REDUCING PROJECT COMPLEXITY WITH COGNITIVE PSYCHOLOGY

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Short Abstract

To satisfy the ever-increasing challenges of today's business, more and more tools and methods have to be integrated into modern project management. Coaching, continuous improvement, systemic intervention, root cause analysis, problem solving, theory of constraints, inventing options and system engineering are some of the actual buzzwords. We found out that a lot of processes from different knowledge areas are based on a six steps process: "define", "analyse", "solve", "plan", "do" and "check". From Cognitive Psychology we learn that the human brain always follows these steps to solve problems. This is our way from problem to solution! From Systems Engineering, we learn that project management with "plan", "do", "check" and "act" following the Deming cycle is only the second half of this way. For more project success we can try to work harder, or we can follow the complete way from problem to solution. Problems arise most frequently in projects when initiation gets separated from execution. With our approach, based on Cognitive Psychology and Systems Engineering, we can avoid this matter of fact. We not have to work harder!

Keywords: project management, problem solving, cognitive psychology, creativity, intelligence, reasoning, systems engineering

Paper

The Standish Group, a research firm which produces an influential annual evaluation of IT projects, judged that in 2004 only 29% of such projects "succeeded", down from 34% in 2002. Costs over-runs averaged 56% of original budgets, and projects on average took 84% more time than originally scheduled. For more project success, we can try to work harder, or we can try to find out and to follow new approaches on project management.

Saynisch's model of the project management of second order (PM-2) gives an idea of how comprehensive the view on project management - today and future – can be. The PM-2 is structured in 4 worlds: World 1: Hard facts, classical project management methods; World 2: Complexity, thinking in cross-linked systems; World 3: Soft facts, human behaviour; World 4: Basis models, mindsets. The concept of "Project Management Second Order (PM-2)" was the main result of the Research Programme: "Beyond Frontiers of Traditional Project Management". PM-2 can lead us the way to project management of the future. With the worlds 2, 3 and 4 of the PM-2, we push our thinking envelops in traditional project management, and have a gleam of requirements needed to succeed in future project business.

We found out that some processes in the different worlds (considered as competence areas) have a common structure. The processes are structured in the phases "define", "analyse", "solve", "plan", "do", and "check". Sometimes these steps/phases are named slightly

different. There are two major differences within the usage of these six steps in the different competency areas. The first difference is the point of start and the second difference is the used toolset. So the vital questions are:

- Which tool from which discipline is most appropriate?
- What is the best point of start for our process?

The answers to both of these questions are provided by Cognitive Psychology.

For example root-cause analysis from classical project management (World 1) follows our six process steps: “define”, “analyse”, “solve”, “plan”, “do”, and “check”. We can find these six steps also in the systemic loop or in the reflecting team process from World 3. World 3 is dealing with soft facts and human behaviour. Psychology is the knowledge area of this world and cognitive psychology is perhaps the most successful branch of psychology. The subject matter of cognitive psychology consists of the main internal psychological processes that are involved in making sense of the environment and deciding what action might be appropriate. These processes include attention, perception, learning, memory, language, problem solving, reasoning and thinking. Robert Solso’s book Cognitive Psychology is an excellent text on cognitive psychology by one of the leading authors in the field. From Robert Solso’s book, we can learn that the process how humans solving problems is identical with our six step approach “define”, “analyse”, “solve”, “plan”, “do” and “check”.

There are two major differences when we apply these six steps in the different worlds of PM-2. The first difference is the point of start. For example the Deming cycle for continuous improvement is structured in “plan”, “do”, “check”, “act” and starts with “plan”. Root cause analysis starts as our problem solving process with “define”. The Project Management Institute PMI says that project management have five distinct phases: “initiation”, “planning”, “execution”, “control” and “closure”. Following the PMI phases starting point for project management is the initiation phase, followed by “plan”.

