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Collaborative Solutions *Quick&Clean*: The SFM Method

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Abstract: The SFM method (Solution Finder Model) is a structured, formal procedure to be applied during interactions in small, medium or large multidisciplinary groups where there is a need to collaboratively develop shared solutions of a high quality standard ("clean") and in a short period of time ("quick"). The SFM was developed within the context of various successful knowledge management projects, where different kinds of knowledge-intensive problems or tasks (such as specification, conception, design etc.) had to be solved collaboratively by a multidisciplinary group. The first part of the paper will explain the SFM by describing its theoretical foundations, terminology, components and principles, the procedure for applying it and examples of practical application. The second part will then describe 3 cases in which the SFM has been applied for developing a solution to 3 kinds of knowledge-intensive problems: design, specification and conception. The first example features the collaborative *design* of a Community of Practice by potential members of the planned community who interact in the context of a series of *design workshops*. The second example includes employees from all over the company who interact in terms of the *specification* of ideas within the context of a collaborative online ideas management system. Last but not least, the third example is the *conception* of a didactical model for analysing logfiles in learning management systems. At this point, the reader will have enough information to apply the method to his/ her own cases. In the conclusion, we will briefly look ahead to further planned research covering theoretical foundations and experimental investigations, especially at SMEs.

Keywords: collaborative problem solving, knowledge-intensive tasks, multidisciplinary collaboration, communities of practice, SME

1. Introduction

Today enterprises increasingly need to be flexible and quick in revising, updating and extending their business practices and processes. Such reorganization processes can be considered as knowledge-intensive, in the sense that they "*involve human judgment and experience, complex decision making, and very often, creativity. In fact, they are now being recognized as the most important processes for organizations today (Davenport, 2005)*" (Marjanovic & Freeze, 2012). The high numbers of tasks, their unpredictable nature, and the difficulty of remodelling the entire knowledge of the domain are further aspects of knowledge-intensive processes.

1.1 Some knowledge-intensive processes

In this sense, processes or tasks like requirement specification, system modelling or interaction design can be regarded as knowledge-intensive, especially in those cases where the experience of stakeholders from many departments or groups (multidisciplinary collaboration) is needed and must be combined in order to generate a shared solution. Furthermore, as regards the resources involved, it is important to consider that since a large group of people collaborating simultaneously on the same task has a high specific cost (cost/hour), there is a compelling need for efficient interactions; last but not least, the interactions also need to be effective, particularly in the sense that, regardless of the short time available, the quality of the solution must nonetheless be high.

This is where the SFM method for knowledge-intensive tasks comes in with its value proposition: its procedure is simple (lightweight), it can be executed in a short space of time (quick), it is designed to guarantee a high quality of the solution (clean) and it allows and promotes multidisciplinary collaboration in groups of any size.

1.2 Analogy with the Harvard negotiation method

In a famous story about negotiation, the essential difference between **interests** and **positions** (Fisher, Ury & Patton 1991) is illustrated by two children holding one and the same orange, bringing it to an adult and stating: "I want it!" The adult asks them to explain the reason why they want the orange. One child is hungry and wants to eat it; the other instead needs to bake a cake and wants to have the orange because he needs grated peel for the recipe. Negotiation succeeded! By focusing on the complementary interests (needs) rather than on the conflicting positions (solutions), both children gain a much better solution: orange to eat and orange for

the grated peel (Schwarz et al., 2005, p. 145). In this distinction between interests and positions, which forms the foundation of the famous Harvard model of negotiation, one can see a strong analogy with the distinction that the SFM makes between needs, objectives and solutions in the context of solutions development and supports the author's conviction that their model also has inherent potential and could become equally successful on a large scale.

2. SFM method

The essential, core characteristic of the SFM, which has its theoretical foundations in cybernetics, system engineering and radical constructivism, is the idea of the unity of 3 relevant elements: needs, objectives and solutions. The term *unity* refers here to the guiding principle of SFM: in order to find a high quality solution, the 3 elements should always be explicitly connected to build *a coherent triad* (the unity). This is accomplished by determining the 3 elements and their 3 relations (R1: need ⇔ objective; R2: objective ⇔ solution; R3: solution ⇔ need) in a suitable manner.

