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A Simplified Approach to Soft System Design: Adapting Soft System Methodology

Lukas VALEK[1]*

Abstract

Designing or analyzing of a system is a complex task. To study all elements of a system, its inputs and outputs is usually work of a systems engineer. However, systems thinking should be present in most of activities of human life as a part of a holistic approach. That includes not only so-called well-defined "hard systems", but also "soft systems", which are composed mostly of humans. There are many tools for systems design and analysis of hard systems, but very few for soft ones. One of approaches aimed for soft systems Soft System Methodology (SSM) by Peter Checkland, which is in use for more than 30 years. SSM tends to be a universal tool for system analysis and problem solving in environment of soft systems. On one side, it seems very straightforward in its use of seven basic steps and use of so-called rich pictures for drawing a systemic situation etc. However, its universality requires also awareness of many points of view on a system studied, which again makes it a tool for systems engineers rather than for common people. With proper adaptation it could be used also as an approach for problem-solving and systems analysis and design in non-profit, business or governmental sphere accessible to any manager, employee or a citizen, who would like to take a systemic point of view of a situation. In previous research, SSM was used to break down and re-design a system of complementary economy called Time Bank. During many iterations of the process, a simplified approach to SSM was discovered. The simplification is mainly in proposal of a template for rich pictures, which also includes connection to next steps making it simple to draw and simple to observe transformation process with its inputs and outputs. In result, a person who would like to have an overview on a system (any system that includes people including project management) can use it. The final result is very similar to what was proposed in original SSM, but simplified enough to be used by general public, which brings new added value especially to smaller organizations who cannot afford own systems engineering department, but would like choose a way of holistic approach towards their activities.

Keywords: Soft System Methodology, Time Bank, Systems Analysis, Systems Design.

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1. Introduction

In the world around us we often encounter situations when we need to analyze a situation, solve problem, organize, plan etc. Looking on situation from holistic point of view, seeing that most of elements, which we need to explore and study are interconnected, we come to conclusion we can call them a system. Systems analysis is a mental process of learning about world using systems thinking and a systems approach, understanding that the world is composed of various elements, objects, processes, phenomena, problems, etc. [3] A system we analyze might be "hard" or "soft" system. Hard systems are well defined and typical by apparent chain of causality, so we are able to trace what is happening and why through whole system. Soft systems include unpredictable elements such as human beings. To study those ranks among the most difficult tasks for systems engineering, as soft systems are ever-changing, thus unpredictable and hard to quantify and qualify by experiment. [20]

Systems engineering (SE) is focused on design or/and analysis of systems. In daily life of businesses, non-profit, non-governmental organizations (NGO), or even in life of an individual we are often standing in front of a problem to do analyze or draft a system, yet we lack necessary tools to do it in systemic way. There are many approaches to be used in sphere of SE [3], but most of them are domain of trained systems engineers. It is true that, for example, quite simple V-model [12] could be used without much preparation, but still contextual knowledge is desirable, and V-model is designed to tackle hard systems. An approach to analyze soft systems and to do systemic problem solving is called Soft Systems Methodology (SSM) of Peter Checkland [7]. It requires nothing more than a paper and a pencil, and adherence to set of rules, to explore wider systemic context of any soft system. Even though SSM is quite simple in its essence, its focus to soft systems with ever changing point of view, makes it not so simple to understand, especially for newcomers to domain of SE.

Time Bank (TB) is a socio-economic concept of exchange of mostly services based on a time currency. TB uses concept of co-production [4], which is a tool to solve societal problems [18] by giving target groups a tool to help themselves. Among target groups can be various disadvantaged groups, but also, general population, local municipalities and businesses. It can be also described one of cheapest approaches to social support. [11] The exchange is usually based on an computer based system [2, 19] regardless of a target group. [9] TB is soft system itself [2], and it was never before studied as a system. During research of Time Banking (TB) phenomenon and its

analysis by SSM and its many iterations, a simplified approach to SSM was devised and this approach will be introduced in this paper.

