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AN SSM-TRIZ METHODOLOGY FOR BUSINESS PROBLEM STRUCTURING

Authors: Ibukun Phillips & C. Robert Kenley

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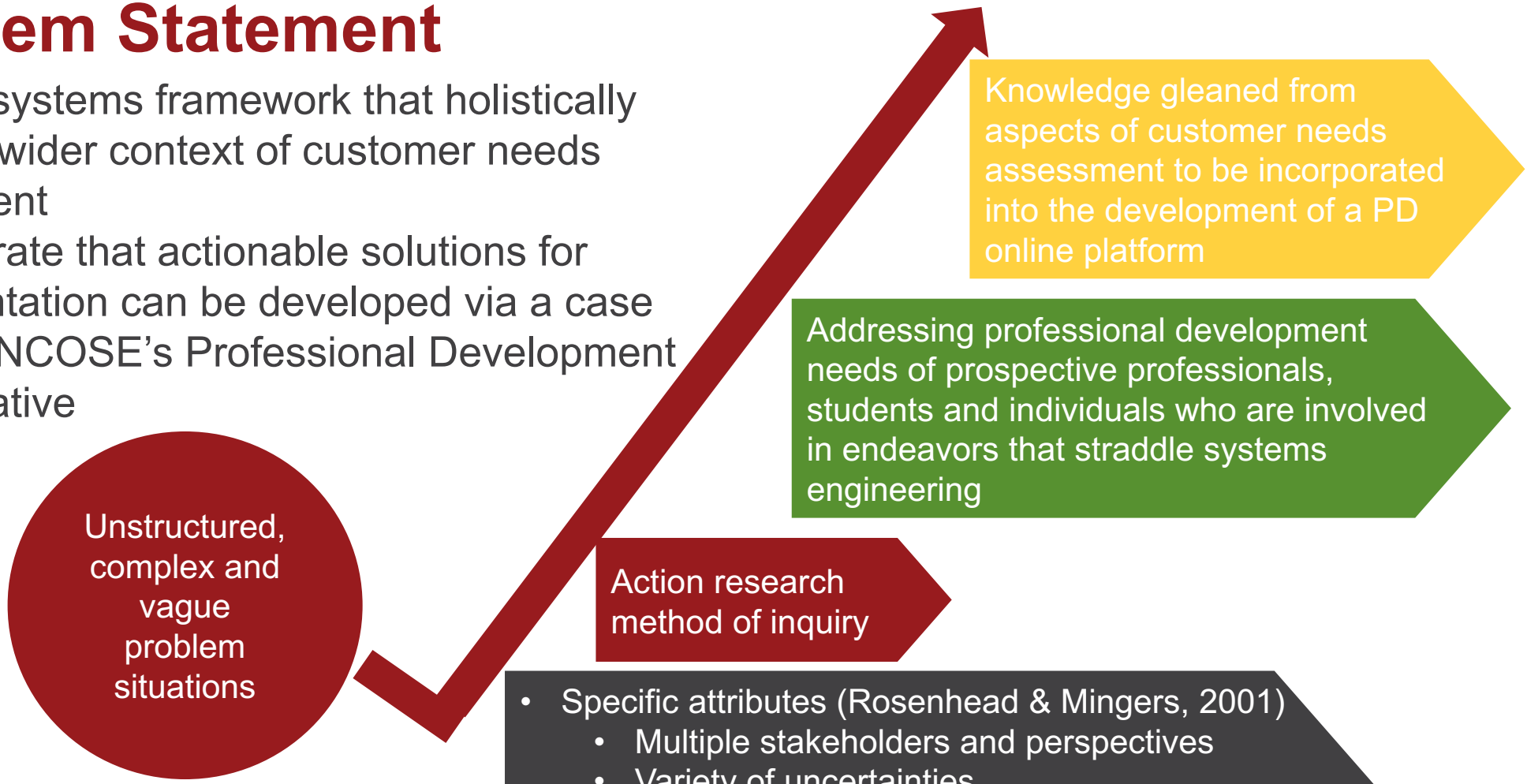
Presentation Outline

- Problem statement and research purpose
- Overview of relevant PSMs
- Strengths and weaknesses of SSM & TRIZ: opportunities for synergy
- The SSM-TRIZ methodology
- Case study: A professional development initiative for INCOSE
- Stages of methodology application in case study
- Further Hard Approaches
- Conclusion and limitations

Problem Statement

Develop systems framework that holistically captures wider context of customer needs assessment

Demonstrate that actionable solutions for implementation can be developed via a case study of INCOSE's Professional Development (PD) Initiative