The SFM is constituted in essence by a set of basic principles or ideas, divided into two groups. The first group are **structural principles** which determine the **model** of a structure which allows thoughts and ideas to be ordered in a specific, peculiar way; this structural model (which is the "what" of the method, the substance of the tool) is the reason why the method has been allocated the term "model". The second group are **procedural principles** which determine how to obtain a structure which complies with the structural principles in a concrete situation; this part is the "how" of the method, the "know-how" needed for using the structural model in a situation where a solution must be conceived.

2.1 SFM structural principles

When one considers the multiplicity and variety of all aspects that determine a solution, she suddenly understands that if, on the one hand, looking at them and taking all of them seriously contributes to obtaining a very good, complete solution, on the other hand, this approach would require a lot of work on many different items and this would present an obstacle to an efficient and effective solution development, especially when this development must happen collaboratively and in a short space of time. Since the authors wanted (and needed) their method to be not only clean (high quality) but also able to deliver results within a short time frame (quick), they had to find a different solution. Intuitively, their approach was to search and identify the smallest required set of elements determining a solution, i.e. an essential set. This search was conducted based on the background of their experience and their theoretical interest in the fields of cybernetics, system engineering and radical constructivism (Bettoni 1990; Bettoni 1991; Bettoni & Bernhard 1993; Bettoni 1997). As a result they devised and formulated the following 4 principles, i.e. the "Tetractys" of their method:

- The Triadic principle: there are three essential elements to any solution and they must form a unity.
- The Connectivity principle: in order to form a unity , the three essential elements must be connected with each other one by one, thus forming three essential connections.
- The Interdependence principle: each connection between two elements is a connection of interdependence.
- The Solution principle: one of the elements must be a **solution** (to our problem) and the two further essential elements, with which it has interdependence, are the **need** (something we are missing) and the **objective** (what we can attain).

By combining these principles, we obtain the following model of a structure (see Figure 1) where we see three main paths for moving between the nodes which correspond to three main uses of the SFM method:

- Path P1 from need to objective to solution = goal-oriented problem solving
- Path P2 from solution to objective to need = goal-oriented solution analysis
- Path P3 from solution to need = justification.

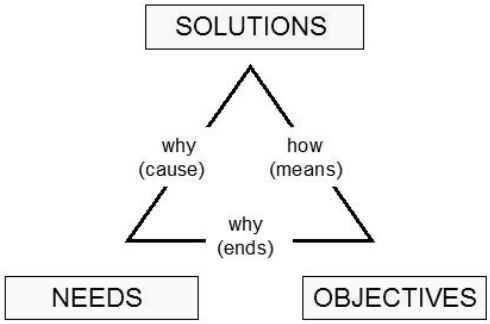

Figure 1: SFM method - the structural model

This structure can be used to organise a set of thoughts (and related statements) generated in the search for a solution to a problem; specifically, the ordering of the statements (that we call "triadic order") will be achieved by operating in terms of a triadic sequence composed of three specific elements :

- Need: the first SFM-element, a **need**, can be anything we are missing: new interests, hopes, concerns, dissatisfaction with a situation, defects to be corrected, new wishes to be supported, etc. which, in general, can be met or satisfied by more than one solution. For example, when dealing with knowledge and learning, the focus could be on knowledge needs; in this case, to identify a knowledge need, the question to ask is: "what do we need or wish to know? (know what?)". When we identify needs we are on a *functional* level.
- Objective: The second SFM-element, the **objective**, comes in because a need is usually not an end in itself: the goal it aims at can be used to achieve some effect (goal, objective). When the need is given, in order to identify a related objective the question to ask is: "what effect should be achieved in order to satisfy the need?" Then, when the objective has been found, the question of "why this objective?" is answered by the needs connected to it. In this step, we move from the specific functional level of the needs to the *general, explanatory* level of the objectives (rationale).
- Solution: Finally, the third SFM-element, the **solution**, is the instrument, tool or method that enables you to reach the objective and satisfy the related need. A solution should be an answer to the question: by which measures (means) can the objective (end) be attained? In this step, we move from the explanatory level to an instrumental level. Vice versa the question of "why this solution?" is answered by the objectives and the needs connected to it.

