The TOC Thinking Processes
Basics Workshop

Presented By: Professor Vicky Mabin, Victoria Business School, Wellington, New Zealand
Date: 4 June 2013
Focus of this Session

Objectives:

• Understand the nature of TOC’s Thinking Processes
  – Quick introduction to the Thinking Processes
  – How to read and understand the TP tools

• Appreciate the role the TP tools play in managing change
Coverage

• Managing change
  • Key questions for successful change
• TOC’s Thinking Process Tools
  • Logic basics
  • The TP Tools
  • Examples
  • How they all fit together
• Harnessing resistance to change
Managing change the TOC way

• TOC is ‘common sense’ ... but not commonly applied
  – Solutions often seem obvious in hindsight

• Keys to success
  – Focus on the constraint!
  – Use the right measures …
  – Understand relationships in the system
    – Re-examine policies, procedures
    – involve people, understand behaviours
    – Consider wider context

Capturing the whole, while focusing on the important parts

But how can we do this reliably?

Theory without practice is empty; practice without theory is blind.

Immanuel Kant
Managing Change – 3 Key Questions

Any improvement is a change, but not every change is an improvement.
Eliyahu M. Goldratt

Three key questions in any improvement process:

1. What to change?
2. What to change to?
3. How to cause that change?

The Expanded Change Questions

1. Why Change?
   - IO Map (Dettmer’s version)
   - List of Undesirable Effects

2. What to Change?
   - Current Reality Tree
   - Evaporating Cloud

3. What to Change to?
   - Evaporating Cloud
   - Future Reality Tree
   - Negative Branch Reservation

4. How to cause the change?
   - Prerequisite Tree / IO Map
   - Transition Tree
   - Strategy & Tactics Tree

5. How to sustain the change?
   - Using the right measures;
   - Repeat?
Two Types of Logic

Necessity-based logic

“In order to achieve A, B must be true.”

In order to reach our goal, certain factors need to be met.

Used in: Evaporating Cloud, Prerequisite Tree and the IO Map

Sufficiency-based logic

“If X and Y, then Z.”

X and Y together are sufficient or enough to cause Z.

Used in: Current and Future Reality Trees, Negative Branch, and Transition Trees
Necessity Logic

A
In order to ...

B...
we must...

A
Pass the test on Monday

B
Spend the weekend studying

A
Make money now and in the future

B
Focus on increasing throughput
Read (from bottom up): If [1], then [2].

1. The order is shipped late.
   - Wages are low.

2. The customer gets the order late.
   - Staff turnover is high.

Example adapted from: Cox, Blackstone & Schleier, Managing Operations: A focus on excellence, p82.
Sufficiency Logic – building the branch

IF

1. The order is shipped late.

THEN

2. The customer gets the order late.

BECAUSE

3. Our policy is to never use premium freight.

Our policy is to never use premium freight. The order is shipped late. The customer gets the order late.
Our policy is to never use premium freight if and only if the order is shipped late, then the customer gets the order late.
The order is shipped late. 

Our policy is to never use premium freight. 

The customer gets the order late.
Sufficiency Logic – changing

1. The order is shipped late.

2. The customer gets the order on time

IF AND

Inj. Use premium freight for important customers
Categories of Legitimate Reservation (CLR’s)

Using the CLR’s, objections can be expressed in an effective and constructive way:

Level I: Clarity reservation  Are the statements clear?

Level II: Entity existence  Do the entities exist?

  Causality existence reservations Is the cause and effect relationship plausible?

Level III: Cause insufficiency  Are the causes sufficient to cause the effect?

  Additional cause Is there some other cause adding to the effect?

  Predicted effect If the cause is true, then what else would you expect to see?

  Cause-effect reversal Are the cause and effect the right way around?

  Tautology reservations Are the cause and effect just stating the same thing?