Research Purpose

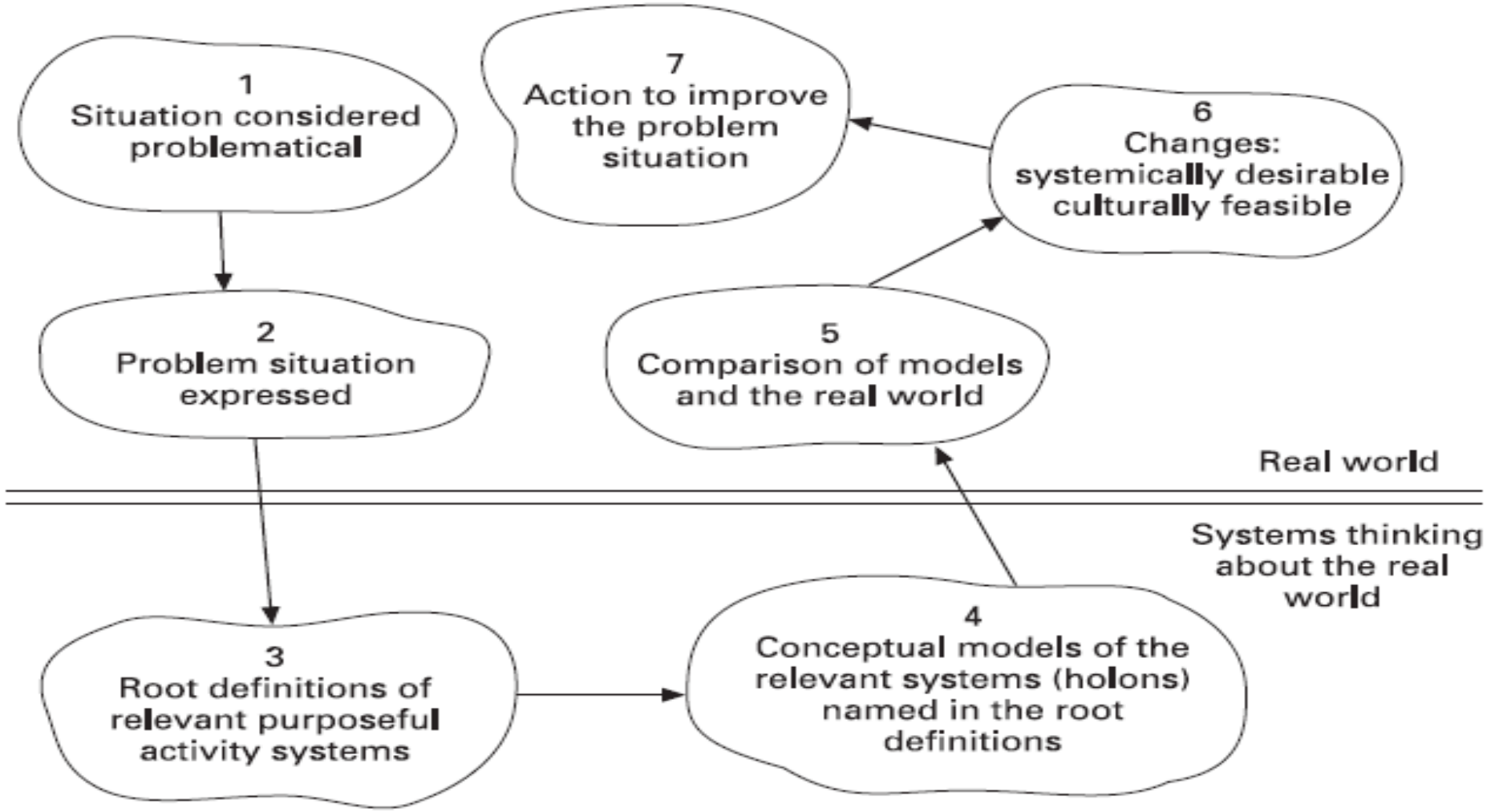
- Address situations with conflicting interests and perspectives
- Present a new methodology (SSM-TRIZ)
- Apply methodology to Professional Development case study.

Overview of relevant PSMs

Notable Problem Structuring Methods (Belton and Stewart 2010, p. 218 & J. Mingers 2011, p.733)

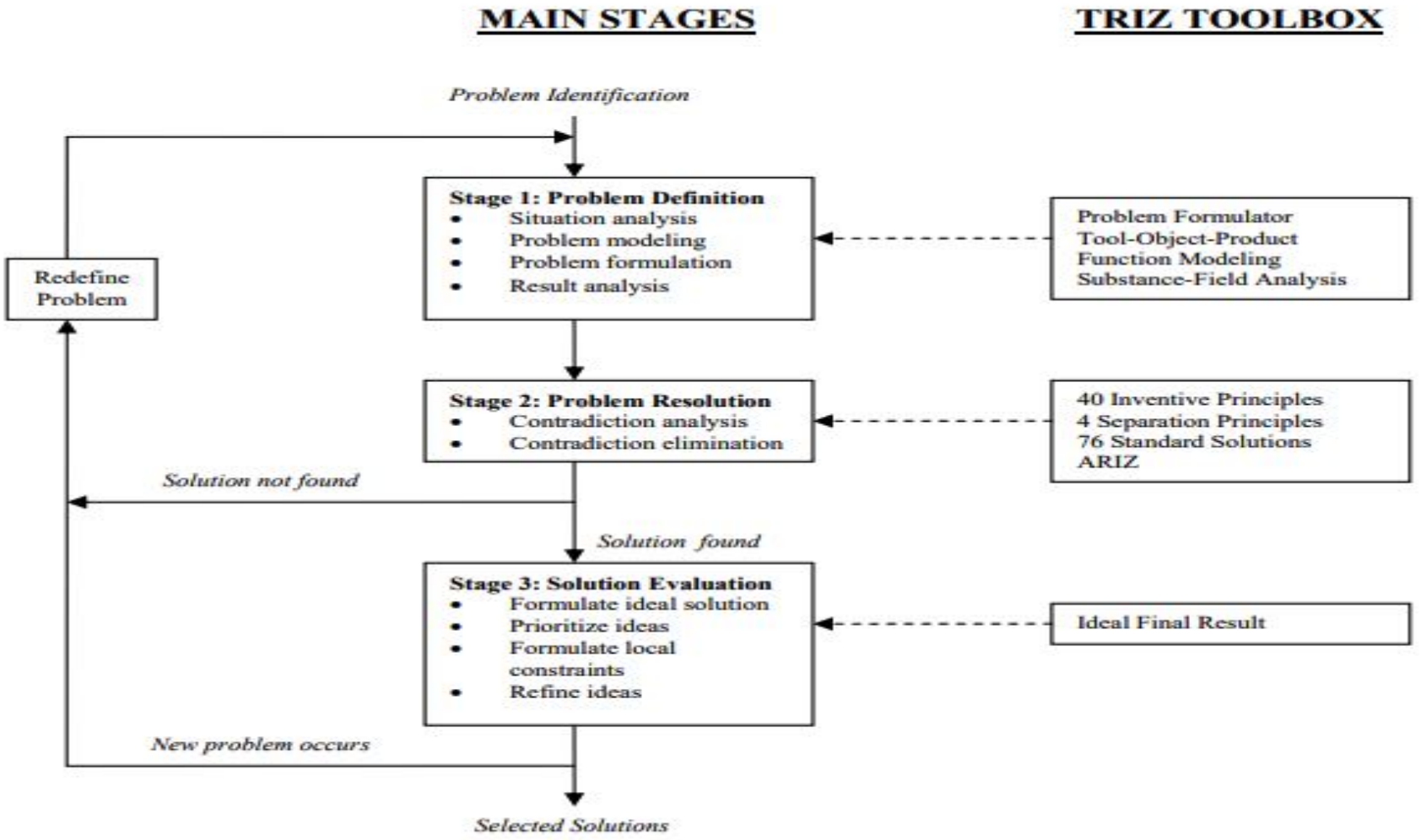
Method	Description	Theoretical Foundation
Soft Systems Methodology (SSM)	Uses rich pictures, CATWOE, root definitions and conceptual models to explore the issue from several different perspectives.	• Churchman's dialectical inquiry • Vickers' social processes • Interpretive sociology.
Strategic Options Development and Analysis (SODA)	Beginning with a process of idea generation, seeks to capture and structure the complexity of an issue reflected by multiple perspectives.	• Kelly's psychological theory of 'personal constructs'
Strategic Choice Analysis (SCA)	Four modes – Shaping, Designing, Comparing, Choosing. Focuses on key uncertainties (about related areas, environment and values) and analysis of interconnected decision options.	• Planning philosophy and methodologies
Strategic Assumption and Testing (SAST)	Used to challenge deeply held assumptions by surfacing then and challenging them with their opposites.	• Churchman's dialectical approach
Critical Systems Heuristics (CSH)	Used to challenge the boundaries drawn up to circumscribe the focus of planning or design.	• Churchman's dialectical approach • Habermas's critical theory
Hypergames, Metagames and Drama Theory	Appropriate in multi-party contexts, where the outcome is dependent on the inter-dependent actions of the parties – seeks to identify stable options.	• Game Theory
Robustness Analysis	Focuses on identifying options which perform well in all possible futures.	• Decision analysis and planning methodologies
Interactive Planning	Used to assist participants design a desirable future for their organization and bring it about.	• Pragmatism and systems theory