Processes	*Process Steps*					
Problem to Solution	System Design			Project Management		
Deming Cycle	Act [4]			Plan [1]	Do [2]	Ceck [3]
Project management	Initiation			Planning	Execution / Control	Closure
Systemische Schleife	Informationen sammeln	Hypothesen bilden		Intervention planen	Intervenieren	
Inventing Options	Problem	Analysis	Approaches	Action Ideas		
Coaching	Kontakt und Orientierung	Situation und Ziele	Lösungen	Transfer		
8D	Describe the problem / Containment Action	Root Cause Analysis	Corrective Action			Standardize Process / Prevent Recurrence
Reflecting Team	Information	Hypothesis	Solution	Measures		
Systematic Problem Solving	Define	Analyze Present/Future	Solve	Plan	Do	Check

Picture1: Processes

The second difference is the use of toolset. If we use our six step process with the tools “open questions” and “simple decision” we follow the systemic intervention procedure “Reflecting Team”.

- Define — *Team Members pose open questions*
- Analyze — *Team Members formulate hypothesis,*
  Case presenter evaluates
- Solve — *Team Members develop approaches which could solve the problem*
  Case Presenter chooses one solution
- Plan — *Case Present and Team Member develops measures for implementation*
- Do
- Check

Picture 2: Reflecting Team

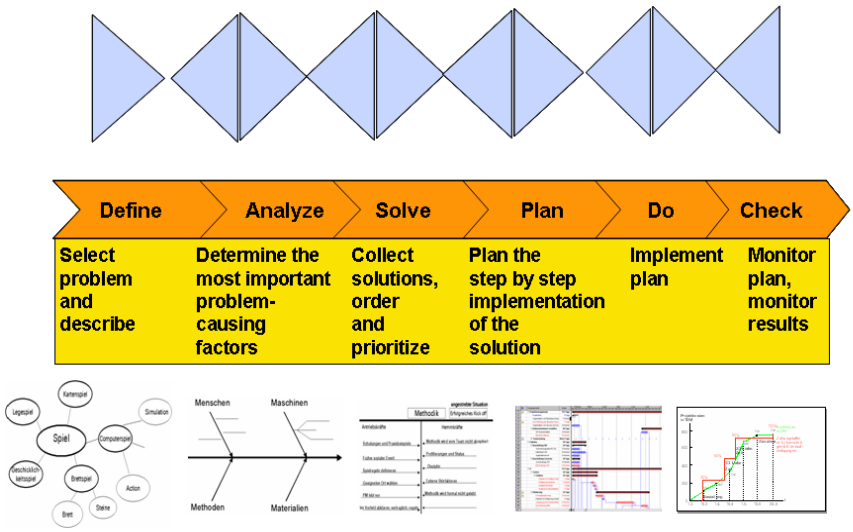
In addition, many well known tools like schedule diagram, fishbone diagram, brainstorming, questioning techniques are applicable to many situations. The question is: What tool from which discipline is the most appropriate for a given situation?

The answer is provided by the patterns of divergent thinking and convergent thinking, which correspond to the capabilities of creativity and intelligence. With creativity (divergent thinking, lateral thinking) new ideas are generated; with intelligence (convergent thinking) the new ideas are developed and selected. Tools, such as brainstorming, fishbone diagram, bisociation or association support divergent thinking; tools such as interrelationship digraph, voting and preference matrix support convergent thinking.

Arthur Koestler used the story of Archimedes and the gold crown as an example for bisociation: Archimedes was given the task by the tyrant of Syracuse to determine whether or not his crown was really made of gold. Under threat of penalty he was forbidden to destroy the crown. By weighing the crown Archimedes could determine the weight. But was the crown really made of pure gold or was it just gold-plated? Archimedes thought for a long time about this problem. Exhausted from the heat of the day he treated himself for a bath. As he got into the water of the bathtub, he noticed that the water level rose by its body. He contemplates that this would apply to the crown or for a lump of gold. The crown and a lump of gold of the same weight would thus cause the water level to rise to the same mark. Koestler named this process of combining known and unknown facts the “bisociative act”.

Howard Gardner investigated human intelligence (convergent thinking) by studying seriously ill patients and car accident victims whose brain cannot function normally and described the results in his book “The Mind’s New Science”. Gardner’s findings show that intelligence involves many aspects. He distinguishes the following forms of intelligence in his model: Personal intelligence; Physical, kinaesthetic; Linguistic; Mathematical, logical; Spatial and Musical. This model was consciously left open by Gardner and in later studies it was expanded by him and other scientists. Intelligence allows us to order, structure, combine, evaluate, select thoughts that we have found and thereby move towards a solution.