Source:  Cox, Boyd, Sullivan, Reid, Cartier, 2012. TOCICO Dictionary,  2nd Edn, p27

Lastly, check the ‘big picture’

Seek first to understand before seeking to be understood.  (Proverbs 18)
The Thinking Process Tools - Overview

The TOC Thinking Process

- Strategy & Tactics Tree (SnT / S&T)
- Intermediate Objectives Map (IO Map)
- Current Reality Tree (CRT)
- Prerequisite Tree (PRT)
- Transition Tree (TT / TrT)
- Evaporating Cloud (EC / CRD)
- Future Reality Tree (FRT)
- Negative Branch Reservation (NBR)

Goal

CSF
CSF
CSF
NC
NC
NC
NC

Inj.

1
2.1
2.2
3.1.1
3.1.2
3.2.1
3.2.2
4.11.1
4.11.2
4.22.1
4.22.2
5.112.1
5.112.2
5.112.3
5.112.4

Action

Need

Obs. 10.
IO 10
Obs. 6
Obs. 3
IO 3
Obs. 4
IO 4
Obs. 9
IO 9

Target

B

C

D

D'

Inj.
The IO-Map (Dettmer’s version)

Intermediate Objectives Map (IO Map)

Current Reality Tree (CRT)

Evaporating Cloud (EC / CRD)

Negative Branch Reservation (NBR)

Future Reality Tree (FRT)

The TOC Thinking Processes

Goal
Make money now and in the future

CSF
Maximum revenues

CSF
Optimized Cost

CSF
High return on investment

NC
Sales equal prod. capacity

NC
Sufficient production capacity

NC
Efficient production operations

NC
Optimized Overhead

NC
Optimized inventory management

NC
Effective capital investment

CSF = Critical Success Factor
NC = Necessary Condition


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The Current Reality Tree

- Analyse the current situation full of UnDesired Effects (UDE’s) using cause and effect (sufficiency logic)
- Diagnose the root cause(s)
- Explain how the root cause leads to the current undesirable situation

*If we dive deep enough we’ll find that there are very few elements at the base, the root causes, which through cause-and-effect connections are governing the whole system. The result of systematically applying the question 'why?' is not enormous complexity, but rather wonderful simplicity.*

Eliyahu M. Goldratt, *The Choice*
Complexity vs Simplicity

Which system is easier to manage?

System A

System B

Source: Goldratt, The Choice, p 40
• Connect UDE’s using cause-effect relationships until all are connected

• Keep building down until you have identified the ‘core problem’

• Read bottom up, using If … and… then …

• Check and correct using CLR’s

A small CRT

4 Pillars of TOC

Inherent Simplicity
Every Conflict Can Be Removed
People Are Good Always A Win-Win
Every Situation Can Be Substantially Improved

Source: Goldratt Consulting
The Evaporating Cloud (EC)

1. Frame the problem taking both sides into account
2. Surface assumptions
3. Challenge assumptions till win-win solution is found

We can't solve problems by using the same kind of thinking we used when we created them.

If you can't explain it simply, you don't understand it well enough.

Note: Some authors use the term Conflict Resolution Diagram (CRD)
EC – A Business Example

G-Roy Hotel

Common Objective

A
Business that yields high profits

Needs or requirements

B
Maintain high level of customer satisfaction

D
Maintain excess capacity on all resources

D’
Do not maintain excess capacity

Customer service focus

Maintain high level of customer satisfaction

Cost focus

Ensure low costs structure

... because demand varies a lot and customers expect services to cope with peak demands.

EC – A Personal Story

A good start to the day

B
Get exercise

Vicky’s side

Emily’s side

D’
Go by car

Don’t walk up the hill

How could we get B and D’ at the same time?
Better still... Our way!

A  A good start to the day

B  Get exercise

C  Don’t walk up the hill

D  Walk to school

Vicky’s side

Emily’s side

How could we get C and D at the same time?

A good start to the day

A

Get exercise

Don’t walk up the hill

Walk to school

Better still... Our way!
The 3-cloud process

Generic Evaporating Cloud

- The hospital must B Provide best treatment outcomes for patients.
- The hospital must C Operate within its resources.
- Management must D' Allocate all resources.
- Doctors must D Be able to demand how resources are allocated.

UDE: The Hospital does not consistently deliver best quality care.

Individual Evaporating Clouds

- Clinicians must B Have 100% accurate patient information.
- Managers must C Have new EHR on time & within budget.
- Doctors must D Schedule appointments.
- Nurses are D' Well trained and work within resources.
- Pharmacy staff must be D' Rostered in medicines information.