Soft Systems Methodology Process



Learning cycle of Soft Systems Methodology (Jackson, Michael C. 2003)

TRIZ (Theory of Inventive Problem Solving)

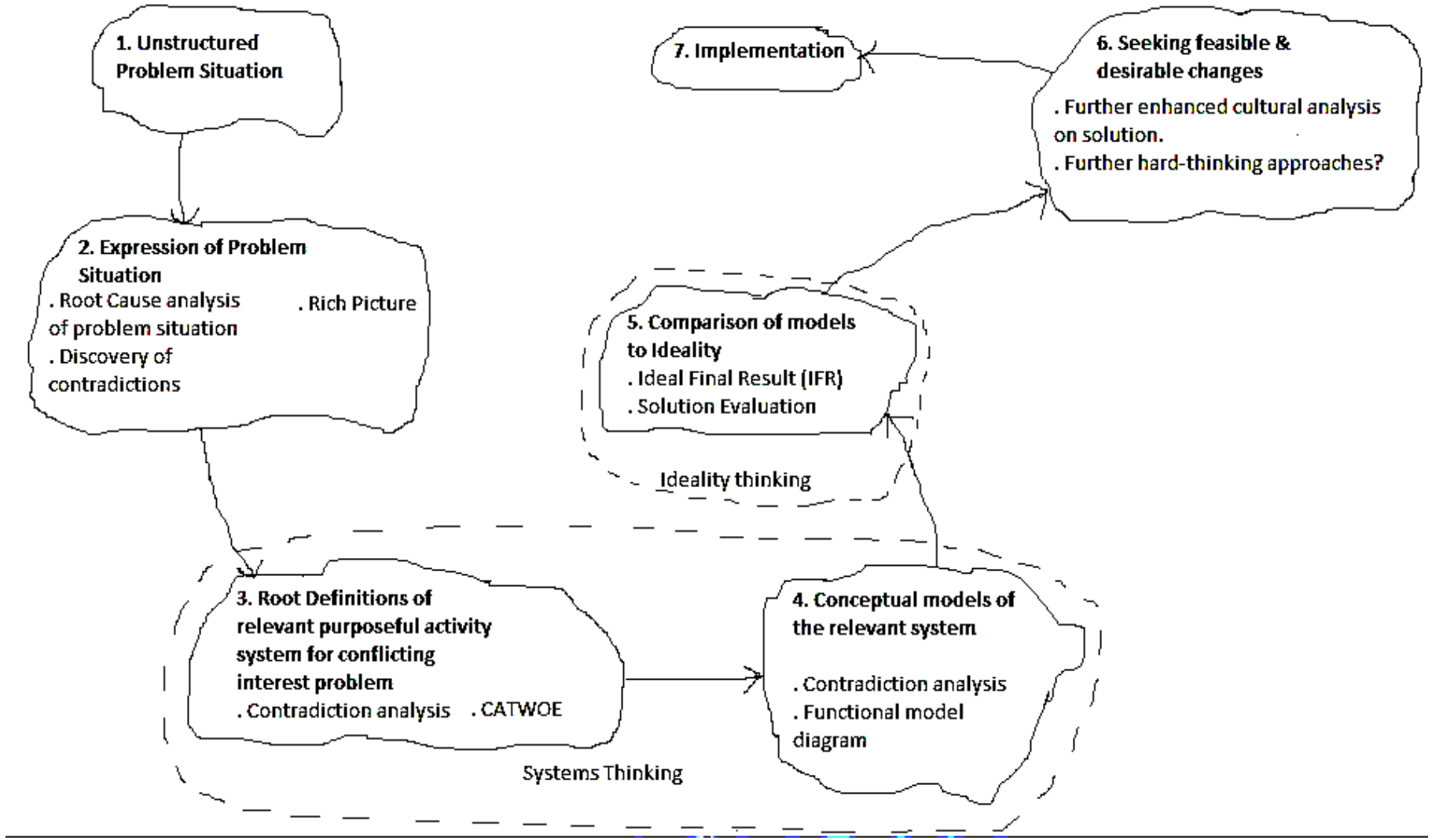


TRIZ Problem solving model (Zhai, Chang and Tan 2005)

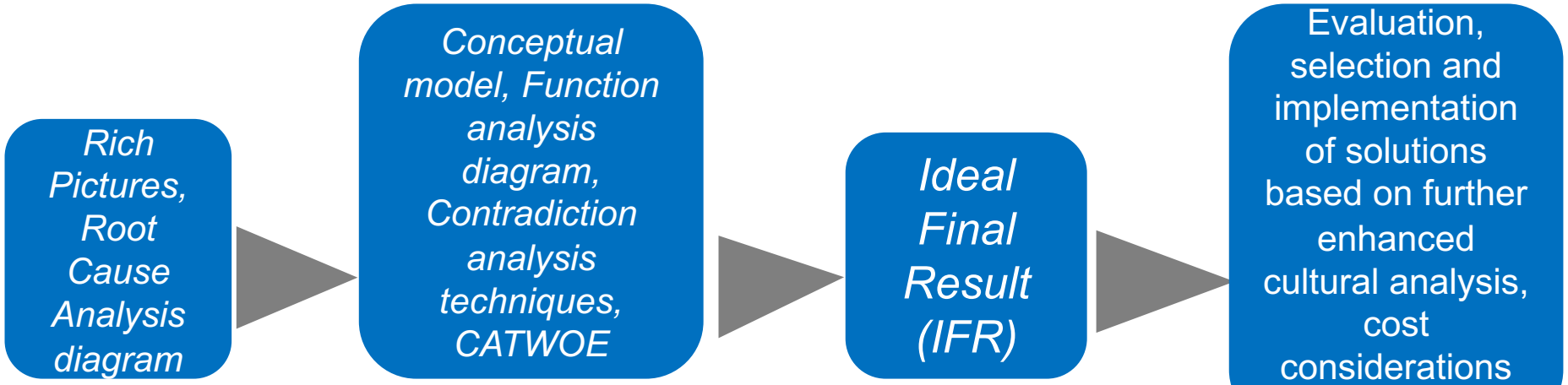
Strengths And Weaknesses Of SSM And TRIZ: Opportunities For Synergy