2. Reasons for the research

Origins of this paper are related to need of advanced problem solving and systems analysis tool, which would be also accessible to general public from sphere of small and medium enterprises, NGOs and individuals with specific focus on Soft systems. In order to progress further we need to define what a system is and outline the difference between hard and soft system

2.1 A System

As for the definition of a system, according to Derek Hitchins a system is: "A collection of interrelated entities such that both the collection and the interrelationships together reduce local entropy". [6] To clarify this along the lines of the term "Systems approach," this is based on the principle that all aspects of a human problem should be treated together in a rational manner combining theory, empiricism and pragmatics. [17] A system therefore is a set of elements which has the following features [16]:

- Interrelationship and interdependence of objects and their attributes
- Holism
- Goal seeking
- Transformation process
- Inputs and outputs
- Entropy
- Regulation
- Hierarchy
- Differentiation
- Equifinality and multifinality

2.2 Hard and Soft systems

At this point we come to the dichotomy of a "hard" and "soft" system. In his work "Skeleton of Science" Kenneth Boulding proposed the Hierarchy of systems complexity which is shown below [1, 14].

1) Frameworks. The geography and anatomy of the universe: the patterns of electrons around a nucleus, the pattern of atoms in a molecular

formula, the arrangement of atoms in a crystal, the anatomy of the gene, the mapping of the earth, etc.

2) Clockworks. The solar system or simple machines such as the lever and the pulley, even quite complicated machines like steam engines and dynamos fall mostly under this category.

3) Thermostats. Control Mechanisms or Cybernetic Systems: the system will move to the maintenance of any given equilibrium, within limits.

4) Cells. Open systems or self-maintaining structures. This is the level at which life begins to differentiate itself from not life.

5) Plants. The outstanding characteristics of these systems (studied by the botanists) are first, a division of labor with differentiated and mutually dependent parts (roots, leaves, seeds, etc.), and second, a sharp differentiation between the genotype and the phenotype, associated with the phenomenon of equifinal or "blueprinted" growth.

6) Animals. Level characterized by increased mobility, teleological behavior and self-awareness, with the development of specialized 'information receptors (eyes, ears, etc.) leading to an enormous increase in the intake of information.

7) Human Beings. In, addition to all, or nearly all, of the characteristics of animal systems man possesses self-consciousness, which is something different from mere awareness.

8) Social Organizations. The unit of such systems is not perhaps the person but the "role" - that part of the person which is concerned with the organization or situation in question. Social organizations might be defined as a set of roles tied together with channels of communication.

9) Transcendental Systems. The ultimate and absolute and the inescapable unknowable, that also exhibit systematic structure and relationship.

As seen above, according to the Kenneth Boulding, the hierarchy puts “Social organization” on the 8th level of the hierarchy are the social systems which supposed to contain all human life with its complexity and richness [1] which is actually only one step from highest possible system definition, which are transcendental systems. This suggests that social systems are one of most complicated systems existing.

2.3 Hard systems

Hard systems are considered to be systems which can be designed based on knowledge of the behavior of their parts; they are predictable and rather mechanistic. By way of typical hard systems we can imagine, for example, construction projects, computer program design, automotive

industry projects, etc. A system can be designed by the sequence mentioned in previous section on systems engineering, and although there could be some emergent behaviors, after feedbacking and re-iteration the design should become stable and work as intended. In case of hard systems there could be multiple points of view from the engineers involved, and it is a task of the systems engineer to adhere to the most systemic approach. [3] Divergent perspectives need not drastically change essence of whole system. This approach is very straightforward and accesses apparent features of a system in relation to its elements, which in hard systems [17] can be easily identified.

2.4 Soft systems

Soft systems are not as well-structured and predictable as their hard counterparts. They are based on vague definitions and take into account human behavior. [7] As outlined above, systems which include the human factor are high in complexity [1] and the perception of a problematic issue and design also depends on the particular points of view of individuals. [3] In this paradigm, not only systems engineers, but others who are parts/elements/objects of the system itself must participate. Soft system design requires a specific approach which would take into account these specifics and would be able to work them out. The design of a soft system has no predetermined solution; it is fluid, and the solutions found are hard to test by any experiment. In short, there is no ideal best solution, there will be always only be suitable ones. Although this might sound grim, without any approach to design and problem solving in soft systems the situation would remain in its original level of entropy. Thus a structured approach or methodology should be used whether we would like to just describe and define the situation, change it, improve it or solve some ill-structured problem. [7] This approach is SSM.

