Knowledge sharing in expert-apprentice relations
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Chapter 7

The C4 protocol for expert-apprentice relations

This chapter presents the C4 protocol for expert-apprentice relations. Through an iterative process in twenty case studies the final C4 protocol was developed. The protocol is presented in detail next. The chapter ends with an examination of the indications and contraindications for using the C4 protocol.

7.1. The C4 protocol

The aim was to select a name for the protocol that was both easy to remember and which contained the core of the protocol. The protocol resulted in a staged method. The stages of the protocol need to encompass the different identified stages of expert-apprentice relations, which are about matching the participants, getting to know each other and active knowledge sharing. For easy reference, the steps were renamed. This process resulted in the four C’s of expert-apprentice relations which represent the four stages in the protocol which together form the expert-apprentice relation. These four stages are, in chronological order: Composing the relation; the stage of Connecting between expert and apprentice; the Culminating stage in which the relation is at its optimum; and finally the stage of Completing the relation, which is the fade-out stage.

COMPOSING → CONNECTING → CULMINATING → COMPLETING

The four stages identified are each presented in a separate paragraph. In each paragraph the stage is subdivided into a number of practical steps. These steps are the start of each paragraph. The protocol contains different types of steps. Some are part of every expert-apprentice relation, while others only apply in some specific cases. Some steps occur only once, while others have to be repeated. The steps are then presented in more detail in the four paragraphs. Throughout the process, the protocol has three different routes, one for each of the three types of experts that were previously identified in Chapter 2. These in turn lead to three primary types of expert-apprentice relations:

1. The I-dominant relation. In this type of expert-apprentice relation, the Information-component of the expert’s knowledge, that is, the knowledge that is to be shared, is dominant. The knowledge in this relation concerns dominantly codified knowledge, and is about knowing. Combined with the dominant Experience-component, experts of this type can be described as being on a high-codified level, meaning that the
knowledge that is to be shared has a high information density, in which experience plays a major part in interpreting the data. Often, the knowledge is on a highly abstract level. Examples of I-dominant expert-apprentice relation are a professor with a doctoral student, and Plato and Aristotle.

2. The S-dominant relation. In this type of expert-apprentice relation, the Skills-component of the expert’s knowledge is dominant. The knowledge in this relation concerns dominantly skills and crafts (technical dimension). In general these skills can be both in interacting with the environment, like communicative skills and manual skills, and skills which are present within the experts’ heads, like analytical and creative skills. However, in this type of expert-apprentice relation craftsman’s skills and techniques are dominant: this relation is about doing. Examples of S-dominant relations are a surgeon with a resident and a carpenter sharing his craft with a pupil.

3. The A-dominant relation. In this type of expert-apprentice relation, the Attitude-component of the expert’s knowledge is dominant. This component refers to the basic beliefs of the expert: values and norms that determine someone’s attitude and feelings in a situation and his perception and drives. The Attitude-dominance in this relation appears in close relation with the internal skills of S-component: the skills that are about reflection, intuitive skills, and creativity. The knowledge in this relation is about approaching: it is about someone’s way of acting, managing and treatment of the environment. In expert-apprentice relations of this type, the personality of the expert seems to play an important role in his expertise. Examples of A-dominant expert-apprentice relations are a CEO with a trainee and a guru with a follower.

The C4 protocol is presented in more detail in the following paragraphs, starting with the Composing stage.

7.1.1. Composing
The first stage of the protocol is the Composing stage. The Composing stage of the C4 protocol is about building the expert-apprentice relation: it ranges from identifying the need for an expert-apprentice relation up to the start of the relation, where the Connecting stage begins. The Composing stage is about matching an expert with an apprentice and defining their relation. In some cases the organisation assigns who will participate in the relation, in other cases the expert and apprentice take initiative. However, in all cases the need for initiating an expert-apprentice relation is identified. This is therefore the first step in the protocol. The steps that are part of the Construction stage are listed in figure 3 and presented in more detail next.
Figure 3  The steps in the Composing stage
1) **Identify the need for an expert-apprentice relation**

The need for an expert-apprentice relation can be identified from outside or inside an organisation. Also, the need for Composing an expert-apprentice relation can be identified by the intended expert and/or apprentice, or by the organisation as a whole. Indications for the need of an expert-apprentice relation are diverse. For example, the following organisational characteristics can indicate that there is a need for an expert-apprentice relation:

- The existence of a lot of tacit knowledge within an organisation;
- The crucial knowledge of an organisation exists within just one or a few employees;
- The organisation depends for a large part on (tacit) knowledge which can not easily be replaced or transferred;
- The half-life of knowledge of experts within the organisation is shortening;
- The absence of relevant (side-)knowledge;
- An expert with crucial knowledge for the organisation is intending to leave the organisation, the organisation wants to preserve the knowledge for the organisation;
- There is (are) a new employee(s) within the organisation who have to acquire specialised knowledge;
- Existing employee(s) need training and development;
- The organisation wants to create new knowledge, the organisation wants to innovate.