Method	Strengths	Weaknesses
SSM	• Provides holistic understanding of problem from systemic perspective • Integrates various perspectives of different actors involved in resolving problem.	• Does not provide firm guidelines toward uncovering why problems occur • Does not proffer a mechanism/tool for resolving contradictions, which are at the heart of conflicting interests' problems • Ideality thinking is not part toolbox as the aim of resolution is towards rejecting compromise(s). • Discourages hard system thinking approaches in most cases unless worldviews have been collapsed into one.
TRIZ	• Breaks problems into discovering inherent contradictions that provide clues for solutions • Embraces concept of ideality • Possesses contradiction resolution techniques (40 inventive principles, ARIZ, separation techniques, etc.) • Encourages further pursuit of hard thinking approaches for definitive solution implementations.	• Tools for problem definition do not encompass a holistic appreciation of the issue at hand • Resolution process is based on perspective of problem-solver instead of embracing perspectives of other principal actors.

PROPOSED METHODOLOGY: SSM-TRIZ STAGES



Phases Of SSM-TRIZ Methodology



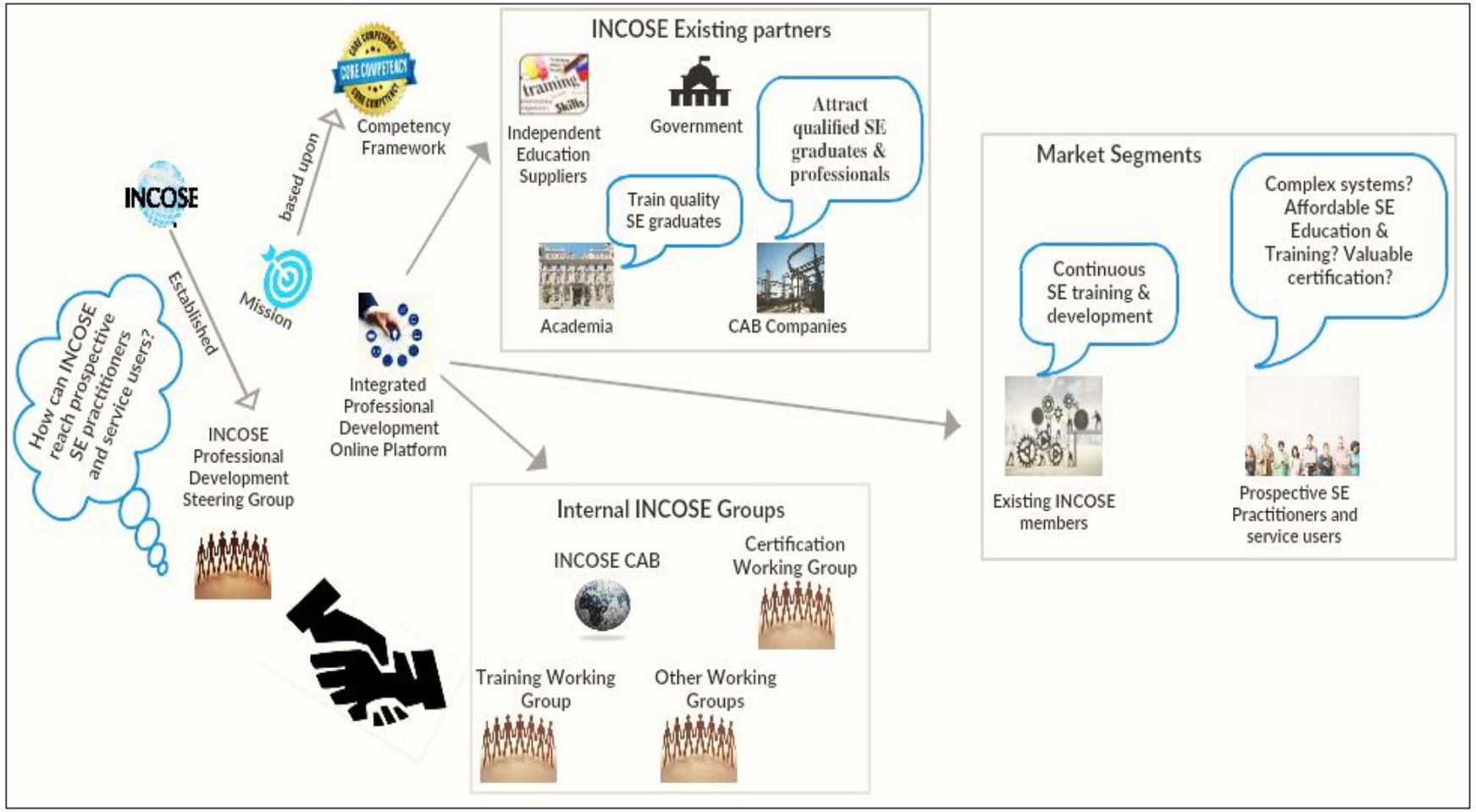
APPLICATION: INCOSE CASE STUDY

- International Council on Systems Engineering (INCOSE): Largest professional organization committed to the development and advancement of Systems Engineers
- INCOSE objective: create value for individuals and corporate bodies by increasing proficiency of global systems engineering workforce.
- Vision: facilitate engagement between suppliers and consumers of systems engineering professional development.
- Solution approach: provide comprehensive professional development capability through an integrated web-based portal.
- Potential benefits
  - Increased competency among systems engineering practitioners
  - Quantitative competency tracking
  - Service analytics and reviews
  - Promotion of general interest in systems engineering
  - Increased revenue for INCOSE

Unstructured Problem Situation

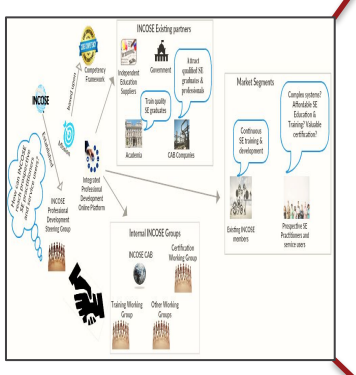
- INCOSE has had issues pinpointing the needs of prospective professionals who are involved in the SE space, need more SE education but are not associated with the organization.
- The major question has been about figuring how to elicit the ‘pains’ of this market segment concerning education and training, certification, knowledge products and other aspects of the value stream without in an inexpensive manner.
- Unlike existing/current INCOSE members, there is no information on prospective members in the SE space.