According to SFM the triadic order of the given thoughts or statements is obtained by identifying in the given set of thoughts one or more unique combinations of three fundamental elements, i.e. a solution to a problem, a need in terms of the essence of the problem to be solved and an objective as the rationale for the need.

As a result of organising a set of statements based on this structural model, a diagram of a solution system emerges which we call a "Solution Map" (see Figure 3) where each element can have multiple connections.

2.2 Exploring the SFM on a practical example

The SFM is used as an analytical tool, where the starting point appears in form of a problem for which you want to find a solution. This little example shows how the method works:

- Problem (starting point): "*I'm hungry*"
- You may think, that "eat" is the solution to the given problem. But this is only the case if "I'm hungry" is the need and "*be satisfied*" is the objective.
- But if the objective is "*to reduce weight*", then the solution will be "*do not eat*" and the need occurs still as "I'm hungry".
- It is also possible, that "I'm hungry" is the objective, then the need can be "*loss of appetite*" and a solution could be "serious sport". It is also possible, that "I'm hungry" is a solution, then "*treatment of anorexia*" could be the need and "*eat*" would be the objective.

As shown in the example above, "I'm hungry" can be need, objective or solution. By applying the Solution-Finder-Method, you will easy find the combination that best fits to your case.

2.3 Procedural principles

As the name "Solution Finder" suggests, in general the SFM method can be applied to any situation in which a solution needs to be found. We will later see a situation of Collaborative Design (case A, section 3.1) in which the contributions of a multidisciplinary group of people resulting from three World Café sessions in a "Problem Meeting" needed to be structured and systematised in order to make the best use of them during the following "Solution Meeting". In another situation called Collaborative Specification (Case B, section 4.1), we will see how in various phases of an online collaboration, a group of employees contribute to the development of an idea with a great variety of statements made during online discussions. At a certain point in the ideas development process (phase 4), the solution ideas need to be compared and evaluated. Finally we will see a situation of Conceptual Modelling (Case C, section 5.1) in which a great variety of statements originating both from theory (e-Learning functions) and from practice (e-Learning requirements) had to be integrated into a consistent model.

In all these cases, there is a search for solutions, the collection of a wide variety of contributions to this search and the need to use the available materials in the best possible way in order to find what we are searching for (see Figure 2).

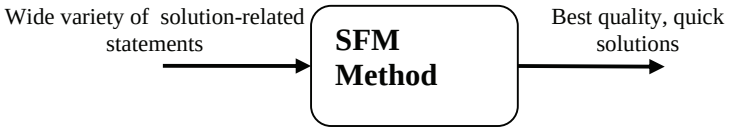

Figure 2: Generic application case

In Case A, the procedure, a variation of the Grounded Theory approach (Charmaz 2006), was as follows. First of all, due to the authors' underlying epistemology, before the meetings they had decided to facilitate the sessions and collect data in an **unstructured way** (unstructured interaction). In fact, they hold a constructivist point of view (von Glaserfeld 1995) and believe that, in order to make the most sense of the participants' contributions, you have to approach their world from their own perspective and reify these contributions in our documents based on their own terms. Secondly, during the Problem Meeting the authors' team collected detailed notes of the individual statements which the participants had contributed in three different sessions: 1) actual situation, 2) vision & feasibility, 3) priorities. Since they as the facilitators, following their unstructured interaction approach, did not use predefined questions and did not have any hypotheses about the possible contributions, the content of the notes is similar to those which can be obtained as part of unstructured interviews (Zhang & Wildemuth 2009). Coding of the material was carried out between two meetings in terms of the concepts of our Solution Finder Model; the analyst read the statements from the minutes, demarcated segments within them by comparing similar expressions (similarity of content and category) and then labelled each segment with a "code"; codes were mainly "need", "objective" and solution", but also other words or short phrases that emerged as frequent categories when various statements were collected into a cluster. Next are examples of statements taken from the minutes of a Problem Meeting (August 2011); first comes the statement number, as second the person's acronym, third is the statement and finally the code (N= need, O= Objective, S=Solution, D=Defect, M=Measure):

