution is not a solution to the problem. We give the details in the next section.
## Process calculus primitives

<table>
<thead>
<tr>
<th>Operation</th>
<th>Notation</th>
<th>Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>prefix</td>
<td>$\pi.P$</td>
<td>sequencing</td>
</tr>
<tr>
<td>action</td>
<td>$x(y)$\text{(\overline{xy})}}$</td>
<td>communication</td>
</tr>
<tr>
<td>summation</td>
<td>$a.P + b.Q$</td>
<td>choice</td>
</tr>
<tr>
<td></td>
<td>$\sum \pi_i.P_i$</td>
<td></td>
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<tr>
<td>recursion</td>
<td>$P = {\ldots}.P$</td>
<td>repetition</td>
</tr>
<tr>
<td>replication</td>
<td>$!P$</td>
<td></td>
</tr>
<tr>
<td>composition</td>
<td>$P \mid Q$</td>
<td>concurrency</td>
</tr>
<tr>
<td>restriction</td>
<td>$(\nu x)P$</td>
<td>encapsulation</td>
</tr>
</tbody>
</table>
Ad Hoc Work

Customer
Process work

Case worker

Case worker

Case team

Customer

Expert
Sales as Chaos

Pursuit of all opportunities

Premature presentation of price

Miscommunication and information attenuation

“Team” decision-making

Customer confusion

Vanishing team members
Sales as Process

Preliminary business case development (strategic relevance, financial opportunity, competitive position)

Customer requirements analysis

Customer solution development

Finalize contract

Finalize strategy and present proposal
GE’s Evolution Towards Quality

Process are not new, but how best to manage them?

- Six Sigma Quality: The Road to Customer Impact
- Key Strategy Initiatives: QMI, NPI, OTR, SM, Productivity, Globalization
- Change Acceleration Process: Increase Success and Acceleration Change
- Process Improvement: Continuous Improvement, Reengineering
- Productivity/Best Practices: Looking Outside GE
- Work-Out/Town Meetings: Empowerment, Bureaucracy Busting

Intensity

High

1990 Time

Low

BPM
Things we do with processes

- Automational, eliminating human labor from a process
- Informational, capturing process information for purposes of understanding
- Sequential, changing process sequence, or enabling parallelism
- Tracking, closely monitoring process status and participants
- Analytical, improving analysis of information and decision-making across processes
- Geographical, coordinating processes across distances
- Integrative, consolidating and integrating sub-processes and tasks
- Intellectual, the process of capturing and distributing intellectual assets
- Disintermediating, eliminating intermediaries from a process
- Computational, performing calculations as part of a distributed process
- Collaborative, allowing participants to manage sets of shared work processes
- Compositional, building new processes from elementary reusable process patterns
Reengineering reengineering
Texas Instruments and the reengineering abyss

“Just one step back Jim and we can take the picture that tells the CEO we have finished the reengineering project }
From “As Is” lowest cost to “To Be” time to market, the challenge for Texas Instruments in the era of reengineering.
“If I were you, I’d raise a P24D”

P24D: Request for IT-Project Prioritization Review

Smug grin of corp IT

9 Months Later

It's not what I need now
It's not what I asked for then
A reengineering tale of woe
The Dilemma at the heart of the Value of IT debate

As Is Processes
“Open a check account”

Symptoms
There is too much paper
The cycle time is too long
We have dissatisfied customers
The process is too labour intensive

Problem
Replace As Is Processes with New To Be Processes

Traditional Solution
Reengineering/ERP
Systems Development
Time, Cost, Resource
Go Back To Jail Card for New processes

Solution
Integrate existing systems
Automate existing tasks
Provide a new user interface
Measure flows in tasks and activities
Escalate or re-direct tasks in exception cases
Organisational Change, Roles, Training

BPM
IT: What are you doing?

BUSINESS: Modeling the business processes we need?