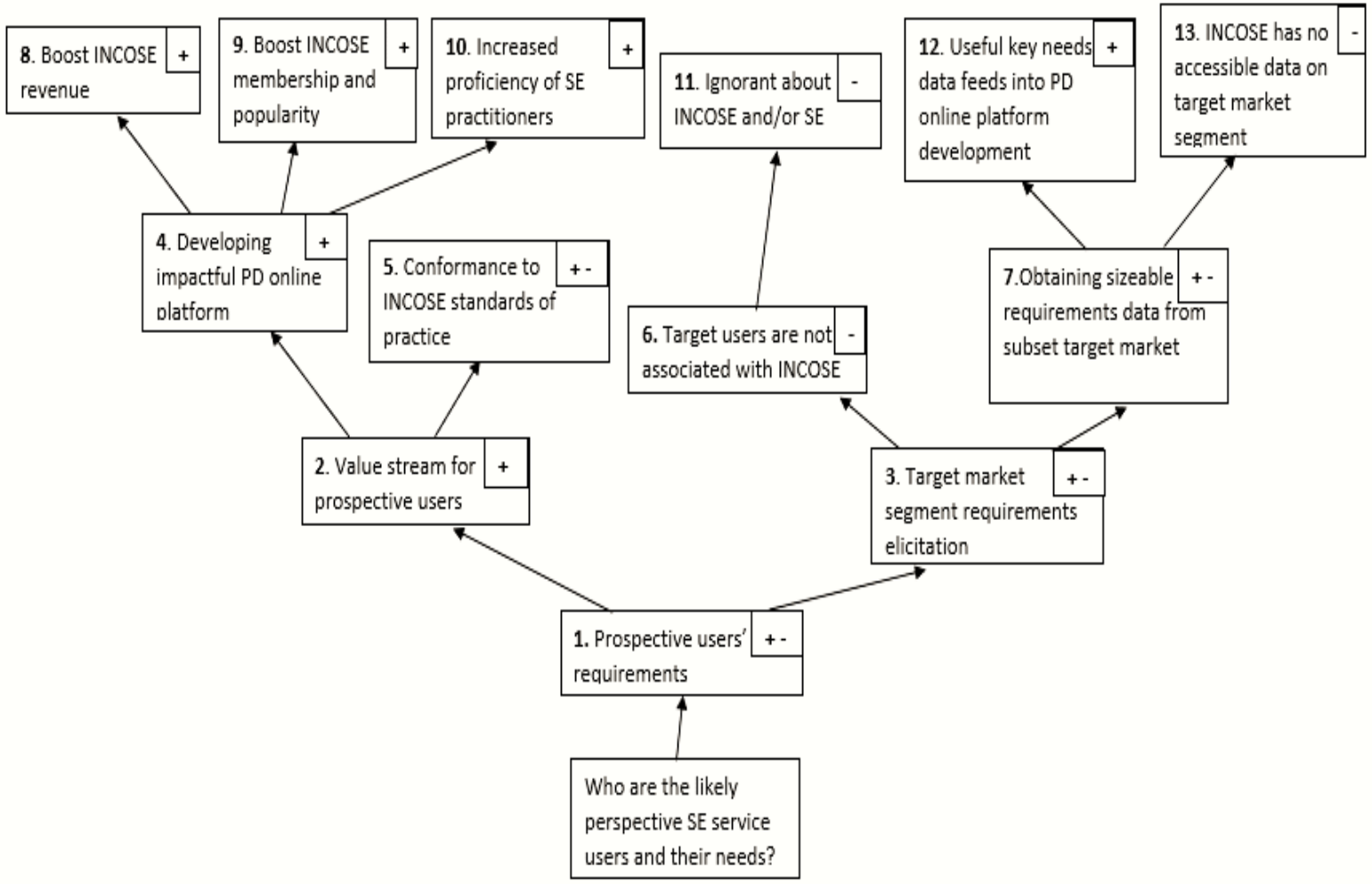
Phase 1: Perception of problem situation