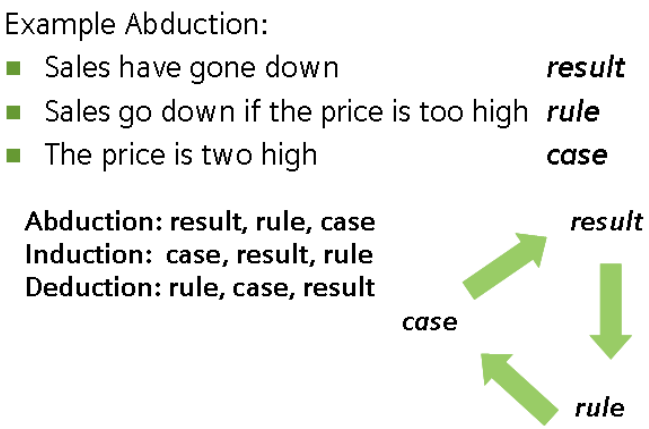
Now equipped with our thinking patterns divergent thinking (creativity) and convergent thinking (intelligence) we are able to apply the right tools in a given situation in each phase of our problem solving process. In every phase ideas are initially produced with the help of creativity techniques (divergent thinking). Thereafter convergent thinking is used (decision-making techniques) to order, evaluate, select the results and finally summarise them.



Picture 3: Divergent and convergent thinking within systematic problem solving

The results of a phase are then worked on in the next phase. If the results worked on in the next phase do not lead to the desired success, the second best result of the previous phase will be drawn upon or we can go back to the starting point of the previous phase. At the end of the process, the problem is solved, or the project is implemented or the root cause is analysed and the solution is implemented.

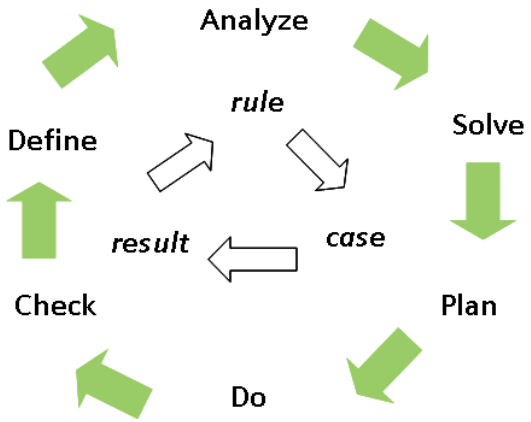
Also cognitive psychology can answer our second question: What is the best point of start for our process in a given project situation? Barbara Minto used in her "Pyramid Principle" the different ways of logical conclusions: deduction, induction and abduction. In any reasoning process we always deal with three distinct entities: A result, a rule and a case. A result is an expected or observed occurrence, given the application of the rule in this case. A rule is a belief (Hypotheses) about the way the world is structured. A case is an observed fact that exists in the world.



Picture 4: Abduction, induction, deduction

Abduction can lead us to truth or untruth (false) results. And also induction can lead us to false results. For truth results we have to follow the deduction.

Problem solving with “define”, “analyse”, “solve”, “plan”, “do”, and “check” is abduction. To follow the deduction, we have to start with the rule. This is possible within a second try, or if we can deduce the rule from previous results. For this we have to close our six steps process to a cycle.



Picture 5: The systematic problem solving cycle

If we start with “plan” as in the Deming cycle we have an induction. After “do”, we have the results of what we did and now with check we can analyse our results to find or verify our rule. With respect to the deduction, we will have a better chance to find the best solution on the second run if we document all the procedures, data, and other relevant information properly during the first unsuccessful or not optimal attempt.

Our problem solving process is, equipped with the appropriate tools, applicable in daily project business for problem solving, systemic intervention or root cause analysis and more. The best point of start is given by the actual situation and as showed above it is not so important to start with the right phase. It is most important to close the process to a cycle.