IT: Why are you doing that? Just specify the user interface and we’ll take care of the rest. No need for you to get involved in these details.

BUSINESS: But this is the first time we have been able to express requirements so they won’t get distorted when implemented.

IT: It won’t work, we cannot be responsible for the model you are creating, we will need to translate it into our architecture.

BUSINESS: In that case, goodbye.
Example processes

• Disaster/Insurance claim
• Life history/Health record
• Logistics/Lost parcel
• Support/Trouble ticket
• Goal/Project
• Emergency response/Incident
• Customer/Service request
• Procurement/Order
• Management/Initiative
• Farm animal certification/Tag
• Provisioning/Service
• On-boarding/Employee
• Publishing/Book
• Change Mgt/Change request
• Public health/Campaign
• Criminal/Case file
The BPMS
The Next Fifty Years?
Process can be separated

Evolution of data centric applications
- Early: Embedded data, Proprietary schema
- Innovator: Embedded data management, Proprietary schema
- Mature: Separate database, Standard data schema

Evolution of process centric applications
- Early: Embedded processes, Proprietary schema
- Innovator: Embedded process management, Proprietary schema
- Mature: Separate process management, Standard process schema
From packaged processes to packaged process management

Sales Campaign Management

Aerospace Industry

Chemicals Industry

Fashion Industry

Paint to Distributors

Bulk chemicals To wholesalers

Pesticides to farmers

Customer A

Customer B

Customer Segment X

Process Improvement Lifecycle

Design the campaign

Deploy the campaign

Execute the campaign

Measure the campaign

Customize the campaign

Optimize the campaign

Sales Campaign Management
## Trends in enterprise applications

<table>
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<tr>
<th>Applications</th>
<th>MRP</th>
<th>ERP, CRM, SCM …</th>
<th>BPM, BPO, BPU …</th>
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<td>Mainframe</td>
<td>Midrange + Unix</td>
<td>Web services</td>
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<td>Language</td>
<td>DL/1</td>
<td>SQL</td>
<td>BPEL, BPQL</td>
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<td>Sharing</td>
<td>Hierarchical data</td>
<td>Relational data</td>
<td>Process data</td>
</tr>
<tr>
<td>System</td>
<td>HDBMS</td>
<td>RDBMS</td>
<td>BPMS</td>
</tr>
</tbody>
</table>
Typical BPMS Stack

**Business Driver**
- Fast and responsive service

**Supply Chain Strategy**
- Production improvement
- Transportation improvement
- Logistics improvement
- Demand improvement

**Tools For Business**
- Plan-to-produce
- Trigger-to-Replenishment
- Order-to-Cash
- Demand-to-Fulfil
- Build-to-Order

**Business Process Management System**
- “As Is” Business Processes
  - Enterprise resource planning
  - Warehouse, Manufacturing
  - Supply chain software
  - Financials
  - Computer Network

**Existing Business Infrastructure**

**Lifecycle**
- Process discovery
- Process design
- Process deployment
- Process execution
- Process operations
- Process analysis
- Process optimization

**Business Process “To Be”**
- Order-to-Cash
- Demand-to-Fulfil
- Build-to-Order

**End to end**
Innovating Processes: P-TRIZ
Do you have problems?

**Known Problems**
you must solve and for which you have no known solution

**Unknown Problems**
preventing progress that must be revealed, and subsequently solved

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New concepts

Mind

Barriers, obstacles, contradictions, inertia

Research ... Development ... Operations ... Marketing ... Sales ... Distribution

Business coming in

Market
What Innovation Is

Innovation is the reliable business process by which firms create significant value from all sources of creativity and knowledge.
Stuff can be …