Rich Picture of INCOSE's Current Professional Development Situation

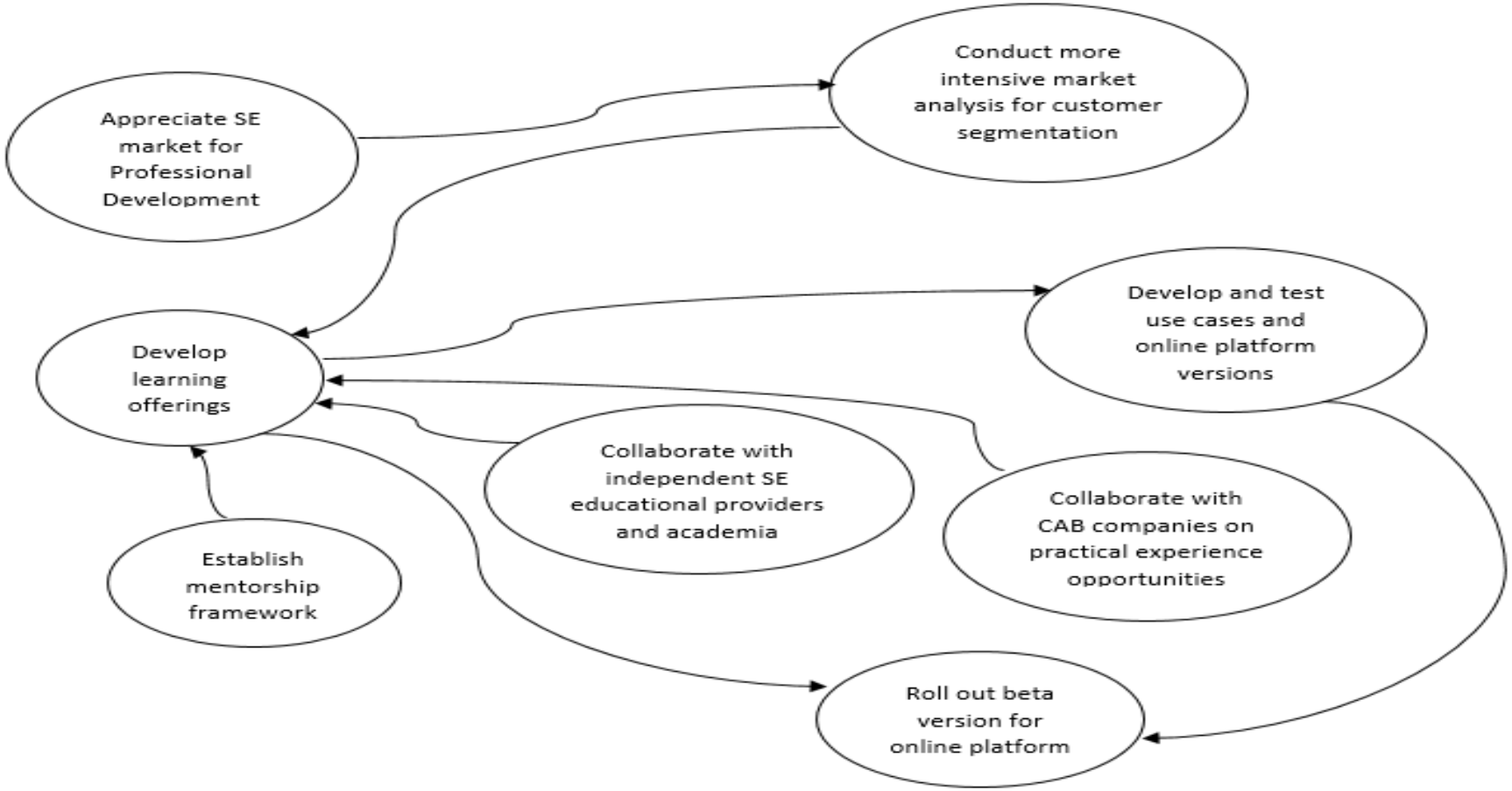
Mapping of Rich Picture to Root Cause





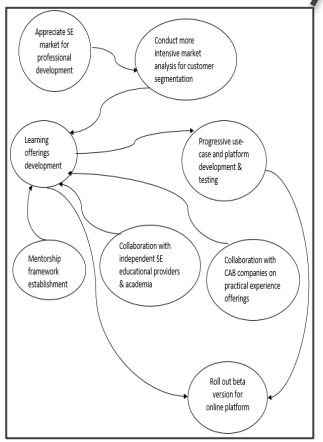
Root Cause effect chain for profit generation.