- 09, SK, "Information about HW parts is missing", D
- 10, CS, "for magnets we need a database", S
- 13, JA, "each employee has data and should be able to upload them", N
- 15, JA, "it was planned to manage data with a CMS", M
- 62, ME, "avoid that anyone calls the development team for support", O
- 66, SC, "Tools that we have developed should gain better visibility", O
- 73, DM, "we have lot of tools but application oriented information is missing", N
- 90, RS, "Contact persons could be found if we had a directory appropriately organized", S

After the coding and ordering of the statements into clusters with the same code, the analyst was able to compile triads each composed of a need, an objective and a solution following the structural model presented above (Figure 1). An example of a small part of such a solutions map is reproduced in Figure 3.

In Case B and C, the authors were basically able to use the same fundamental approach except for some variations needed to adapt the procedure to the different settings. In case B, one main difference was that the statements analysed, interpreted and coded originated from postings in discussion forums, i.e. from asynchronous, written interactions; in case C, the origin of the statements was different, resulting from a literature search and analysis by a researcher and requirements elicitation by means of an online survey, workshops and face-to-face interviews.

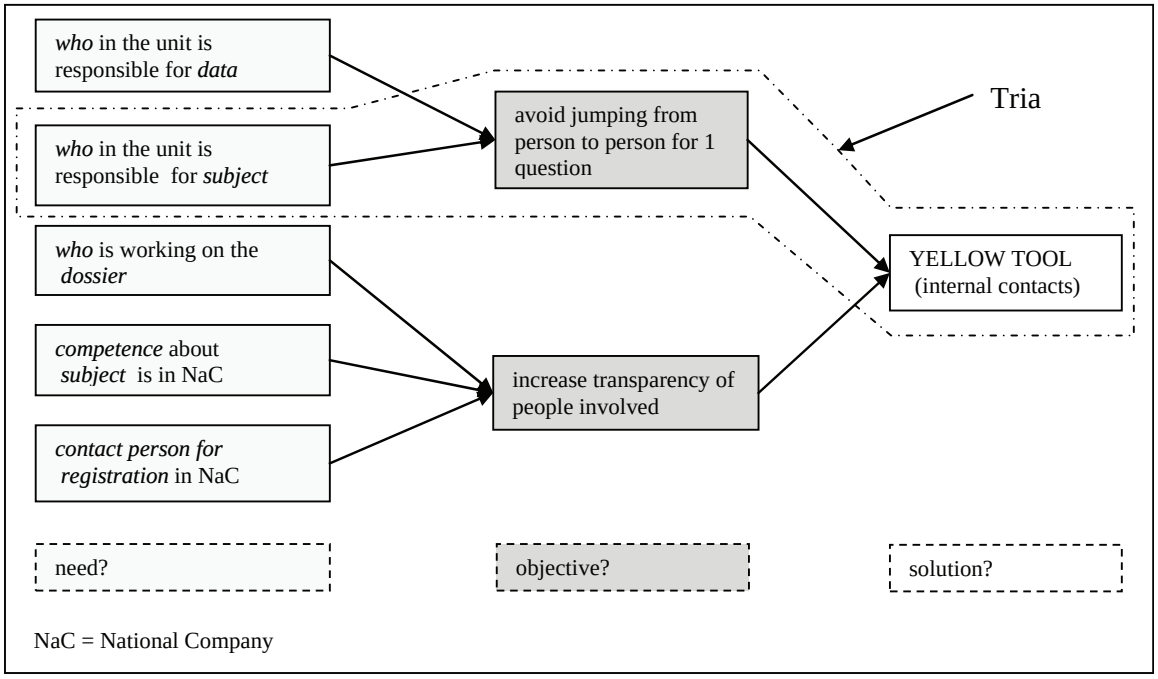

Figure 3: Solution map case A (excerpt)

