Knowledge sharing in expert-apprentice relations
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Chapter 8

Testing the C4 protocol

In the previous chapter the C4 protocol for expert-apprentice relations was presented. In order to be able to conclude on the protocol, the protocol is tested in four additional cases. In this chapter the protocol is tested in order to collect evidence about the effectiveness of the final protocol. This chapter presents the results of the testing of the protocol. Overall, the test cases supported the effectiveness of protocol, with some results leading to adjustments and improvements of the protocol. These adjustments are already included in the protocol as it is presented in chapter 5.

This chapter is structured as follows: the four cases in which the protocol was tested are individually described and the results of the testing of the protocol are discussed. The protocol is evaluated after which the implications for the different parts of the protocol are described. The adjustments that are a result of this evaluation are presented in the last section of this paragraph. But first, this paragraph starts with some general remarks on testing in DSR.

8.1. Pragmatic validity through alpha and beta testing

The C4 protocol for expert-apprentice relations presented in this research, is a result of DSR. As a consequence of this, its form is a solution concept: it aims to solve a problem. Heuristic solution concepts cannot be justified conclusively. In this research, the C4 protocol is therefore justified by using what is referred to in DSR as pragmatic validity (Van Aken, 2004). Pragmatic validity means that the solution concept is tested in its intended context which can lead to sufficient supporting evidence. The main goal of testing design knowledge is justification. Within testing of design knowledge, there is a distinction between alpha and beta testing (Van Aken, 2004). Alpha testing and beta testing serve the same purpose, but in different stages of the research. During the concept development, alpha testing takes place when the concept is tested by the researchers themselves. Subsequently in beta testing, the concept is tested by third parties to obtain more objective evidence. The alpha and beta testing can offer further insight into the intended as well as the unintended consequences of its possible application, in its indications and contraindications, and in the scope of its possible application, its application domain (Van Aken, 2004; Stam, 2007). The aim of the testing is to collect supporting evidence in order to reach a point of theoretical saturation (Van Aken, 2004). Beta testing serves the purpose of ruling out the rival explanation of investigator bias (Yin, 2003) or the experimenter
effect: is it the method itself or the unique combination of knowledge, experience and strong determination of the deviser that makes the method succeed (Stam, 2007)?

In this research the C4 protocol was tested in four different cases. In these test cases the protocol was applied in two ways: in two cases the researcher tested the protocol, while in the two other cases the protocol was tested without further interference by the researcher. In the first two cases the researcher was present in the relations and implemented and adjusted the protocol, these two cases can therefore be considered as alpha testing. In the two final test cases the protocol was implemented by a different person, with the researcher only observing it’s results. These latter test cases can be considered as a form of beta testing. The four test cases were part of the Talent Project which was described in chapter 4. After each case the facilitator, researcher and participants of the project evaluated the protocol. The next paragraph describes these four cases, differentiating between what can be considered as the alpha test cases and the beta test cases.

The next paragraph describes the four cases where the protocol was tested. This is done by discussing both the implementation of the protocol itself and the outcomes of the protocol implementation. The discussion of the test cases focuses on two aspects of the protocol: (1) the way in which the protocol serves its goal and creates the desired outcomes, and (2) the way the facilitator operates the protocol: how easy is it to apply? This latter aspect is mainly described in the beta test cases. Before this, the test cases which were performed by the researcher are discussed and evaluated.

8.2. Test cases 1 and 2: alpha testing the C4 protocol
This section discusses the test cases where the researcher facilitated the relation. In test project 1 an expert-apprentice relation was installed in a consultancy firm, while in test project 2 the protocol was used in a technical environment. The protocol was applied in these cases and results were evaluated using semi-structured interviews, logbooks by the apprentice and observation techniques.

Test case 1
The first test case of the C4 protocol took place in a medium sized consultancy firm. In this case, a student was matched with an expert from the firm: the firm’s director. This expert-apprentice relation was identified as a type A-dominant relation. The relation was identified as A-dominant because the director’s expertise was mainly based on his attitude and personality use within the organisation. The director signed up for the project, while the apprentice was chosen from a list of students who had been accepted for the project. The knowledge domains of expert and apprentice were matched based on their formal education and working activities.
According to the participants, the expert-apprentice relation functioned well. At the start of the project, the expert expressed the expectation that he would gain new knowledge from the apprentice’s presence. At the end of the project he claimed that he had become more consciously aware of his knowledge and that his knowledge domain had deepened. He further stated that he had gained most from the new theories the apprentice had explained to him and from the questions he had asked. The apprentice evaluated the relation very positively and claimed that he gained a lot of new knowledge. The social relation between expert and apprentice was positively evaluated. However, the expert and apprentice experienced some difficulties in connecting their expert-apprentice relation to the surrounding organisation. The expert found that he needed a more formal status for his apprentice. He formalised the expert-apprentice relation by appointing his apprentice to a role that already existed within the organisation in an attempt to further legitimate the presence of the apprentice within the organisation. This expert-apprentice relation worked according to the steps in the protocol. They recognised the four stages of the expert-apprentice relation. They concluded that they had both gained new knowledge as a result of their participation in the expert-apprentice relation.