Phase 2: Root definition & Conceptual model of relevant system

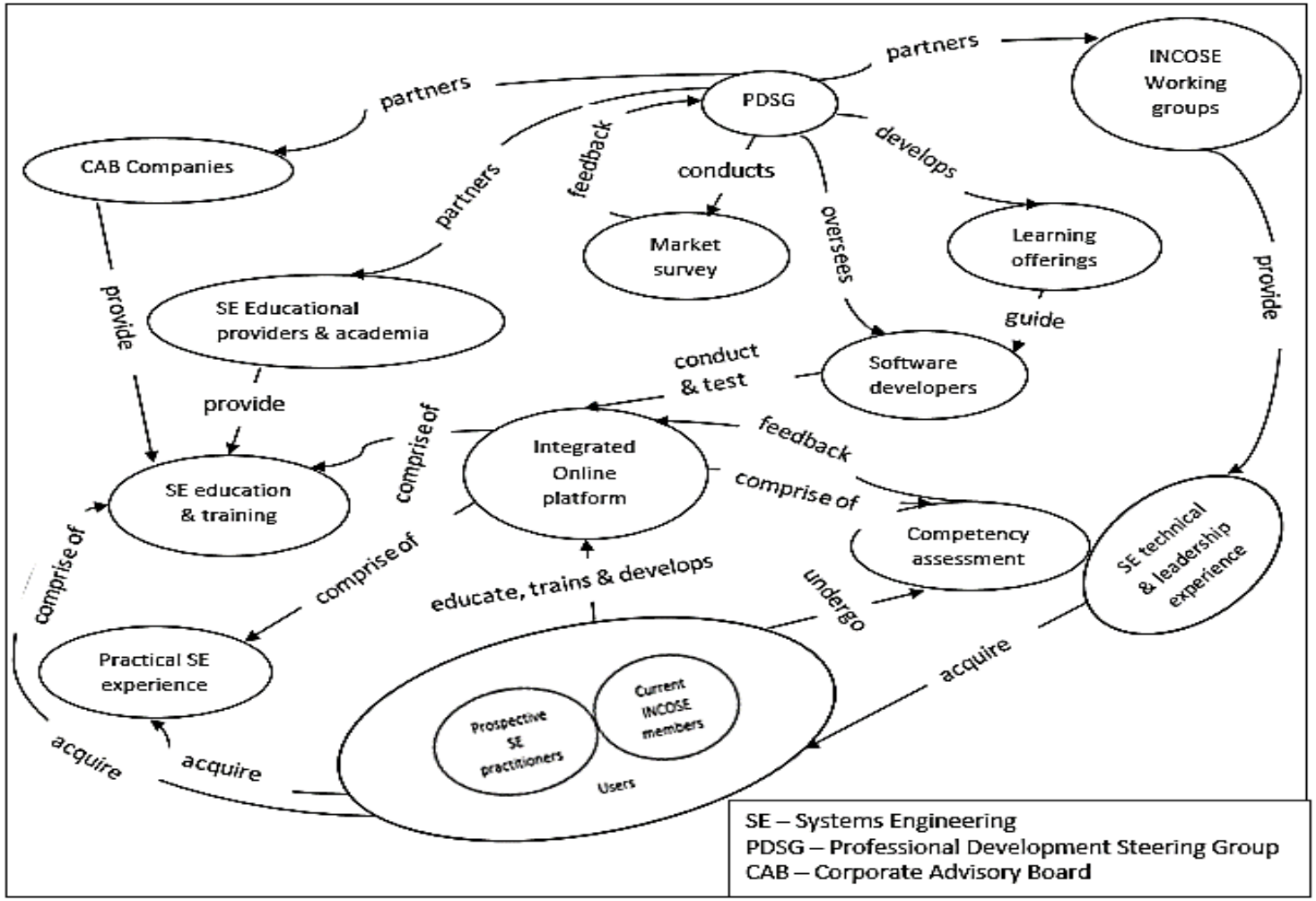


Conceptual model for purposeful activity system

Mapping of Conceptual Model to Function Analysis Diagram



Conceptual model



Function Analysis Diagram

CATWOE Elements

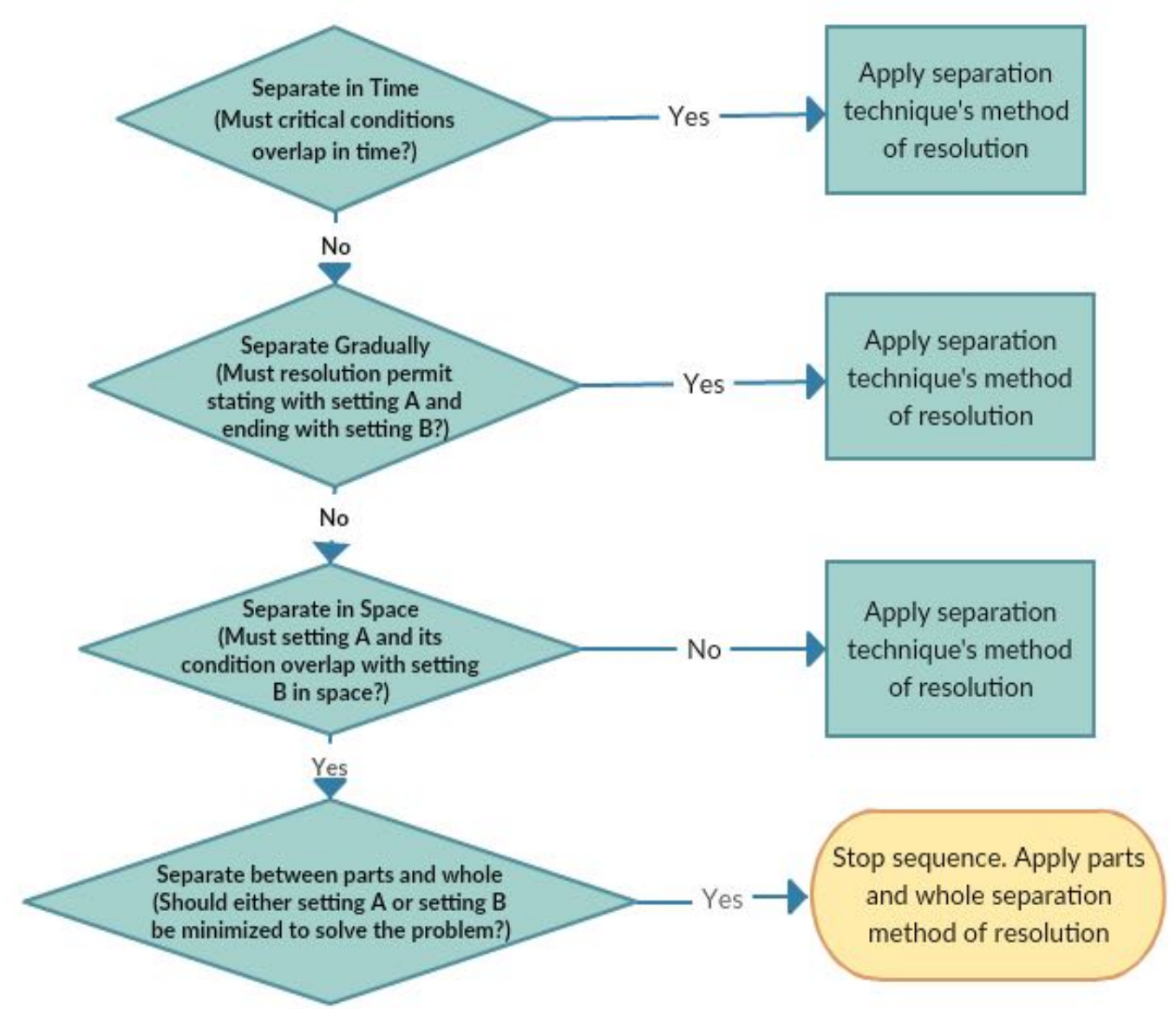
Contradiction Analysis

- Contradiction is the presence of conflicting elements, features or solutions.
- Contradictions with '+-' signs from the root cause effect chain diagram were reviewed and one of them selected for analysis in this study.
- Selected contradiction is:

  'Useful key needs data will enrich PD service development during platform development but there are no accessible data on the target market segment'.
- Contradictions can be subdivided into element, settings and condition.
- For selected contradiction,
  - Element: PD service development.
  - Setting A: Useful key needs data feeds into platform development.
  - Setting B: No accessible data on target market segment.
  - Condition A: online platform development.
  - Condition B: requirements gathering.

Contradiction Analysis contd…

Contradiction separation techniques and logical sequences from *opensourcetriz.com* used to resolve contradiction



Contradiction resolution flowchart

Contradiction Analysis contd…

- Resulting separating techniques evaluated to arrive at adequate separation technique

	Does Contradiction pass separation technique test?	
Separation Technique	**✓ (YES)**	**× (NO)**
Time	✓	×
Gradually		✓
Space		×
Parts and Whole		×

Phase 3: Comparison of models to Ideality

- Contradiction statement was resolved using the separation by time and gradually techniques.
- Solution strategy from separation by gradually technique is the method of repeated use and is below as solution 1:

  Solution 1: *INCOSE can obtain useful key needs data that enrich PD service development during platform development when there are no accessible data on the target market segment by identifying professional disciplines from the target market segment (not associated with INCOSE) and obtaining available public data concerning professional needs of the practitioners that can be resolved using SE domain knowledge..*
- Solution strategy from separation by time technique is the separation on condition method and is below as solution 2:

  Solution 2: *INCOSE can collaborate with established PD organizations such as PMI in gathering PD needs of professionals from disciplines that apply activities closely related, intertwined or can be improved with SE. Since organizations such as PMI has these data not available to INCOSE, this contradiction is resolved*
- Ideality ideal resolution for our studied contradiction is for INCOSE to offer an array of quality platform courses online without incurring costs of course delivery.
- Solution Evaluation Constraints: Cost, Time and Ease of Implementation
- Solution 1 is selected ahead of solution 2 based on these constraints.