UDE: clinicians do not support new verification system.

- The Hospital must A Operate efficiently & provide quality patient care.
- The Hospital must A Deliver the best treatment for patients.
- The Hospital must A Provide timely and excellent service to all patients.
- The Hospital must C Provide best quality care.

The hospital must D Make treatment decisions that exceed contract volumes.

- Managers want to D' Adopt new method of data verification in new EHR.
- Managers want to D Made treatment decisions that exceed contract volumes.
- Nurses must D' Only provide treatment within contract volumes.
- Nurses must C Have job satisfaction.
- Pharmacy staff must be D' Rostered in medicines information.

Hospital pharmacy must A Provide timely and excellent service to all patients.

UDE: bottlenecks in pharmacy production, high workloads causing staff dissatisfaction

Source: Mabin, Babington, Caldwell, Yee, Moore, 2011. Change is good as a rest. DSI, Boston.
• Show how the Injection leads to the desired effects (DE’s)
• Incorporate extra injections as needed to ensure that all effects at top are DE’s
• Whenever you encounter “Yes, but …”, use the Negative Branch Reservation tool to prevent possible negative effects (every NBR improves the FRT!)
The Negative Branch

- **Anticipating and preventing unintended negative consequences of a proposed action:**
- **Example:** in response to a problem of low staff morale, we decide to pay our staff more, but we’re concerned that our profits will be reduced. 😞

The NBR is used to fill in the missing logic and identify where to stop the negative effects from occurring.
Negative Branch – an example

When details are missing, Shipping needs to contact the customer for delivery details

Adapted from: Cohen, 2010, Daily Management with TOC, Ch 24, TOC Handbook, p718
The Negative Branch - uses

Use the Negative Branch for:

- Checking and improving injections from the Evaporating Cloud (EC)
- Improving half-baked ideas
- Giving/receiving criticism creatively and constructively
- Dealing with chronic conflict – use in conjunction with the EC.
The Prerequisite Tree

1. **State the target clearly** - something that looks hard to achieve (often an injection)

2. **List all Obstacles**

   - O1
   - O2
   - O3
   - O4
   - O5
   - O6
   - O7

3. **Next list Intermediate Objectives (IO’s)**

   - IO1
   - IO2
   - IO3
   - IO4
   - IO5
   - IO6
   - IO7

4. Lastly, place all Intermediate Objectives in time/precedence order, starting from the bottom, using “We must do [lower IO X] in order to get over {obstacle X}, before we can achieve [upper IO Y]”. 

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### The Prerequisite Tree - Example

**Target:** Make good use of the TOC TP tools at work

<table>
<thead>
<tr>
<th>Obstacles</th>
<th>Intermediate Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Competing demands for my time</td>
<td>1. Set specific time aside to work on it.</td>
</tr>
<tr>
<td>2. Work has piled up while on the course.</td>
<td>2. Delegate.</td>
</tr>
<tr>
<td>3. My colleagues are sceptical.</td>
<td>3. Apply to small scale situation.</td>
</tr>
<tr>
<td>4. I’m not practised at using the tools.</td>
<td>4. Practise in my own time eg movies.</td>
</tr>
<tr>
<td>5. I’ll forget the tools.</td>
<td>5. Summarise the tools and stick it up. Quick reference guide.</td>
</tr>
<tr>
<td>6. Work politics will stop me from applying them.</td>
<td>6. Use the tools to analyse problems to get around office politics.</td>
</tr>
<tr>
<td>7. I have little influence in my job position.</td>
<td>7. Make them think it’s their idea.</td>
</tr>
<tr>
<td>8. Inertia.</td>
<td>8. Take the first step. Get started. Just do it!</td>
</tr>
<tr>
<td>9. There are a lot of tools ... which tool do I use when?</td>
<td>9. Review the material and select. Don’t worry if not the right one – just use another tool as well.</td>
</tr>
<tr>
<td>10. I’ve got limited skills and resources.</td>
<td>10. Develop a robust business plan detailing resources and present it to my boss.</td>
</tr>
<tr>
<td>11. I’m scared I might not get it right.</td>
<td>11. Educate others about priorities.</td>
</tr>
</tbody>
</table>

The Prerequisite Tree - Example

Target: Make good use of the TOC TP tools when I go back to work.