According to Daenzer/Buechels book Systems Engineering, the way from problem to solution is structured in system design with the steps “define”, “analyse” and “solve” and in project management with the steps “plan”, “do” and “check(act)”. Problem solving is not only a discipline within project management. Project management is the second half of problem solving!

With Daenzer/Buechels finding and our knowledge about reasoning, problem solving and thinking from cognitive psychology, we are able to improve today's project management significantly. First of all, we need a perfect project start. We have to find out the best solution for our given problem or given issue with the use of our toolset and the first three phases “define”, “analyse” and “solve” of our six steps problem solving process. To succeed in project management we have to go the complete process from problem to solution. With this we strengthen the initiation phase and we avoid that initiation gets separated from execution. With respect to deduction, we need project debriefings to “check” our project plan and to check our project results. From project debriefing we can get all the information and we can “act” on this information to find out best solutions for our next issues.

Thinking Patterns	Processes	Process Steps						References
	Problem to Solution	System Design			Project Management			[11] Daenzer/ Büchel: Systems enginnering
	Deming Cycle	Act			Plan	Do	Ceck	[1] Brassard & Ritter, The Memory Jogger II; Goal/QPC
	Systemische Schleife	Informationen sammeln	Hypothesen bilden		Intervention planen	Intervenieren		[2] Roswita Königswieser, Alexander Exner (2002): Systemische Intervention;
	Inventing Options	Problem	Analysis	Approaches	Action Ideas			[3] Ury: Getting to Yes
	Coaching	Kontakt und Orientierung	Situation und Ziele	Lösungen	Transfer			[4] Fischer-Epe, Maren: Coaching: Miteinander Ziele erreichen
	8D	Describe the problem / Containment Action	Root Cause Analysis	Corrective Action			Standardize Process / Prevent Recurrence	[6] Ford: The 8 Disciplines of Problem Solving
	Systematic Problem Solving	Define	Analyze Present/Future	Solve	Plan	Do	Check	[7] Werner Otto: SPL Seminar handouts (Siemens internal; not published)
	Practices / Tools							
Divergent								
	Open Questions	x	x	x	x	x	x	[4]
	SWOT	x						
	Project Assessement / Radar chart	x	x				x	[1]
	Brainstorming	x	x	x	x			[1]
	negative Brainstorming		x	x				
	Brain Writing 6-3-5		x	x				
	Splitting	x						[8] Michael Michalko (1991): Thinker toys: A Handbook of Creativity in Business;
	Situation Analysis	x						[5] Kepner, Tregoe: The new Rational Manager
	Problem Analysis		x					[5]
	Potential Problem Analysis		x					[5]
	Fish bone diagramm		x					[1]
	Affinity Diagramm		x		x			[1]
	Cluster / Mind Map		x	x	x		x	[8]
	Work breakdown structure (Tree)				x			[1]
	Product breakdown structure (Tree)				x			[1]
	check sheet		x				x	[1]
	Force field analysis				x			[1]
	lateral thinking							[6]
	bisociation			x				
	association			x				
	analogy			x				
	morphologic box			x				
Serial								
	Flow Chart	x	x		x			[1]
	work package list				x			
Parallel								
	System Description	x						[9] Frederic Vester: Die Kunst vernetz zu denken
	4 thinking hats	x	x	x	x		x	[6] deBono, Edward (2002), de Bono's Thinking course
	network plan				x			[1]
	gantt chart				x			[1]
	TRIZ			x				[10] G. S. Altschuller: ТРИЗ – Теория Решения Изобретательских Задач
Convergent								
	active listening	x	x	x	x	x	x	[4]
	expert decision	x	x	x	x	x	x	
	SMART	x						
	voting	x	x	x	x			
	multi voting	x	x	x	x			[1]
	Nomial Group Technique	x	x	x	x			[1]
	Selection Matrix	x						
	Preference Matrix		x					[1]
	Decision Analysis		x					[5]
	Evaluation of alternatives			x				[1]
	Interrelationship digraph		x					[1]
	Eisenhower matrix				x			
	Pareto Chart	x		x	x		x	[1]
	Cost Benefit Analysis				x			

Picture 6: Tool selector

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