3. Case A: Collaborative design

At a pharmaceuticals company, an SME (for reasons of discreteness we will call it "Phar AG") with its headquarters in Switzerland and about 30 worldwide independent national offices, the "Phar International Regulatory Affairs" (PIRA) department based at the company's headquarters oversees and supports drug registration processes worldwide in collaboration with the aforementioned national offices. The drug registration process is the process of preparing, submitting and correcting a drug application for obtaining approval of its use from the national consumer protection agency of the specific country in which the drug will be sold. Success in registration projects depends heavily on having an optimal flow of information, and the increasing internationalisation of Phar AG had created new demands on their communication and collaboration processes, particularly knowledge-sharing.

After evaluating various kinds of knowledge management solutions, it was the concept of an Online Community of Practice (CoP) that the authors proposed which raised the interest of PIRA. After its launch, the CoP generated a new means of collaboration within the PIRA department. All employees dealing with the registration of pharmaceutical products were able to collaborate worldwide in forums and wikis, for example discussing new legislative requirements or developing a shared FAQ about them. In addition, documents could be shared and viewed worldwide on the platform. Finally, the CoP enabled transparency: by means of a wiki using personal profiles designed according to the "Yellow Tool" concept (Bettoni, Bernhard et al. 2007), it was easy to find out who was working on what subject, where the expertise was available and how to contact the person.

3.1 Needs and objectives

As preparation for the actual participatory design of the community elements (domain, community and practice, see Wenger et al. 2002, p. 27 ff.), the authors conceived two full-day meetings: a so-called "Problem Meeting" and a "Solution Meeting" for dealing with actual situation, visions, feasible solutions and priorities in two stages. Since both meetings required the participation of employees representing the major groups that would become members of the CoP, finally what came together was a multidisciplinary team of people with a

variety of nationalities, backgrounds, experiences, roles, tasks and countries of affiliation. Based on this diversity and with the objective of making the meeting effective (relevant outcomes) and efficient (limited time), an adapted version of the "World Café" was selected as main method of interaction.

It was between the aforementioned two meetings of this project that the SFM was invented (end of 2007). In fact, since each of the three World Café sessions (actual situation, visions, and priorities) had delivered a huge and complex mix of statements belonging to a variety of categories, simply listing these statements in the minutes or also organising them in a huge mind-map would have caused the reader to become lost. In order to facilitate the activities planned in the solution meeting, a very good **orientation knowledge** had to be provided, something like a structured, systematic view of the outcomes of the problem meeting. But how to structure such a huge, complex, intertwined mix of statements? Which system could be used to bring order to this variety? By applying the SFM method to itself, we could say: the SFM has been the *solution* that builds a stable triad together with the *needs* and *objectives* of this case.

4. Case B: Collaborative specification

Like the previously mentioned pharmaceutical company, the Swiss Distance University of Applied Sciences (FFHS) is also an SME with about 260 employees; nearly 60 of them (administration, technical services, research, education managers) have a permanent contract and about 200 lecturers have a part-time, teaching contract. In 2008, the Board of Directors at the FFHS sought ways to encourage employee participation in the development and improvement of the university; ideas management was selected as the most promising opportunity and the Research Management Unit (RMU) of the FFHS (which at that time included the first two authors of this paper) was allocated the responsibility for conceiving, designing, implementing and running this new initiative and developed an innovative, collaborative model of enterprise ideas management based on a human-centred approach and supported by a Moodle online space (Bettoni, Bernhard et al. 2010).

4.1 4.1 Needs and objectives

The innovative ideas management process, based on the authors' approach called "Seven Phases Tendril" (Op. cit., Table 1) supports not only the conventional process (submission of ideas, testing, decision, award) but also a specific, facilitated and collaborative "cultivation process" which serves to unfold an individual idea and further develop it (together with the idea-giver) during the course of an online collaborative process (e-collaboration) leading to a workable, shared solution.