- IO 2: Delegate.
  - Obs 8: Inertia.
  - Obs 12. Our traditional ways are ingrained.

- IO 3. Apply to small scale situation.
  - Obs 2. Work has piled up while I'm on the course.
  - Obs 4. I'm not practised at using the tools.

- IO 4. Practise in my own time, at home.
  - Obs 5. I'll forget the tools.
  - Obs 9. There are a lot of tools ... which to use?

- IO 5. Summarise the tools, Create a quick reference guide. Stick it up.
  - Obs 6. Work politics will stop me from applying them.
  - Obs 7. I have little influence in my job position.

- IO 6. Use the tools to analyse problems to get around office politics.
  - Obs 1. I've got limited skills and resources.
  - Obs 3. My colleagues are sceptical.

- IO 7. Make them think it's their idea.
  - Obs 10. I've got limited skills and resources.

- IO 8. Take the first step. Get started. Just do it!
  - Obs 11. I'm scared I might not get it right.

- IO 9. Review the material and select. Don't worry if not the right one – just use another tool as well.
  - Obs 12. Our traditional ways are ingrained.

- IO 10. Develop a robust business plan detailing resources and present it to my boss.
  - Obs 1. I've got limited skills and resources.
  - Obs 3. My colleagues are sceptical.

- IO 11. Educate others about priorities.
  - Obs 12. Our traditional ways are ingrained.

  - Obs 2. Work has piled up while I'm on the course.
  - Obs 4. I'm not practised at using the tools.

- IO: Make good use of the TOC TP tools when I go back to work.
The Transition Tree

- Uses:
  - Planning how to cause the change, by using knowledge of how people are likely to behave.
  - Detailed action plan
  - Preparing transformational speeches
  - In change projects: often omitted in favour of project plan or Strategy & Tactics Tree
How they all fit together

TP Roadmap

What to Change?
Identifying the Problem

Analysis

1. Three-Cloud Process:
What core conflict is responsible for the UDEs?

2. Current Reality Tree:
Is the core conflict really the core conflict?

3. Evaporating Cloud:
What assumption(s) are we going to challenge?

How to Cause a Change?
Designing the Implementation

Tactics

4. Future Reality Tree:
Ensures that the starting injection will lead to all the DEs without creating negative branches.

5. PreRequisite Tree: In what order do we implement the T.O.s and what blocks their implementation?

6. Transition Trees: What actions must we take to implement the PreRequisite Tree?

To What to Change?
Constructing the Solution

Strategy
The Strategy & Tactics Tree

- S&T Tree sums up TP analysis
- Combines both logics

<table>
<thead>
<tr>
<th>Step ##</th>
<th>Necessary Assumptions</th>
<th>Strategy</th>
<th>Parallel Assumption</th>
<th>Tactic</th>
<th>Sufficiency Assumption</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“Why” this Strategy/Tactic pair (step) is needed to achieve the step in the level above</td>
<td>The purpose of the initiative (“what for”)</td>
<td>The “why” of the tactic, the conditions in reality leading us to choose this way to achieve the strategy</td>
<td>The “how” – what needs to be done to achieve strategy</td>
<td>The “why” of the next level below; explains why a next level is necessary</td>
</tr>
</tbody>
</table>

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- Negative Branch Reservation (NBR)
- Transition Tree (TT / TrT)

- Goal
- CSF
- NC

Event 1

- 2.1
- 2.2
- 3.1.1
- 3.1.2
- 3.2.1
- 3.2.2
- 4.11.1
- 4.11.2
- 4.22.1
- 4.22.2
- 5.112.1
- 5.112.2
- 5.112.3
- 5.112.4

Event Triangle:

- B
- A
- C
- D
- D'

Transition Tree:

- Obs 10
- IO 10
- Obs 3
- IO 3
- Obs 4
- IO 4
- Obs 9
- IO 9
- Obs 6
- IO 6
- Obs 7
<table>
<thead>
<tr>
<th>Tool</th>
<th>Nec</th>
<th>Suff</th>
<th>Question</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intermediate Objectives Map</td>
<td>x</td>
<td></td>
<td>Why change?</td>
</tr>
<tr>
<td>Current Reality Tree</td>
<td></td>
<td>x</td>
<td>What to change?</td>
</tr>
<tr>
<td>Evaporating Cloud(s)</td>
<td>x</td>
<td></td>
<td>What to change?</td>
</tr>
<tr>
<td>Future Reality Tree</td>
<td></td>
<td>x</td>
<td>What to change to?</td>
</tr>
<tr>
<td>Negative Branch Reservation</td>
<td>x</td>
<td></td>
<td>How to make the change</td>
</tr>
<tr>
<td>Prerequisite Tree</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Transition Tree</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Strategy and Tactics Tree</td>
<td>x</td>
<td>x</td>
<td></td>
</tr>
</tbody>
</table>

*Nec = Necessity logic; Suff = Sufficiency logic*
Quiz – What do you remember?

1. Which TP tool is used to resolve a conflict?
2. Where do you find and-connectors (bananas)?
3. How do you read a Current Reality Tree?
4. Where do you start when presenting a cloud?
5. How do you read necessity logic?
6. How do you recognise necessity logic?
Managing Change, Harnessing Resistance

• So many factors are needed when planning and carrying out major strategic change:
  − big picture with clarity on goals
  − logical and compelling argument …
  − communicated well
  − develop trust and teamwork
  − excellent leadership

• But how do you achieve all this?

• TOC Thinking Processes provide the roadmap for change in a way that harnesses resistance

Layers of Resistance

0. There is no problem (CRT)
1. Disagreement on the problem (CRT)
2. The Problem is out of my control (Core Conflict Cloud)
3. Disagreement on the direction of the solution (FRT)
4. Disagreement on the details of the solution (NBR)
5. Yes but… the solution has negative ramifications (PRT, S&T)
6. Yes but… we can’t implement the solution (TRT)
7. Disagreement on the details of the implementation
8. You know the solution holds risks
9. “I don’t think so” – Social and psychological barriers

Weary Will’s Dilemma: To change or not to change?

Source: Efrat Goldratt, 2010. The Layers of Resistance – the buy-in process according to TOC, TOC Handbook, Ch 20, p575; Cox, Boyd, Sullivan, Reid, Cartier, 2012. TOCICO Dictionary 2nd Edn, p 116. For an animated explanation, see http://m.youtube.com/#/watch?v=hcZ1aZ60k7w&desktop_uri=%2Fwatch%3Fv%3DhcZ1aZ60k7w
### To change or not to change?

<table>
<thead>
<tr>
<th>Change</th>
<th>Don’t change</th>
</tr>
</thead>
<tbody>
<tr>
<td>‘Pot of gold’</td>
<td>‘Mermaid’</td>
</tr>
<tr>
<td>‘Broken legs’</td>
<td>‘Crocodiles’</td>
</tr>
</tbody>
</table>

Sources: Efrat Goldratt, 2010. The Layers of Resistance – the buy-in process according to TOC, TOC Handbook, Ch 20, p575; Cox, Boyd, Sullivan, Reid, Cartier, 2012. TOCICO Dictionary 2nd Edn, p 116; Ferguson, 2010. TOC Handbook, Ch 34. [http://m.youtube.com/#/watch?v=hcz1aZ60k7w&desktop&feature=share](http://m.youtube.com/#/watch?v=hcz1aZ60k7w&desktop&feature=share) for an animated explanation

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Buy-in processes

Minus-Minus

1. Agree on the problem.
2. Agree on the direction for the solution.
3. Agree on the solution details.
4. Agree that the potential negative consequences of the solution can be prevented.
5. Agree that the obstacles to implementing the solution can be overcome.
6. Overcome unverbalized fears.