3. Research Question and Aim of the research

Main research question for this paper is: Is it possible to simplify SSM so it is usable by wider public?

Aim of the research is therefore, to find a way how to make SSM accessible for wider public aside of systems engineers allowing them to make systems analysis and problem solving in soft systems with a simple and efficient tool.

4. Soft System Methodology overview

SSM is very powerful tool for systems analysis and problem solving. It stands on main seven steps, which are to be iterated as many times as necessary to find appropriate answer and breakdown of a system.

4.1 Stages of SSM

- **Problem situation unstructured:** Is the first encounter with a problem situation (in this context word "problem" is more related to problem solving and has no negative connotation). It means a situation which we need to analyze and solve. However, it is pure expression of the situation without any deeper analysis.
- **Problem situation expressed:** Means breaking down the problem situation using a tool called rich pictures. That means drawing all elements, flows, inputs, outputs, of the situation or a system known at the moment.
- **Root definitions:** With a focus on what the systems (elements of problematic situation) are, not on what they do [7] the definitions have to be broad enough and include possible restrictions in order to count on them further. It is desirable to create quality definitions which would allow us to produce suitable conceptual models. To assure the connection between these two factors and reality, it is recommended to use the so-called CATWOE model. [7] The acronym comes from C – customers: the entity for which the change is done and who are affected by it. A – actors: the agents who carry out main activities of the system, especially its transformation. T – transformation: the means by which defined inputs are transformed into defined outputs. W – weltanshauung: an outlook, framework or image which makes this particular root definition meaningful. O – ownership: an entity which have prime concern over the system and can cause the system to cease to exist. E – environmental constraints: features of system's environment which has to be taken as "given". [7, 20]
- **Conceptual models:** Knowing actual system/problem situation and its properties we can propose new system, which would solve the problem or be in a way better, more efficient, stable, more sustainable etc.
- **Comparison of conceptual model with problematic situation:** We compare our newly proposed conceptual model with situation as it is now.

- **Feasible, desirable changes:** We propose changes to current situation.
- Take action to change the situation

As much as these steps seem logical, to correctly follow them might be not so intuitive. Literature [7] presents a lot of real-life examples to clarify use of all approaches included in SSM. However, its contents and mental model might be not so easy to process for people who are not professional systems engineers. Therefore, new approach is proposed in the next chapter.

5. Findings – The simplified approach

5.1 Design of rich pictures

To simplify the seven steps of SSM for use by anyone a change is proposed. This change mainly comes from practical use of SSM and reflection of its use in literature. Knowing the problem situation, we can start to draw the rich pictures. Rich picture design should be already structured in a way that it reflects point of view of CATWOE and by that a picture is graphical representation of root definitions. By this we already compile three steps into one. Result gives us overview on whole system and allows us to study it more in depth. Moreover, it gives opportunity to study inputs going to system being transformed to outputs.

Proposed model for creating rich pictures also reflects years of experience with implementation of SSM of Peter Checkland and is based on three elemental questions related to a system/problem situation structure [8]:

- What to do? - P
- How to do it? - Q
- Why to do it? - R

As simple as this might sound, these are fundamental questions which define the system we are describing (P), possible sub-systems (Q), and the wider system (R) that surrounds the described one, of which P is a sub-system . This approach keeps focus on a particular system, allowing the exploration of adjacent ones without the limitation of including the elements mentioned above. It shows how and which inputs to analyzed system come from the wider system on an ownership level (entities who have a main interest in the existence of the system), and monitors outputs and feedbacks out of a system. System level analysis shows objects, connections, flows and processes within a system with relation to its sub-systems, which can be then broken down to individual elements as well. The idea of PQR is also supported by other sources which recommend asking the same questions

even in other contexts. [10, 15] This approach also keeps rich pictures structured and informative enough to provide the resources of any system in one page.