If the need for an expert-apprentice relation is established, the expert-apprentice relation needs to be selected as a suitable method for solving the identified problem [→ step 2]. If no need for an expert-apprentice relation is identified, the design ends here. A possible outcome of this first step is that the participating expert and apprentice are already identified. For example, when the need exists to preserve or deepen the knowledge of an expert within the organisation, this expert has to participate in the expert-apprentice relation in order to fulfil this need. In this specific case, the expert is known and present and the selection of an expert is no longer part of the construction phase [steps (4) and (5) have to be adjusted to this situation]. The same holds when a new employee needs to become part of the organisation: here the step of selecting an apprentice can be omitted. When both expert and apprentice are known as a result of this step, the steps (4) and (5) can be left out completely.

2) **Select the expert-apprentice relation as a suitable method for solving the problem**

In order to answer the general question of when to and when not to use the C4 protocol some indications and contraindications have to be considered. These C4 protocol indications and contraindications are presented in paragraph 5.5. In short, there are some basic conditions that have to be met if expert-apprentice relations are to function. These conditions concern the nature of the relation and knowledge sharing. If there is a need for an expert-apprentice relation, expert-apprentice relations can only be selected, if:

- The problem can be solved using (combinations of) two individuals;
- There is an expert present, or an expert can be selected for the task [step 4 → step 5]
- There is an apprentice present, or an apprentice can be selected for the task [(step 4) → step 5)];
- There is enough time available;
- The organisation is supportive of the relation;
- There is an infrastructure present which the participants can use.
If it is concluded that the expert-apprentice relation is an applicable method, the goals and limitations of the relation have to be defined [→ step 3]. If it is concluded that the expert-apprentice relation is not a suitable method, the protocol ends here [(←)].

3) Define the goals and limitations of the relation
The goals of the expert-apprentice relation should be clear and expressed to the participants and to the organisation the relation has to function in. The defined goals have to agree with the identified need(s) of step 1). The goals should be explicitly stated. In step 3 the limitations set by the organisation and the environment of the expert-apprentice relation become clear. These limitations have to be reported to all stakeholders in the relation. The organisation can place design limitations on the following aspects of the relation:
- The duration of the relation: the organisation may set a maximum (or minimum) duration time;
- The participants of the relation: the organisation may set conditions on who is and who is not to participate in the expert-apprentice relation;
- The intensity of the relation: the organisation can set restrictions on the amount of time the expert and apprentice spend together;
- The location of the relation: the organisation can set restrictions on where and when the expert and apprentice act in the expert-apprentice relation.
All persons and parties involved, have to be aware of and agree with the set goals and design limitations. The outcomes of this step may have consequences for the next step in the protocol, namely defining the participating expert and apprentice, because the outcomes may limit the pool of available participants or result in additional demands on defining a suitable participant in a particular expert-apprentice relation [→ step 4]).

4) Define the participating expert and participating apprentice
Now that, as a result of step 3, the goals and limitations of the expert-apprentice are set, a blueprint can be made with the profiles of the desired expert and apprentice in the relation. Depending on the outcome of step 3 (goal setting), there are four possible tasks in step 4:
1. Both the expert and the apprentice have to be defined
When the goal of the expert-apprentice relation does not result in finding a specific expert and apprentice, step 4 consists of drawing sketches for both the expert and apprentice. If both the expert and apprentice have to be defined, the starting point: the search for suitable participants, is identified as the goal of the expert-apprentice relation. The organisation has to decide whether the expert and/or the apprentice are to be selected from outside the organisation or from within it. The goals of the relation have to be studied in order to
extract the matching knowledge domain. Each expert-apprentice relation is performed within a certain knowledge domain. When, for example, the organisation is aware that most of its crucial knowledge is tacit and thereby finds itself vulnerable, the organisation has to decide in which knowledge domain the tacit knowledge exists: this is, then, the knowledge domain of the expert-apprentice relation. As a consequence, the expert’s and apprentice’s knowledge has to be in that particular knowledge domain. Also, if the organisation has set limitations to the design, these have to be added to the list of requirements of the potential expert and apprentice. For example, when the organisation does not want an apprentice to have customer contacts, it is not advisable that the duties of the expert in this relation involve him having a lot of costumer contacts. Lastly, the culture of the organisation can also be part of the definition. Once the expert and apprentice are defined, the relation type can be identified \[ \rightarrow \text{step 5} \] and the expert and apprentice can be selected and matched \[ \rightarrow \text{step 6} \].

