Application of the Theory of Constraints in Knowledge Management

Ewa Moroz, Jerzy Szkutnik

Czestochowa University of Technology, Poland
emoroz@adm.pcz.pl, szkutnik@el.pcz.czest.pl

Kornelia Lazanyi

Obuda University, Hungary
lazanyi.kornelia@kgk.uni-obuda.hu

Abstract: Organizations today are increasingly recognizing the effectiveness of knowledge management for the primary or at least one of the main sources of competitive advantage. At the same time need to process enormous amounts of information, and necessity to generate useful knowledge requires increasingly sophisticated tools with the enormous complexity of algorithms. Theory of constraints (TOC) is a philosophy of management that offers a set of tools that can be sucessfully appied in knowledge management. These tools are gathered in TOC Thinking process. The aim of the study is to present basic tools of TOC Thinking process and to explain how to use them.

Keywords: Theory of constraints, knowledge management

1 The role of knowledge management in modern organization

Knowledge assets of organizations are on the one hand the sum of the knowledge of individual employees and teams, all intellectual assets in the database and the information that an organization uses to operate, however, on the other hand they encorporate tacit knowledge, such as operational processes and cultural values. Employees capable of converting data into infomration and that into knowledge and finally wisdom [1] using it for the benefit of the company is a key element of knowledge management in every organization. Nowadays the processes of information management, and in consequence knowledge management, cross all units, processes and management functions at strategic, tactical and operational level. Simultaneously the more accurate the information, the higher its quality is,

the more efficient and reliable and action and its effect will be [2]. However, higher quality of the information also increases the cost of obtaining it [3]. It is also important not to get lost in the volume of non-essential information that can obscure the true picture of the situation. Moreover, computers that were to bring streams of information are flooding us with a flood of data [4].

Good algorithms should support the process of assimilation of information (to facilitate understanding, accelerate the search for information), should not distort the source data, and should support the decision-making process; which means, it should support the ability of the audience to understand the data. Typical examples of the transformation process of information into knowledge are: aggregation of information, disaggregation, searching, selection, arithmetic operations (statistical methods), comparing, ranking, sorting [5]. Meanwhile, the data is not information, and information is not knowledge [6].

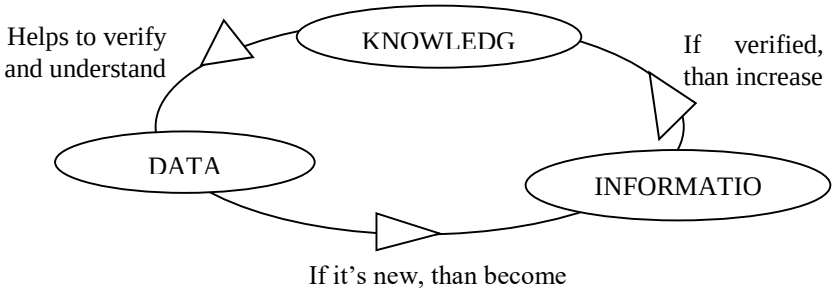

Figure 1

Knowledge, data, information

Data, if it is new, becomes information. If information is verified than it can increase knowledge. Knowledge helps to verify and understand data. Regarding knowledge, there are four main categories: to know "what"; to know "why"; to know "how", to know "who" [7]. You can also find the following categories: to know "when" and to know "where" [8].

There are four features that distinguish knowledge from traditional resources [9]. The first is domination. This feature gives knowledge a priority among other resources. It has a strategic importance for the functioning of modern enterprises. It also determines to a large extent, their position on the market. Often, its skillful use contributes to the effective management of other resources, and thus also to achieve the objectives of the organization.

The second is inexhaustibility. This feature indicates that knowledgeis the only resource, which is not diminished as it is beeing used. At the same time the more you use the more its value is increasing. As the amount of available knowledge

increases, synergies appears. This phenomenon lies in the fact that during its transfer by any number of people it does not lose its value, but it is often developed with new elements created during this process.

The third feature that distinguishes knowledge form other resousces is simultaneity. Due to this feature the same knowledge can be used by many entities at the same time and multiple locations simultaneously. Having knowledge does not ensure that an organization is the only entity that can use it. The essence of gaining and maintaining a competitive advantage is the use of knowledge before your competition does so.

The fourth specific feature of knowledge is non-linearity There is no close relationship between the amount ofknowledge and the benefits arising from its use. Large resources of knowledge does not predefine the position of the leading organizations in the market, but often contribute to its win. Decisive here is the ability to its appropriate use.