The protocol functioned well in this project. The matching of expert and apprentice followed the steps of the protocol. The need to formalise the relation was not covered by the protocol, however a solution was created which was acceptable to the expert, apprentice and the organisation and which was within the boundaries of the protocol.

**Test case 2**
The second test case took place in a construction factory. The expert was asked by his executive to participate in the project. The apprentice was a student who applied for this specific project and was accepted and approved by the facilitator and the expert. This expert-apprentice relation was identified as a S-dominant relation. The expert’s expertise was of a technical nature, although his function and expertise within the organisation consisted for a large part of A-knowledge as well. The expert had developed his expertise through years of experience and the apprentice matched this knowledge with his technical education. According to the expert and apprentice they matched socially as well: their personalities were quite similar. The protocol was implemented according to the successive steps. The researcher and the participants evaluated the case. The expert did not voluntarily participate, but was assigned to the task. Therefore, the commitment of the expert was closely monitored to make sure this boundary condition was met.

In this project the expert and apprentice held each other in great esteem. In their evaluation they said there grew a personal connection and an emotional bond. According to the expert and apprentice, their personalities corresponded, as did their expectations of the expert-apprentice relation. The protocol successfully resulted in a social relation. With respect to the knowledge sharing, according to the expert and apprentice, the development of the
apprentice was distinct. The apprentice experienced a lot of different situations and practices. The expert said he gained most new knowledge through reflecting on his existing knowledge: he called this learning by teaching. The expert and apprentice claimed that participating in this project made them aspire to achieve higher goals than they would normally aim for. The positive results of this project became known throughout the organisation; people started watching them. According to the participants, the first positive outcomes accelerated their project and resulted in an increased motivation and led to better results. This positive stimulation was an aspect that had not been anticipated.

The second test case indicates that applying the protocol can result in an effective expert-apprentice relation in which both expert and apprentice gain new knowledge. This case also showed that the protocol had a focus on negative aspects of the expert-apprentice relation, and ignored possible positive stimulations.

8.3. Test cases 3 and 4: beta testing the C4 protocol

In the following two test cases the C4 a third party applied protocol. The researcher observed the relation and evaluated the project with the facilitator and the participants. The facilitator was asked to keep a journal in which he registered his findings. At the end of the projects the facilitator evaluated each step of the protocol in relation to the results of the two test cases. Using the semi-structured interview technique the experts and apprentices were asked to evaluate the project.

Test case 3

In the third test case the C4 protocol was implemented in a specialised research and consultancy organisation. The expert applied to the project with a specific knowledge request: he asked for an apprentice with a specific knowledge domain. The apprentice was selected and matched according to the steps of the protocol as well as according to the preferences of the expert. The expert’s expertise existed within a specific technical domain. Because he was the managing director of the firm and had broadened his knowledge domain over the years with general management knowledge. As was requested by the expert, the apprentice had a technical background with an education in management and organisation: the knowledge domains matched partly on the technical domain and partly on the management domain. This expert-apprentice relation was identified as an I-dominant relation because of the specialised knowledge within the organisation.

The expert and apprentice in this project evaluated their relation as valuable and useful. In their evaluation, they indicated that it took a while before they trusted each other, and therefore it took time to move on to the next phase in the relation. The facilitator said that the first stage of their relation lasted longer than they had anticipated. At some point in this phase they had questioned the development of their relationship and had considered
quitting the project. However, once they got to know each other better, and trust developed, the relation improved. With hindsight they were glad they continued. The knowledge sharing was positively evaluated by the participants. According to the expert, he learnt from the knowledge combination of the apprentice in relation to his own knowledge domain. He became aware of his knowledge on management and could relate to the knowledge of the apprentice in that specific domain.

The specific request of the expert for an apprentice with a specific knowledge domain could be fitted within the protocol. The facilitator who applied the protocol, evaluated the protocol as functional. The instructions in a couple of steps were not clear to the facilitator. In the first phase of the project, the expert and apprentice had some trouble building a trusting relationship. According to the facilitator, in this case it was relevant that he had some experience in coaching social relations.