2. The expert is identified, the apprentice has to be defined
When the goal of the expert-apprentice relation results in finding a specific expert, step 4 consists of defining a suitable apprentice for him. This can be relevant when, for example, a valuable employee is leaving the organisation or when the organisation wants to create knowledge in the knowledge domain of a specific expert. It has to be decided if the apprentice is to be selected in- or externally. The characteristics of the expert serve as the starting point in defining the apprentice. Two characteristics of the expert that are used to sketch the desired apprentice are his knowledge domain and his personality. The definition of the apprentice’s knowledge domain should agree with that of the expert as well as with the goal of their relation. Also, the apprentice’s personality has to be compatible with the expert’s personality and with the culture and needs of the organisation. Finally, if the organisation has set limitations to the design, these have to be added to the list of requirements of the potential apprentice. Once the apprentice is defined, the type of relation can be identified \[ \rightarrow \text{step 5} \] and the expert and apprentice can be selected and matched with the expert \[ \rightarrow \text{step 6} \].

3. The apprentice is identified, the expert has to be defined
When the previous steps of the protocol resulted in assigning a specific apprentice to the relation, then step 4 consists of making a sketch of the suitable expert for this relation. This can be relevant when, for example, a new employee enters the organisation and this person has to acquire specialised knowledge in order to function optimally. It has to be decided if a person from outside the organisation is selected or if an expert is selected internally. The characteristics of the apprentice serve as the starting point in defining the expert. The two aspects that are used to sketch the appropriate expert are the apprentice’s knowledge domain and his personality. The definition of the expert’s knowledge domain should be compatible with that of the apprentice and the needs of the organisation. Also, the apprentice’s personality should be compatible with that of the expert and fit in with the culture and needs of the organisation. Finally, if the organisation has set limitations to the design, these are to be added to the list of requirements for the potential expert. When the
expert is defined, the type of relation can be identified [→ step 5] and the expert can be selected and matched with the apprentice [→ step 6].

4. Both the expert and apprentice are identified

If the previous steps of the protocol resulted in an assigned expert as well as an assigned apprentice, step (4) can be omitted form the protocol. The next step is to identify the type of relation [→ step 5] before evaluating the matching of expert and apprentice using step 6).

5) Identify the type of relation

After setting the goals and definitions of the relation, the expert-apprentice relation can be identified. The knowledge domain of the (intended) expert determines which type of expert-apprentice relation the relation is: an I-dominant, a S-dominant, or an A-dominant expert-apprentice relation. In identifying the relation type it should be noted that the knowledge sharing in expert-apprentice relations is always a combination of the four components of knowledge, however one or two component can be relatively dominant. The type of relation determines which route is to be followed in the design. Analysing the knowledge that is to be shared in the relation (the goal of the relation) will lead to the identification of the relation type. The relation type also affects the selecting and matching of the expert and apprentice [→ step (6)], because different types of relation require different approaches. Throughout all stages of the design this step should be occasionally repeated to check if the type identified is indeed the type of expert-apprentice relation that the expert and apprentice are working in. This identification can be done by the relation’s facilitator, and also by the participating expert and apprentice.

The I-dominant relation: the Information-component of the expert’s knowledge is dominant. The knowledge is about knowing. Expert-apprentice relations of this type can be described as being on a high-codified level, meaning that the knowledge that is to be shared has a high information density, in which experience plays a major part in interpreting the data. Often, the knowledge is on a highly abstract level. Example: professor with a doctoral student.

The S-dominant relation: the Skills-component of the expert’s knowledge is dominant. The knowledge concerns predominantly skills and crafts (technical dimension). In this type of expert-apprentice relation the skills and techniques that make a craftsman are dominant: this relation is about doing. Example: a surgeon with a resident.

The A-dominant relation: the Attitude-component of the expert’s knowledge is dominant. The knowledge in this relation is about approaching: it is about someone’s way of acting, managing and their treatment of the environment. In expert-apprentice relations of this type, the personality of the expert plays an important role in his expertise. Example: a CEO or manager with a trainee.
After the type of expert-apprentice relation is identified, the expert and apprentice that will participate in the relation can be selected and matched [→ step 6)]. If the relation type cannot be identified in this phase, this step should be repeated after step 6 [→ step 5]).

6) **Select and match expert and apprentice**

Because they are so strongly connected, the selection and matching of the expert and apprentice are described in one step. When selecting a participant for an expert-apprentice relation, the goal of the selection should be finding an optimal match between expert and apprentice. The previous steps determine whether both participants should be selected, or if the expert or apprentice has already been identified. When an expert or an apprentice is present, it is advisable to make them part of the selection committee, in order to enhance the matching phase. The descriptions resulting from step 4 serve as a guide in the search and selection of participants. However, there are some aspects that are universally applicable:

- It is important that participants air their commitment to the relation. Therefore a necessary selection criterion could be that expert and apprentice voluntarily participate in the relation, this will prevent people participating against their will, or participating if they are not fully committed;
- The participants should be willing to share their knowledge and be open to engage in a social relation with another person.