There is one more important feature of knowledge. It is viscosity. The viscosity of knowledge is its value as a source of competitive advantage and at the same time a huge problem when trying to share knowledge within the organization. Under viscosity a certain difficulty to transfer definite knowledge and solutions into new environment should be understood. Viscosity of knowledge may explain why it is so difficult to buy knowledge through buying people. People and their knowledge are merging in context and culture of the organization. The transfer to another location may cause that people are no longer able to use its knowledge so that they had done before.

The essence of knowledge management is determined by two very important aspects: good organization of information and its effective (relatively easy) search. Convenience and ease of use are seen as key determinants of the quality of knowledge management systems. The aim of the study is to present a potential algorithm of decision making based on the principles of the Theory of constraints.

2 Theory of constraints – basic assumptions

Effective knowledge management combines four dimensions: 1) function - the relevance and usefulness of the information presented; 2) attractiveness - significant, new and / or interesting facts; 3) consistency - a true, accurate and reliable data; 4) form - that is the beauty of the structure and attractive appearance. Whether preparing to implement knowledge management or improving a current implementation, it's important to learn about best practices or leverage resources.

The Theory of constraints (TOC) is a philosophy [10] that implemented significant improvement in management through focusing on a constraint that prevents a system from achieving a higher level of performance. The Theory of constraints

(TOC) is a concept where the role of constraints in limiting the performance of an organization is emphasized. A constraint [11] is any element or factor that limits the system from doing more of what it was designed to accomplish (i.e., achieving its goal). A constraint can be capacity, market, time constraint or any other system limitation, like lack of knowledge.

The Theory of Constraints can be defined as an overall management philosophy founded on the idea that all systems; whether personal, interpersonal, or organizational; have at least one constraint: something that holds the system back from accomplishing more of its primary purpose, or goal. The rate of this accomplishment is called throughput. The principle of TOC consists of five steps [12]:

1. Identification of the system's constraint(s). It is important to identify these constraints and also necessary to prioritize them according to their impact on the goal(s) of the organization.

2. Decision on how to exploit the system's constraint(s). For example a managerial constraint should not be exploited but be eliminated and replaced with a policy which will support the increase of throughput.

3. Subordination of everything else to the above decisions.

4. Elevation of the system's constraint(s). If existing constraints are still the most critical in the system, rigorous improvement efforts on these constraints will improve their performance.

5. If in any of the previous steps a constraint is broken, the process has to be restarted from step 1. Organizations should not let inertia become their next constraint. TOC is a continuous process and no policy (or solution) will be appropriate (or correct) for all time or in every situation.

The five-step procedure presented above enables to plan the overall process / system or organization and focus attention on the resources with the greatest potential to be affected by changes of the system. These five steps correspond with typical knowledge management processes, where five steps are: collect, use, enrich, share, assess, sustain [13]. Moreover, in classical decision-making process, we can also distinguish several successive phases:1) identification of the decision situation; 2) formulation of the decision problem; 3) building a model of the decision-making; 4) designation of decision limits and decision - sufficient or optimal decisions; 5) the final decision [14]. Typically the Theory of constraints is used to improve throughput in the process like in supply chain management [15]. But TOC offers also a set of tools that can be appied in knowledge management. These tools in general are gathered in the TOC Thinking process.

Theory of constraints offers a set of logical tools presented in an easy-to-follow form known as the "thinking process". Thinking process in the Theory of Constraints provides a set of holistic processes and rules, all based on a systemic

approach, that exploits the inherent simplicity within complex systems through focusing on the few "leverage points" as a way to synchronize the parts to achieve ongoing improvement in the performance of the system as a whole [16]. The philosophy of TOC is based on three simple assumptions [17]:

Basic Assumption 1: Everything within a system is connected by cause and effect relationships. Identification of the causes leads us to converge onto an apparent core problem/contradiction/conflict.

Basic Assumption 2: All contradictions can be resolved without compromise – our level of understanding and our assumptions hold the contradiction in place. A compromise is not usually a win-win solution.

Basic Assumption 3: There is no resistance to improvement – people embrace change because we have brought them to see the win for themselves.

These assumptions naturally fit into the process of knowledge management.

3 Theory of constraints – the strategical thinking process

In the knowledge management process one should pay attention to the differences between efficiency and rationality of the decision-making process. Methodologically rational decisions are taken according to existing knowledge and suggestions, harvesting the information, through techniques, methods and tools developed by the ongoing improvement process, through experience and learning. Businesslike rationality of the decisions relates to its substantive content, it is synonymous with effectiveness and usefulness to the organization. Businesslike rationality is subjective, decisions should maximize the efficiency of the manager (which is assessed ex ante). The effectiveness of the decision however can be assessed ex post, always after the actual implementation and the gathering of information related to its effects**.**

Theory of constraints' thinking process is build on little-known tools and techniques that can be used to improve knowledge management. In general terms dealing with constraints during the implementation of the TOC, requires making three decisions [18]: decide what to change - identify the weakest link; decide what to change to - design a stronger link; decide how to cause the change - operationalize this stronger link into the chain. In details the technique is a bit more complicated.