Products  Services  Solutions  Processes  Organizations  Ideas

Stuff → Improved Stuff
To improve stuff, we must decompose

Stuff
Everything is useful and harmful

Personal transport

Freedom of movement

Pollution

Useful

Harmful

Is it useful or harmful
Decomposition opens pathways to improvement

---

**Example 1**
Replace the system with a new system that does not exhibit the harmful function

---

**Example 2**
Find a way to eliminate or reduce the harmful function

---

**Example 3**
Add a compensating function to limit the impact of the harmful function
More examples of innovation

**Example 4**
Compensate a harmful side effect to break a chain of harmful knock on effects

**Example 5**
Amplify the useful output, to the extent that the harmful function becomes insignificant
Modeling processes for innovation (P-TRIZ)

All processes have costs

Harmful functions have useful functions

Functions are added to systems to counteract harm

Harmful side effects counteract primary objectives
We can automate the generation of solution pathways

1. Find an alternative way to obtain [the] (Personal transport) that offers the following: provides or enhances [the] (Freedom of movement), does not cause [the] (Pollution).

2. Try to resolve the following contradiction: The useful factor [the] (Personal transport) should be in place in order to provide or enhance [the] (Freedom of movement), and should not exist in order to avoid [the] (Pollution).

3. Find a way to eliminate, reduce, or prevent [the] (Pollution) under the conditions of [the] (Personal transport).

4. Find an alternative way to obtain [the] (Freedom of movement) that does not require [the] (Personal transport).

5. Consider replacing the entire system with an alternative one that will provide [the] (Freedom of movement).
Systematic process opens exhaustive solution options

3.1. Find a way to benefit from [the] (Pollution).

3.2. Try to cope with [the] (Pollution).

3.3. Consider ways to compensate for the harmful results of [the] (Pollution).

3.4. Consider creating a situation that makes [the] (Pollution) insignificant or unimportant.

5.1. Consider transition to the next generation of the system that provides [the] (Freedom of movement), but which will not have the existing problem.

5.2. Consider enhancing the current means by which the primary useful function is achieved, to the extent that the benefits will override the primary problem.
P-TRIZ formulation

1. Find an alternative way to obtain [the] (Process) that offers the following: provides or enhances [the] (Output), does not cause [the] (Cost).
2. Try to resolve the following contradiction: The useful factor [the] (Process) should be in place in order to provide or enhance [the] (Output), and should not exist in order to avoid [the] (Cost).
3. Find an alternative way to obtain [the] (Output) that does not require [the] (Process).
4. Consider replacing the entire system with an alternative one that will provide [the] (Output).
5. Find a way to eliminate, reduce, or prevent [the] (Cost) under the conditions of [the] (Process).
P-TRIZ exposes abstract process patterns

1. Find an alternative way to obtain [the] (Function) that offers the following: provides or enhances [the] (Outputs), does not cause [the] (Problem), does not require [the] (Inputs).

2. Try to resolve the following contradiction: The useful factor [the] (Function) should be in place in order to provide or enhance [the] (Outputs), and should not exist in order to avoid [the] (Problem).

3. Find an alternative way to obtain [the] (Inputs) that provides or enhances [the] (Function).

4. Find an alternative way to obtain [the] (Outputs) that does not require [the] (Function).

5. Consider replacing the entire system with an alternative one that will provide [the] (Outputs).

6. Find a way to eliminate, reduce, or prevent [the] (Problem) in order to avoid [the] (Effect), under the conditions of [the] (Cause) and (Function).

7. Find a way to eliminate, reduce, or prevent [the] (Cause) in order to avoid [the] (Problem).

8. Find a way to eliminate, reduce, or prevent [the] (Effect) under the conditions of [the] (Problem).
To whom are things useful and harmful?

Customer
Supplier
Citizen
Government
Child

Useful or harmful?