Plus

1. Agree on the very ambitious objective we desire to reach – a pot of gold.
2. Agree that reaching the pot of gold at the top of the cliff is much more difficult than we originally thought (the cliff is very high and steep).
3. Agree that there is a direction for the solution, an anchor on the cliff against which a ladder can be leaned.
4. Agree on the solution details (the rungs of the ladder).
5. Overcome unverbalized fears, such as the potential NBRs of success (how not to break your legs climbing the ladder).
Conclusions

TOC’s Thinking Processes:

Quick introduction to help you read, understand and appreciate the TOC Thinking Process tools to lead change:

• Key questions for successful change
• Logic used in the Thinking Processes
• TP Tools Overview
• Examples of each tool
• How they all fit together
• Harnessing resistance to change
Reading Recommendations

- Ferguson (2010). **Applications of Strategy and Tactics Trees in Organizations**, TOC Handbook Ch. 34.
<table>
<thead>
<tr>
<th>English</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>Categories of Legitimate Reservation (CLR)</td>
<td>Kategorien Legitimer Vorbehalte</td>
</tr>
<tr>
<td>Current Reality Tree (CRT)</td>
<td>Gegenwartsbaum</td>
</tr>
<tr>
<td>Evaporating Cloud, Conflict Resolution Diagram (EC, CRD)</td>
<td>Wolke, Konfliktlösungsdiagramm</td>
</tr>
<tr>
<td>Future Reality Tree (FRT)</td>
<td>Zukunftsbau</td>
</tr>
<tr>
<td>Injection</td>
<td>Injection, Lösungsidee</td>
</tr>
<tr>
<td>Intermediate Objectives Map (IO-Map)</td>
<td>IO-Map, Zielebaum</td>
</tr>
<tr>
<td>Layers of Resistance</td>
<td>Ebenen des Widerstandes (gegen Veränderung)</td>
</tr>
<tr>
<td>Necessary condition / Necessity Logic</td>
<td>Notwendige Bedingung / Voraussetzungslogik</td>
</tr>
<tr>
<td>Negative Branch Reservation (NBR)</td>
<td>Negativer Zweig</td>
</tr>
<tr>
<td>Prerequisite Tree (PRT)</td>
<td>Voraussetzungsbau</td>
</tr>
<tr>
<td>Root cause</td>
<td>Kernursache, Wurzelursache</td>
</tr>
<tr>
<td>Strategy &amp; Tactics Tree (S&amp;T)</td>
<td>Strategie&amp;Taktik-Baum</td>
</tr>
<tr>
<td>Sufficient cause / Sufficiency Logic</td>
<td>Hinreichende Ursache / Kausalitätslogik</td>
</tr>
<tr>
<td>Thinking Process (TP)</td>
<td>Denkprozesse / Denkwerkzeuge</td>
</tr>
<tr>
<td>Transition Tree (TT / TrT)</td>
<td>Umsetzungsbau</td>
</tr>
<tr>
<td>UDE (&quot;oodee&quot;, UnDesirable Effect)</td>
<td>Unerwünschter Effekt, Negativer Effekt</td>
</tr>
</tbody>
</table>
I smile and start to count on my fingers.

“One, people are good.

Two, every conflict can be removed.

Three, every situation, no matter how complex it initially looks, is exceedingly simple.

Four, every situation can be substantially improved; even the sky is not the limit.

Five, every person can reach a full life.

Six, there is always a win-win solution.

Shall I continue to count?”

Dr Vicky Mabin is Professor in Management, Victoria Business School, Victoria University of Wellington, New Zealand, and Associate Dean (Teaching and Learning) since 2008. Prior to 1991, she worked as an OR scientist and consultant for the NZ government and led the first application of OPT (TOC) in NZ with Expozay International in 1986.

She has published widely on TOC including "The World of the Theory of Constraints: A review of the international literature" (2000), the lead chapter on the TP in the “Theory of Constraints Handbook” (2010), and dozens of journal articles, book chapters, and presentations on TOC.

She holds PhD in Operational Research, University of Lancaster, UK; TOCICO certification in 3 areas, and the academic Jonah qualification in TOC; is a Fellow of the Operational Research Society (UK); past president of the Operational Research Society of New Zealand; and past Chairperson of the Wellington Chapter of the NZPICS. She has served on the examinations board for TOCICO, and as an editor for the Decision Sciences Journal of Innovative Education, and International Transactions in Operational Research.

Hannah Nowak helped create this presentation, and will present the German version.