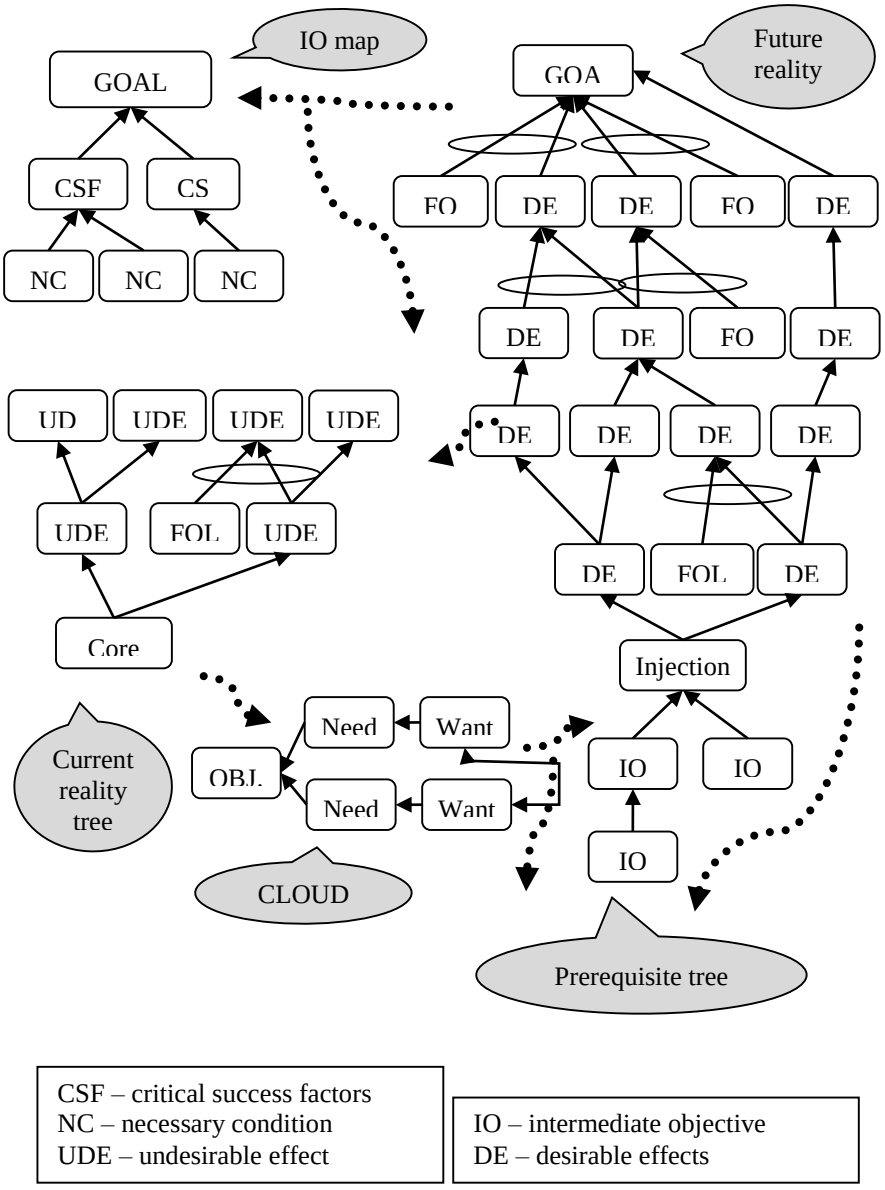

Figure 2
The TOC Thinking process

The Thinking Processes (Fig.2) is based on five visual tools - diagrams, (four trees and a "cloud") and a set of logical rules. The diagrams use two different types of logic to discuss the issue. Three of the trees (Current and Future Reality Trees and the Transition Tree) use cause - effect logic. They are built up by constructing connections between observed effects and causes on the basis of "sufficient cause". Sufficiency can be of three types: "A is sufficient to cause C" or "If both A and B occur together, then they will be sufficient to cause C" or "A and B (separately) both contribute to C, and either of them is sufficient to cause C". The Evaporating Cloud and the Prerequisite Tree both use necessary conditions thinking: "In order to achieve A one must have B". The general idea of TOC Thinking process (presented in fig.1) is described briefly in following sections.

Current Reality Tree (Why is the system sick?)

Current Reality Tree (CRT) is the first diagram in TOC's thinking process. CST tries to find an answer to a question why the system is sick. CRT is a logical structure (if...then...) designed to depict the state of reality as it currently exists in a given system. It represents the most probable chain of cause and effect in a specific, fixed set of circumstances. Starting point for CRT is a set of undesirable symptoms, while end result is the core cause of the symptoms (constraint).