Test case 4
In this fourth test case an expert-apprentice relation was implemented in an advice centre. The expert was asked to participate in the project. The expert was matched with an apprentice with a knowledge domain which partly overlapped. The facilitator of this expert-apprentice relation applied the protocol and identified the expert-apprentice relation as being I-dominant, but with strong S- as well as A-elements. The facilitator monitored the project and the researcher, the facilitator and both the expert and apprentice evaluated the relation.

In their relation the expert and apprentice both tried to find suitable training opportunities for the apprentice. Because the expert’s expertise was in a specific knowledge domain, they sometimes found it hard to select situations where the apprentice could practise a certain skill. According to the expert and apprentice, the environment of this expert-apprentice relation was very supportive. The expert claimed that he gained new relevant knowledge and that the apprentice had gone through a clear development. The relation’s environment also agreed about the knowledge change. The expert as well as the apprentice evaluated this method as effective. The facilitator in this fourth test case stated that the protocol suited this expert-apprentice relation. They followed the protocol without encountering obstructions or barriers. The facilitator stated that the division of the protocol into four phases results in a better understanding of the protocol, due to this the facilitator was consciously aware of the development of the expert-apprentice relation. Related to this is the monitoring of the relation, where the facilitator emphasised the importance of this particular step. The facilitator however, did indicate that he found it difficult to identify the type of relation. He identified this expert-apprentice relation as being I-dominant with A-aspects, but was not so sure of this during the process.
8.4. Evaluation of the test cases

The first two test cases show that the protocol as a whole achieves its goal: the results indicate that by applying the protocol, expert-apprentice relations are installed in which both expert and apprentice gain knowledge. These two cases support the protocol. Although case 1 and case 2 differ significantly, the protocol seems to fit both relations. Both types of relations can be supported by the protocol. However they also give cause to a few improvements, in particular two additions to complete the protocol. The improvements are: adding the opportunity to formalise the relation and focussing on the positive effects of the relation.

The last two test cases indicate that a third party can apply the C4 protocol. The facilitator could use the protocol and for a large part understood the stages and steps of the protocol. The results of the two test cases have resulted in the rewriting of a couple of steps in order to make them clearer to the protocol users. The results of the fourth test case indicate that the definitions and descriptions of the different types of expert-apprentice relations should be evaluated as well. However, whether test case 3 and 4 qualify as cases of beta testing is questionable. In these cases, the C4 protocol was applied by a third party, but in relatively similar contexts as in the alpha test cases and the developing test cases. In the beta test cases the protocol was applied by the same person. For the objectivity of the results, the test cases would have been preferably applied by different users. However, the comment that the contexts of the test cases were similar to previous cases, can be countered by the fact that the two test cases were applied in two distinct organisations, with different conditions and characteristics. This holds for all four test cases: because the cases differed in various aspects, it was possible to test the protocol in four distinct situations. Between the cases, differences can be seen in type of organisation, type of participants and type of expertise.

In general, the test cases supported the effectiveness of protocol. In the four cases, applying the C4 protocol resulted in expert-apprentice relations where expert and apprentice shared their knowledge. The outcomes of the four test cases show that applying the protocol can result in the expected knowledge sharing between an expert and an apprentice. In the four cases applying the protocol resulted in expert-apprentice relations in which both the experts and the apprentices experienced a change in knowledge, i.e. they learnt. Within the results of the relation, the possible learning outcomes observed were identified in chapter two: increasing knowledge, new synergetic knowledge of new non-synergetic knowledge. The apprentice’s knowledge changes were mostly in the expert’s knowledge domain, but were also influenced by the environment of the relation. Whether or not the facilitator communicates these different learning effects and the content of the knowledge domains to the expert and apprentice, depends on the type of participants. In the four cases different matching strategies were used. In two cases the expert was appointed by the organisation, while in the other cases the experts applied themselves. In the matching of knowledge
domains other differences could also be found: the expert could make demands on the apprentice’s knowledge domain. The protocol anticipates these different strategies and offers various routes, all leading to the realisation of functioning expert-apprentice relations.

Applying the protocol resulted in a social relation between the experts and the apprentices. The four test cases show a clear distinction in the intensity of the social relation, although eventually all participants indicated they trusted their partner in the knowledge sharing process and experienced a social bond. In one case the participants indicated that the protocol permitted too little time in the second stage for establishing a trusting relation. Within the protocol the activities in the expert-apprentice relation may vary according to the type of relation and type of knowledge. According to the participants, all activities fitted into the relation in a natural way. In two cases the positive outcomes of the relation resulted in an increased motivation of both experts and apprentices. The motivation resulted in the active search for additional joint activities. The environments of the expert-apprentice relations accepted the relation in three of the four cases. In one case the expert had difficulties with the informal status of the apprentice.