Based on this information above a completely new approach was devised. The approach of PQR created a unique frame of a circular design where inside there is a system: "P", which has its connections towards the sub-systems "Q", which are encompassed in the wider system (the "R"). This division – and the structure – will define following descriptions of all nine TB systems. This approach is also unique, because it comes from many iterations in application of SSM in analysis of TB and makes it simpler in the way, that it already includes root definitions into previous step and prepares the output for another steps. The SSM is like that simplified for common use, even though it is originally a tool for systems engineers. [20]

5.2 Example of a PQR scheme

The main core is already implementing the perspective of CATWOE when drawing a rich picture or a diagram of a system. Most important is W – weltanschaung – where the "resolution" of the picture selected, i.e. the main system being studied, its sub-systems as well as outside influences. To keep this resolution working, it is necessary to maintain a certain level of discipline and not to allow yourself to go too deep into the various subsystems, in which case the resolution would change and a single subsystem could reveal in too much superfluous detail its own subsystems and their subsystems. For this reason, originally selected W should be strictly adhered to until a picture of desired system is clearly drawn, and then we would proceed to more deeply exploring its subsystems. By means of applying CATWOE in the stage of expressed problematic situation T is considered as a space of the system where the transformation of inputs to outputs occurs, a step which is in the PQR model designated as P, with this transformation also using subsystems Q. This all is encompassed in the wider system R, which contains O and E from CATWOE. Thus, the level of ownership has control over the system, but also level of external environment. Finally, on all levels we have to consider C and A of CATWOE – Customers and Actors, i.e. those for whom the transformation is done and who are the entities allowing the transformation to happen. The result is a circular structure in which the inner circle contains P with its Qs, and the outside of the circle is the domain of R. An example related to the TB system is shown in the diagram below. [20]

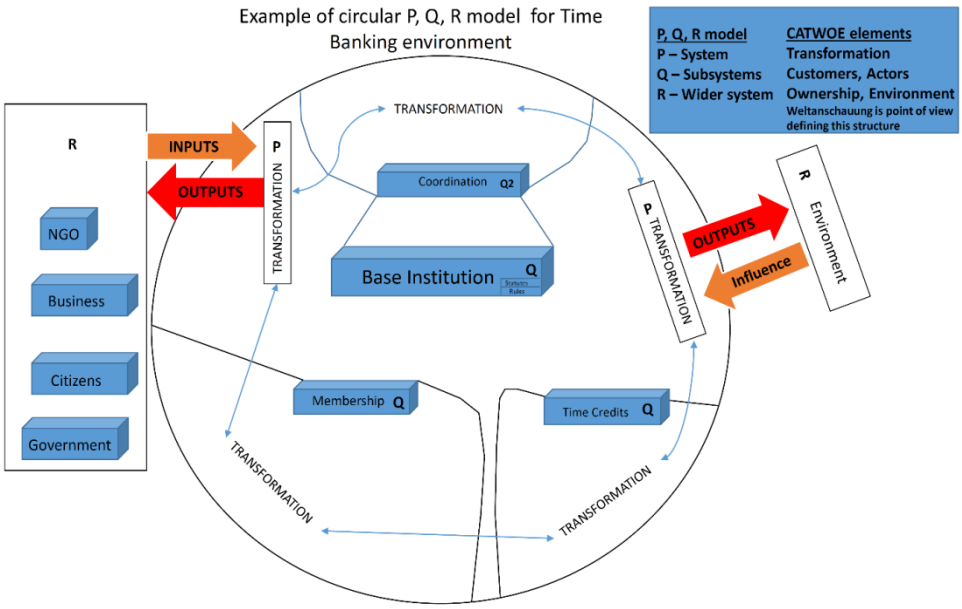


Diagram 1: Example of circular model for TB environment. Source: [20]

5.3 Example of use and result

To illustrate results further is shown final diagram of previously unstructured and not clearly defined system of Person to Person TB. The initial situation (vague definition) was, that Person to Person TB is a socio-economic approach, based on five main core values, which are: Everyone is an Asset, Redefining work, Reciprocity of exchange, Social Capital creation and Respect [5, 13] where individuals exchange services using a time currency (called Time Credit). TB was broken down as a system and aforementioned circular approach was used several times to finally uncover all entities and processes in the TB system. It shows inputs (in orange) going in transformation area P and being transformed to outputs listed in following table (they can be drawn to the diagram, but due to limited space and to ensure clarity they are presented separately). Other colors present are blue for ordinary flows and processes and green for feedbacks.