CRT is designed to achieve several objectives: provide the basis for understanding complex systems, identify undesirable effects (UDEs) exhibited by a system, relate UDEs through a logical chain of cause and effect to root causes, identify, where possible, a core problem that eventually produces 70% or more of the system's UDEs, determine at what points the root causes and/or core problem lie beyond one's span of control or sphere of influence, isolate those few causative factors (constraints) that must be addressed in order to realise the maximum improvement of the system, identify the one simplest change to make that will have the greatest positive impact on the system. It is essential to locate just one (or just few) key problems. It is a starting point to remove almost all of the most important problems, and this is the mail goal of the management process. Often before one can move forward the core conflict must be solved. And for that "a cloud" is necessary.

Cloud (What conflict is preventing the cure?)

This diagram is also known as a conflict cloud, a dilemma cloud, or a conflict resolution diagram. It helps to answer the question what conflict is preventing the cure. The Cloud provides a solvable verbalization of a conflicted situation where solvable is defined as "win-win." Starting point for this diagram is a conflict underlying a constraint, while end result should be a possible win-win solution. The cloud has one arm in the present and one arm in the future. The present contains things that one do have and do not want, the future contains things that one do not

have and do want. The conflict is between the present and the future. The cloud diagram is placed between the present problem and the future solution. To move forward one have to change the assumptions within the cloud: invalidate erroneous assumptions and overcome valid assumptions. Most often an “injection” must be created. Injection overcomes some current practices and creates a desired solution for the future. The injection must be transferred to future reality tree.

Future Reality Tree (Will the injection lead to all desired effects without creating new undesired effects?)

The Future Reality Tree (FRT) is similar to the CRT in structure, but with new proposed actions, policies, and behaviors injected into it in order to create a new vision of the future reality of the system. FRT is trying to answer the question whether the injection leads to all desired effects without creating new undesired effects. For this diagram starting point is a proposed win-win solution, while end result shoud define neseccary changes that should be implemented to process proposed solution and avoid new problems. Using FRT we ensure that all the undesirable effects (UDE’s) of the CRT are changed by the injection into desirable effects (DE’s). Sometimes one core injection is enough. Unfotrunatelly usually there are prerequisites that must be actioned and often also some obstacles that must be overcome. One can describe this part of the process with a prerequisite tree.

Prerequisite Tree (What currently prevents the implementation of the injection?)

The Prerequisite Tree (PRT) takes advantage of people's natural ability to point out why something can't get done. PRT focuses on the question what currently prevents the implementation of the injection. Strarting points for this diagram are major objectives and the obstacles to overcome them. End results are milestones that overcome all obstacles. The first step in building a PRT (after identifying the team's ambitious objective) is to collect all the obstacles that the group can come up with. Then each individual identifies an "intermediate objective" (IO) that would overcome the obstacle. The PRT is important because it lists the individual major actions that must be undertaken in order to suceed. Prerequisite tree helps to set priorities. From this point of view the prerequisite tree can be called the execution plan.

IO Map (or Transition Tree: what actions one has to take to effectively implement the cure?)

This tool supports the need to describe how to make the change happen. It tries to answer the question what actions have to be taken to implement the cure effectively. Starting point for this diagram is to define a set of goals, while end result brings

detailed actions to achive the goals. The IO Map (Transition Tree) is built on "necessity-based" logic. It sets the goal, critical success factors, and necessary conditions for success. IO Map is necessary to move forward from predefined goal (or a short list of goals) to a set of defined critical actions that both: help to achieve the goals and at the same time deliberately avoid undesirable effects.

Conclusions

The aim of the study is to present thinking metodology based on theory of constraints that can make an impact in knowledge management. The five stage thinking process in Theory of constraints starts with a Current Reality Tree (CRT). CRT shows what needs to be changed in the first place. Next tool, the Cloud, is used to understand and brake the conflict inside the system. The injection in the cloud breaks the constraint in the present and unlocks the future. It maximizes the leverage throughout the system. Third diagram, the Future Reality Tree (FRT) takes injection for change and ensures the new reality created would solve the unsatisfactory systems conditions and not cause new ones. Fourth diagram, the Prerequisite Tree (PRT) defines obstacles to implementation and presents ways to overcome them. Last tool, the Transition Tree (IO Map) is a graphical presentation of step-by-step implementation plan. The combination of five diagrams creates a complete, logical system supported by simple graphical presentation tools. Presented study prooves that the thinking process included in the theory of constraints complies with all the requirements of a solution acceptable from the point of view of the knowledge management understood as a tool to support the process of acquiring and maintaining long-term competitive advantage.

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