To you
To me
Everything is useful and harmful from many perspectives

- Loss of rural environment: Harmful
- Freedom of movement: Useful
- Pollution: Harmful
- Oil profits: Useful
- Environmental damage: "?"
- High speed economy: Useful
Selected pathways create the innovation manifesto

1.3. Find a way to obtain [the] (Freedom of movement) without the use of [the] (Personal transport).

1.4. Find a way to decrease the ability of [the] (Personal transport) to cause [the] (Pollution).

3.2. Find a way to obtain [the] (Oil profits) without the use of [the] (Pollution).

3.3. Find a way to decrease the ability of [the] (Pollution) to cause [the] (Environmental damage).

5.3. Find a way to obtain [the] (High speed economy) without the use of [the] (Freedom of movement).

5.4. Find a way to decrease the ability of [the] (Freedom of movement) to cause [the] (Loss of rural environment).

8.1. Consider transition to the next generation of the system that provides [the] (High speed economy), but which will not have the existing problem.

8.2. Consider enhancing the current means by which the primary useful function is achieved, to the extent that the benefits will override the primary problem.

9.2. Try to cope with [the] (Loss of rural environment).

9.3. Consider ways to compensate for the harmful results of [the] (Loss of rural environment).

9.4. Consider creating a situation that makes [the] (Loss of rural environment) insignificant or unimportant.

10.2. Try to cope with [the] (Environmental damage).

10.3. Consider ways to compensate for the harmful results of [the] (Environmental damage).

10.4. Consider creating a situation that makes [the] (Environmental damage) insignificant or unimportant.

11.2. Find additional benefits from [the] (Oil profits).

12.1. Consider transition to the next generation of the system that provides [the] (Oil profits), but which will not have the existing problem.
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<th>Brand</th>
<th>Experience</th>
<th>Usability</th>
<th>Design</th>
<th>Technology</th>
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<td><img src="image" alt="Usability" /></td>
<td><img src="image" alt="Design" /></td>
<td><img src="image" alt="Technology" /></td>
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<tr>
<td>Performance</td>
<td><img src="image" alt="Performance" /></td>
<td><img src="image" alt="Function" /></td>
<td><img src="image" alt="Market" /></td>
<td><img src="image" alt="Business model" /></td>
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<tr>
<td>Manufacture</td>
<td><img src="image" alt="Manufacture" /></td>
<td><img src="image" alt="Delivery" /></td>
<td><img src="image" alt="Service" /></td>
<td><img src="image" alt="Support" /></td>
<td></td>
</tr>
</tbody>
</table>
To improve, we must decompose in many ways

Aspects
Perspectives

Functions

Useful
Harmful
Many models are needed – expect contradictions
The more cars the better?

2. Try to resolve the following contradiction: The useful factor [the] (Personal transport) should be in place in order to provide or enhance [the] (Freedom of movement), and should not exist in order to avoid [the] (Pollution).

“Air leaving the tailpipe could actually be cleaner than the air coming into the engine”

Every thing that exists, or is yet to exist, is attended by an inseparable companion ...
The innovation shadow-self

Innovation Models

Formulated Evolved Possibilities

Current Generation

Improvement

Next Generation
Our options expand as we add knowledge

Stuff

Innovation enriches intellectual property

Functions

Pathways

1 7
3 19
7 40
15 91
Innovation expands by asking questions, e.g.

**Does A really produce B directly?**

- A → B
- A → U → B

**What is harmful about A?**

- A → B
- A → H → B

**What direct consequence of A yields H?**

- A → H
- A → AH → H

**What specifically about A counteracts H?**

- A → H
- A → AU → H
Lateral thinking and systematic methods are complementary

Example technique:
Five Whys

```
<table>
<thead>
<tr>
<th>Cause</th>
<th>Effect</th>
</tr>
</thead>
<tbody>
<tr>
<td>Why?</td>
<td>?</td>
</tr>
<tr>
<td>Why?</td>
<td>?</td>
</tr>
<tr>
<td>Why?</td>
<td>?</td>
</tr>
</tbody>
</table>
```

Useful / harmful

Exhaustive solution pathways generated

Formulator expands intellectual property
An alignment of many models is required
The high level innovation process looks like this

Stuff → Innovation models → Innovation direction

"Magic happens"

Innovation pathways

Generations

Improved Stuff
We must improve everything always

- Engineering design
- Process design
- Organizational design
- Production design
- Operations design

Improvement, renewal, replacement
We can open existing intellectual property to innovation

Schematic, document, etc.