Phase 4: Seeking feasible and desirable changes

Selected solution statement: *INCOSE can obtain useful key needs data that enrich PD service development during platform development when there are no accessible data on the target market segment by identifying professional disciplines from the target market segment (not associated with INCOSE) and obtaining available public data concerning professional needs of the practitioners that can be resolved using SE domain knowledge.*

- Further hard systems thinking approaches are needed for a definitive implementation of the selected solution.
- How do we achieve the selected solution statement?
  - Firstly, there is a need to identify disciplines that overlap with SE
  - An option is business analysis (BA) which intersects a lot with SE in its activities, and whose practitioners can apply some SE knowledge and practice in resolving their various PD needs

Refined Solution Statement: *INCOSE can obtain useful key needs data that enrich PD service development during platform development when there are no accessible data on the target market segment by identifying professional disciplines from the target market segment (not associated with INCOSE) and obtaining available public data concerning professional needs of the practitioners that can be resolved using SE domain knowledge. INCOSE can obtain user-generated data and glean key professional requirements and needs from available BA online forums.*

FURTHER HARD APPROACHES

- Solution statements are the result of the SSM-TRIZ approach. However, there are applicable situations that require definite solutions for implementation
- quantitative methods of inquiry are required to extract key phrases and topics that can provide insights into developing the online platform tool.
- One of such methods is text mining which is a process of extract interesting and significant patterns to explore knowledge from textual data sources (Fan, et al. 2006)
- Text Mining steps employed for this study:
  - Collection of unstructured data: almost 3000 threads were extracted from modernanalyst.com with python scripting language
  - Text processing and transformation: JMP software using bag of words approach
  - Feature selection and latent semantic analysis: Removal of redundant features and Document Term Matrix (DTM) operations such as Singular Vector Decomposition (SVD).
- Results revealed key phrases and terms in the Business Analysis space congruent with Systems Engineering. Topical analysis of results provides central topics similar to INCOSE PD initiative.

Result output from text mining

Modern_analyst_NEW - Text Explorer of Posts - JMP Pro

Text Explorer for Posts

Number of Terms	Number of Cases	Total Tokens	Tokens per Case	Number of Non-empty Cases	Portion Non-empty per Case
13650	2695	334133	123.983	2684	0.9959

Term and Phrase Lists

Term	Count
business	2951
requirements	1884
ba	1697
analyst	1312
project	1084
use	1011
new	996
analysis	890
one	853
system	836
like	827
process	818
experience	814
work	813
cases	773
need	704
job	622
working	600
years	600
company	597
data	582
software	563
time	561
management	553
please	538
systems	490

Phrase	Count	N
business analyst	795	2
use cases	520	2
business analysis	393	2
business process	162	2
business analysts	145	2
business requirements	120	2
systems analyst	111	2
functional requirements	110	2
requirements gathering	109	2
business rules	90	2
project management	90	2
greatly appreciated	77	2
user stories	77	2
currently working	75	2
business processes	72	2
project manager	71	2
software development	71	2
years of experience	66	3
business systems	66	2
please let	59	2
information systems	56	2
requirements management	55	2
text indent	55	2
modern analyst	54	2
paper source	53	2
requirements document	52	2

Word Cloud

Top key-phrases, terms & word cloud

Result output from text mining…

Top Loadings by Topic

Topic 2		Topic 3		Topic 4		Topic 5	
Term	Loading	Term	Loading	Term	Loading	Term	Loading
people	0.43100	system	0.67997	years	0.55003	plan	0.69122
even	0.42718	cases	0.64039	experience	0.51711	management	0.65363
like	0.41497	use	0.61604	career	0.43069	documents	0.62241
time	0.37874	users	0.60416	analyst	0.40498	project	0.53276
one	0.35783	requirements	0.56928	working	0.39946	change	0.50348
well	0.34766	stakeholders	0.53795	worked	0.39556	document	0.45146
make	0.34451	user	0.51918	ba	0.38549	documentation	0.45051
ask	0.33756	design	0.44960	degree	0.34091	model	0.44207
far	0.32469	functional	0.44657	skills	0.32854	environment	0.44021
say	0.32273	needs	0.34802	job	0.31201	report	0.35182
things	0.32057	scope	0.32304	work	0.30966	may	0.34791
questions	0.31702	software	0.30703	background	0.30168	risk	0.32940
look	0.31513			advice	0.29887	testing	0.32348
go	0.30236			currently	0.29532		
someone	0.30037			move	0.28657		
good	0.29771						
done	0.29702						

Topic 6		Topic 7		Topic 8		Topic 9		Topic 10	
Term	Loading	Term	Loading	Term	Loading	Term	Loading	Term	Loading
data	0.52033	agile	0.67748	university	0.78429	knowledge	0.52917	community	0.3942
models	0.48397	development	0.57760	specific	0.62162	industry	0.51683	site	0.3909
customer	0.47159	software	0.44930	related	0.59545	please	0.43311	risk	0.3413
modeling	0.40685	changes	0.44303	engineering	0.58014	answer	0.42573	resources	0.3164
sales	0.39364	quality	0.43121	techniques	0.56889	study	0.38325	tool	-0.3024
order	0.35013	technology	0.33723	full	0.53983	one	0.33260	needs	0.2924
develop	0.34917	various	0.31880	skills	0.46828	ba	0.33223	available	0.2816
organization	0.34149	developers	0.31274	training	0.46235	important	0.33215	may	0.2688
business	0.31732	place	0.30078	include	0.33280	question	0.30719	certification	0.2666
processes	0.31727	world	0.30074	courses	0.32683	give	0.30663	excel	-0.2588
tools	0.29167	see	0.29188	ideas	0.27953	mba	0.30612	used	-0.2462
understand	0.28440	great	0.28009			another	0.30201	another	-0.2461

Topical clustering of thread posts

CONCLUSIONS AND FUTURE RESEARCH

- Conclusions
  - Results revealed key phrases and terms in the Business Analysis space congruent with Systems Engineering. Topical analysis of results provides central topics similar to INCOSE PD initiative.
  - Solution statements are the result of the SSM-TRIZ approach. However, there are applicable situations that require definite solutions for implementation
  - SSM-TRIZ transforms unstructured business problems into structured soft solutions that can expose questions that could be easily solved quantitatively.
  - Insight gleaned from INCOSE PD application case study support platform design concept and enhance suitability for intended market segment
  - TRIZ does not provide definite solution implementations for technical and business problems
    - Can be supplemented with quantitative methods.
- Future Research
  - Further case studies needed to enhance SSM-TRIZ methodology
  - Empirical and deductive studies to quantitatively assess effectiveness and performance of TRIZ.

Disclaimer: The conclusions and recommendations for the application case study expressed in this paper are those of the author and do not necessarily reflect the positions of the International Council on Systems Engineering (INCOSE).

QUESTIONS!!!

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