How does it work? The online collaboration is enabled by a suitably designed and equipped Moodle space. After publishing the new idea in a *news forum* and forming a group of employees interested in that specific issue and wishing to contribute to its development, the group interacts via a specific *discussion forum* and is guided by a facilitator through up to 7 phases of the ideas development process.

Phase 2 is a convergent thinking phase which results in a mind-map that visualises a more detailed understanding of the problem to be solved and of related tasks in its branches and nodes. Phase 4 is the filtering process, where ideas from phase 3 are structured and evaluated. The convergent thinking style of phase 4 allows criticism and leads to results ready for phase 5 where improvements will be the goal.

How can one evaluate the solution ideas derived from phase 3? Similarly to case A, we have here a situation in which a wide variety of statements originating from discussions about the idea under development (in this case online discussions, not f2f) have to be put in some kind of order. Since we need to compare the various solutions as part of the evaluation, what was needed here was **generalisation knowledge** in the sense of a structure or framework in which all items to be evaluated can be placed (interpreted) as specifications of the same **generic** paradigm. A suitable generic paradigm for this was found in the SFM structural model (Fig. 1) by considering that a great part of the contributions could be viably interpreted as direct or indirect assertions either about needs or about objectives or solutions.

5. Case C: Conceptual modelling

When teaching and learning are supported by learning management systems (LMS), then the logfiles (user interaction traces) of the LMS offer opportunities for understanding the activities of students and teachers; this understanding then provides a good basis for devising ways of improving the quality of teaching and learning. Unfortunately, the logfiles provided by a LMS are seldom used; one of the main reasons for this

shortcoming is the fact that data is not aggregated from a didactical perspective. As a contribution to overcoming this difficulty, an inter-university team (directed by the main author of this paper) has developed MOCLog, a monitoring system that helps to analyse the logfiles of the LMS Moodle by interpreting the data based on a suitable didactical model that we call "MOCLog model" (Mazza, Bettoni et al., 2012).

Unlike case A and B, in which the sources of the highly diverse statements to be organised were of a **synthetic** type (group discussions), in this case C, the sources are of an **analytical** type, namely the analysis of research literature and a requirements analysis that were performed as a basis for the creation of the MOCLog model.

5.1 Needs and objectives

Based on the research review and requirements analysis, the development of the model began by creating a concept map that had the function of clarifying the concepts involved and their relationships. Next it became evident that one needed to integrate theory and practice with the aim of producing a solution: a) theory in the shape of a framework of didactical objectives and related means obtained from our literature review; and b) practice in the shape of stakeholder requirements (obtained from the requirements analysis) and LMS metrics (log codes, logfile entry formats) of the Moodle system.

As a consequence, the question that had to be answered here was of a methodological type: which set of concepts and which methodology would allow the integration of theory and practice available in the form of a very diverse set of statements provided by two analytical sources? As in the previous two cases A and B, the SFM method has been the solution that builds a stable triad together with the needs and objectives of this case C.

6. Conclusion

The SFM method originated from the need to solve an unexpected problem which arose during a consulting project (case A). It was further developed in the context of similar knowledge-intensive processes like that of case A (collaborative design) as well in new types of knowledge-intensive processes like collaborative specification (case B) and conceptual modelling (case C). As a result of these and other successful project experiences, we have now at our disposal a practical method which promises to have the potential to become a major tool of organisational consulting for enterprises which increasingly need be flexible and quick in collaboratively revising, updating and extending their business practices and processes.

The next steps that the authors are planning consist of developing an explicit theoretical foundation, revising the method by adapting it to this explicit foundation and after that, evaluating its application in practical cases. For the theoretical inquiry, it is planned to extend the existing theoretical foundations by looking in particular at various theories of needs (Maslow, Herzberg, McClelland etc.), at action research (actor-network theory, theory of structuration, etc.) and knowledge management research (Bettoni 2005).

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