Innovation mark-up

Innovation model

Formulator

Innovation pathways
We can mark-up any artefact to create innovation

Inter-personal and inter-departmental relationships

Org chart innovation mark-up

3. Find a way to protect [the] (Direction) from the harmful influence of [the] (Mid Management).
   3.1. Try to compensate for the harmful influence of [the] (Mid Management) towards [the] (Direction).
   3.2. Try to reduce the sensitivity of [the] (Direction) to the harmful influence of [the] (Mid Management).
Processes can be analyzed for innovation

Swimlane process model

Useful data flow

Useful data processing

Useful activity

Harmful participant

Harmful activity

Data flow

Harmful state change

State flow

People, systems, machines

Etc.
… opening pathways to alternate process designs

“As Is” Process model → Innovation model → Reengineering options
P-TRIZ and BPMN
P-TRIZ can cope with fuzzy processes not amenable for formal process modeling

- Long program duration
- Mega Project
- Large program scope
- Long planning horizon
- Changes in market
- Difficult planning
- High risk
- High investment
- Detailed planning
- Frequent program reviews
- Frequent redirection of project
- Schedule slippage
- Added features
The innovator is a problem solver

- Resources few, Projects many
- Resources many, Projects few

Mind → Innovation Process → Market

Problem → Solution

Improved Stuff → Delivered Stuff

Technical feasibility … Market feasibility … Manufacturing feasibility … Delivery feasibility
Because we are talent limited, it’s all hands to the pump

Directed evolution

Stuff

Impossible problems

Potential Stuff

Problem solving

Delivered Stuff

Employee creativity

Employee knowledge

Raw ideas

Idea Development

Validated ideas

Solution concepts

New ideas

Challenge – Capture – Develop - Exploit
The roots of systematic innovation should be acknowledged

• Genrich Saulovich Altshuller
  • Father of TRIZ
  • Controlling and predicting innovation
  • 15 October 1926 – 24 September 1998

• Boris Zlotin and Alla Zusman
  • TRIZ masters and inventive methodologists
  • Pioneering the foundations for the development of a modern TRIZ methodology
  • Ideation International
A fool with a tool is still a fool, and better tools are needed - leading to a convergence of innovation methods.

**Ideation’s ‘Knowledge Wizard’ – A basic TRIZ support tool**

Solution directions generated by the tool’s traversal of the model.

TRIZ model showing causal relationships between functions of the thing being improved.

Hypertext of ‘TRIZ operators’ (solution patterns) with examples.
So innovation is more than just a good idea

- Stuff
- Innovation
- Invention
- New stuff
- Mind
- e.g. Technical feasibility
- Market feasibility
- Manufacturing feasibility
- Delivery feasibility
- Innovation
- New product/service introduction
- Development
- Commercialization
- Market
Remember… stuff can be:

Products  Services  Solutions  Processes  Organizations  Ideas

Stuff → Improved Stuff
So what’s this “magic happens” stuff?

Impossible problems

Problem mark-up

Solution pathways

Problem pathways

Solution mark-up

Unlikely solutions

Combinatorial innovation
The same models can describe solutions leading to problem-finding pathways

**Solution**
Hydrogen Combustion

**Problem**
Petrol Combustion

1. Find a problem that if resolved would counteract the (Oil Industry Profits) and (Environmental damage) and which exists for the production of (Freedom of Movement)
The next generation of knowledge management for innovation
http://howardsmith.editme.com

The Innovator Is A Problem Solver

Do You Have Problems?
A modern TRIZ Overview

What Innovation Is

White paper
38 pages

P-TRIZ Formulation

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