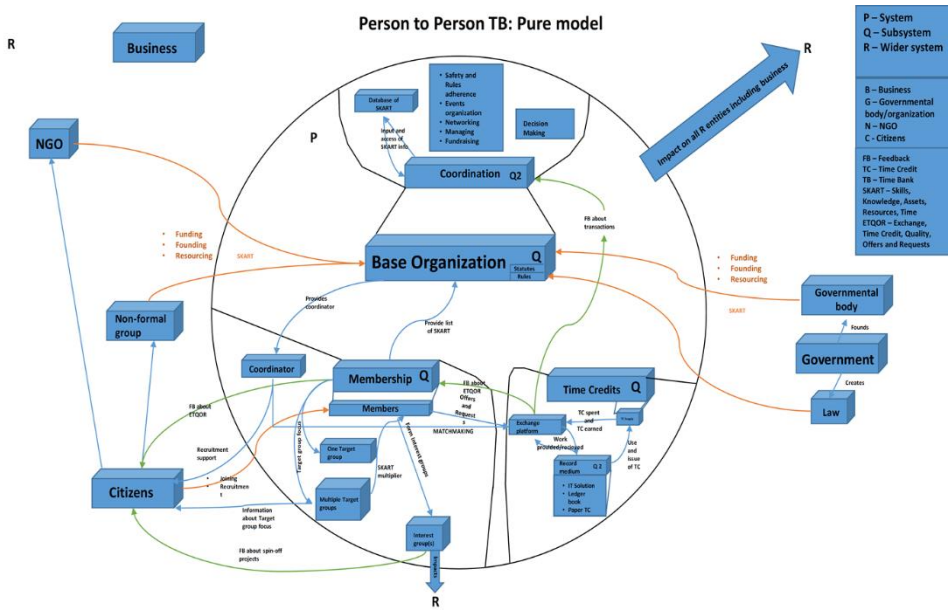


Diagram 2: Example of full systems point of view on a TB as a system in basic Person to Person model of TB. Source: [20]

Table 1: Outputs of the Diagram 2. Source: [20]

Outputs	
Impacts on "R" entities	
Feedback of security keeping by coordinator and existence of rules of a TB raise credibility	
Information about TG variety stimulates joining	
Feedback about participation (motivation for recruit.)	
Feedback about spin-off events and activities of IG	
Savings	Social sphere
	Innovations
	Local business development
Systemic outputs (on outside environment)	
Utilization of unused SKART	
Societal "bottom-up" problem solving by co-production	
Employability	
Non-formal Education	
Healthcare improvement (de-institutionalization)	
Awakening of dormant markets	
Reviving local economy	
Spin-off projects and innovation	
Learning - Enhanced Information and Knowledge sharing	
Systemic feedbacks	
+	All outputs above induce positive feedback towards its own "R" entity
-	Misunderstanding about social/business role towards some "R" entities
-	Could be misunderstood by government and restricted/forbidden

6. Discussion of results

After countless iterations of application of SSM in TB environment, an approach was devised. The approach answers positively to the research questions and fulfills the aim of this paper. It is believed that the proposed circular design can be used in various contexts aiding understanding of complexities of a soft system in few minutes with use of only a pencil and a paper. To achieve desirable results the design of rich picture and resulting diagram, should be done strictly as shown including already CATWOE approach within. A high level of attention should be given to discipline in keeping same point of view/resolution/weltanschaung whole time. In addition, it is recommended to iterate the approach more times, firstly identifying main entities and their sub systems, and flows among them progressing to drawing of complete model.

7. Conclusion

The simplified design to SSM came as a by-product of wider analysis of TB concept. Nevertheless, it proves to be potentially powerful tool for anyone who would like to make soft system analysis for whatever reason. It can be used in project management, planning, feasibility studies, problem solving, analysis of structure of a system etc. especially by small and medium enterprises, NGOs and individuals, such as managers and entrepreneurs. Further testing in real-life situations would be desirable to prove its universality. Nevertheless, its usability was already proven on very variable and fluid environment of TB.

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