The second part of the evaluation, is the evaluation of how to use the protocol. The user-evaluation is positive as well: the facilitator of the third and fourth test case found the protocol easy to apply, with for the most part clear instructions and a logical structure. A characteristic of design solutions is that they are meant to be used by professionals in the field. Here, the relation facilitator had some previous experience with learning situations in organisations and coaching in social relations. The test cases show that this is an important indication for the protocol. The facilitator should be able to select and match expert and apprentice, and be capable of coaching the relation.

To summarise, the test cases resulted in a positive evaluation of the C4 protocol. The outcomes corresponded with the intentions, and the different aspects of the relation were present as expected. The test cases also resulted in some comments on the protocol and uncovered some indistinct instructions. The facilitator commented on two steps of the protocol which were unclear to him, and emphasised the monitoring instructions. Some participants thought the apprentice needed a formal status, and others claimed that the first phase of the relation was too short for them to build a trusting relationship. These test outcomes resulted in the protocol’s approval with some minor improvements. The implications of the evaluation for the protocol are subject of the next paragraph.

8.5. Implications for the C4 protocol

Due to its positive evaluation, it can be claimed that the C4 protocol is justified by pragmatic validity: applying the protocol in its intended context resulted in intended
outcomes. The test cases indicate that the protocol needs no major improvements. However, the evaluation does indicate that some aspects of the protocol can be improved by making a few adjustments. First, the evaluation of the protocol implementation in the two alpha test cases resulted in adjustments of the protocol.

In a specific case the expert wanted to give his apprentice a more formal function. Within the protocol, there was no possibility to do so. Therefore the opportunity to formalise the relation is acknowledged and added to the protocol. Also, in a specific case the expert and apprentice experienced a lack of trust after entering the Connecting stage. This negatively affected the relation. An implication for the protocol is that the requirement is added to give experts and apprentice enough time to build up trust. Trust is also emphasised in the evaluation step of the Connecting stage. The next adjustment results from the case in which positive results increased the participant’s motivation. Because the participants considered this effect substantial, it was also added to the protocol. The adjustments are described below.

- When the positive results of a project are presented during the course of the relation, the people outside the relation are increasingly willing to support the project: success creates success. An addition to the protocol is therefore that expressing the positive outcomes of an expert-apprentice relation to the expert and apprentice can result in increased motivation.
- It may take some time for experts and apprentices to create and build a trusting environment in which the knowledge sharing can take place. It is therefore essential to give the participants enough time to develop a trusting relationship, i.e. to go through the phase of acclimatisation.
- In some organisations the apprentice needs to receive a more formalised status. The tasks and duties of an expert in a (knowledge intensive) organisation are not always easy to identify or directly observe. After formalising the apprentice’s presence, his status and proximity to the expert becomes legitimised. Therefore formalising the status of the apprentice can be useful in certain contexts.

The results of the alpha test cases refer to the content of the protocol: the expert-apprentice relation itself. The results of the beta testing also indicate whether or not the protocol is easy to use. The beta test cases resulted in implications for the use of the protocol: the way the C4 protocol can be used by third parties.
- The facilitator in the test projects commented on the instructions given in two steps. The facilitator did not completely understand the meaning and purpose of the instructions. These two steps were rewritten in order to be clearer to the facilitator. The rewritten steps were proposed to the facilitator who approved them;
- The test cases resulted in four different matching processes. This led to an adjustment in the Composing stage: the different routes taken in the matching of expert and apprentice are emphasized and extended;

- The use of the protocol indicated that the facilitator applying the protocol should be a professional in the field: a person who has some experience in selecting and matching as well as in coaching. This observation resulted in the tightening of an indication: the C4 protocol should only be used if a competent professional facilitator is present and available;

- The types of expert-apprentice relations need to be further defined. The facilitator had difficulties in identifying a specific expert-apprentice relation. In order to make this easier to use, the definitions of the typologies have been extended and examples have been added.

In this chapter the iterative development of the C4 protocol was specified. The creation of the design through the field-test case studies resulted in a ultimate protocol, which was tested in four additional cases. In general the four test cases support the C4 protocol for expert-apprentice relations. Although the division of the test cases into Alpha and Beta-cases leaves room for discussion, the outcomes do indicate that the protocol result in functioning expert-apprentice relations. This is an important conclusion of this research. The overall conclusions as well as an evaluation and overview of the main findings are subject of the next and final chapter.