The descriptions of the desired expert and/or apprentice serve as a guide to their selection: the actions that are part of this step depend on whether the participants are to be recruited from within the organisation or not. Selecting by knowledge domain can be done by studying resumes and by interviewing the candidates. When it is desired that several candidates apply, standard recruiting methods can be used. When both expert and apprentice are to be selected in this step it is important to keep in mind that the expert and apprentice have to perform in a social relation. When one participant is already present, whether it is the expert or the apprentice, the personality and characteristics of this person should be part of the selection process. In step 5 the dominant component of the relation is identified. The characteristics of the different types of relation should be considered in the matching process. The matching of the expert and the apprentice consists of two levels, namely on a knowledge level and a social level. Firstly, the matching of expert and apprentice based on their knowledge domains is described.

In expert-apprentice relations the knowledge match between expert and apprentice influences the realisable results of the relation. The goal of the expert-apprentice relation therefore affects the matching of expert and apprentice by their knowledge domains. This indicates that in some cases it is important that the apprentice has relevant side-knowledge in the knowledge domain of the expert, and in other cases this is recommended but not a requirement. It is important when matching expert and apprentice on the knowledge level that at least the contours of their knowledge are known. Therefore the intended expert and
apprentice should be interviewed about their knowledge domain and their resumes should be studied – even when one of the two participants has already been selected. Matching on a knowledge level has the following requirements:
- The expert and apprentice speak the same language;
- The apprentice is in the competence stage within the expert’s knowledge domain;
In most cases, the expert can assess whether or not the intended apprentice’s knowledge is of a high enough standard.
- The expert and apprentice have (at least) some mutual, shared knowledge or interests;
This can be difficult to assess, however a list of past practice and experiences can be used to evaluate this point.

If the knowledge level matching is successful, then the social level matching can begin. Often, these two levels are simultaneously active. Social level matching depends on the goal of the relation and on the intention of the participants. However, both expert and apprentice have to decide for themselves if they are willing to spend time and share knowledge with their intended expert-apprentice partner. The expert and apprentice should meet before entering the relation, and should approve of each another. To be able to develop a social relation to develop, it is important that there are no obstacles preventing the expert and apprentice from bonding:
- The expert and apprentice have no conflicting interests;
- The expert and the apprentice have matching personalities;
- The expectations of the experts and apprentice are communicated in advance;
- The ways of working (formal or informal) of the expert and apprentice match;
- The orientations (task – or relation) are similar or not too dissimilar.

When matching the participants’ personalities, the aim is that the expert perceives the apprentice to be similar. However, in some cases it can be useful to match specific traits. When a trait of the expert is a positive aspect of his knowledge domain, then this factor has to be treated like other knowledge aspects: the distance to the apprentice should not be too large and the apprentice should have attained a certain level. For example, if an expert has an extrovert personality in a commercial domain, the apprentice should have this too to a degree in order for him to be able to catch on. However, with ‘negative’ traits, matching opposites can have a positive effect as well, depending on the factor of personality type. For example, if an apprentice is unstructured, matching him to an expert with a conscientious personality can have a positive effect on him. In general however, expert and apprentice have to be able to understand each other and to form a social relation. Therefore, the personalities of the expert and apprentice should not be too dissimilar.

I-, S-, and A-route
In the different types of relations, the two matching levels, that is the knowledge domain and the social relation, are balanced differently. In A-dominant relations the personalities of the participants play a relatively important role in the knowledge sharing, whereas the in I
and S-dominant relations the level and capacity of the knowledge domains of the apprentice is a key factor. However in all expert-apprentice relations the knowledge matching as well as the social matching should be observed.

When the participating expert and apprentice are known after the setting of the goal of the relation, i.e., if the expert and apprentice have been identified after step 3, their matching should be evaluated using the matching criteria of step 5. When expert and apprentice as well as the organisation approve of the match, the expert and apprentice need to agree on the goals of the relation as well as on the actions and activities that will be part of it. The expectations of the participants should be clear. The expert and apprentice should both be aware of the implications of their participation, negatively as well as positively. To increase their commitment, and that of the organisation, it is be helpful to generate high expectations. When it is not possible to match an expert and an apprentice according to the above requirements, the expert-apprentice relation will probably not be optimal and the protocol may be ended [(←)]. When expert and apprentice are matched to work in the expert-apprentice relation, the relation should be placed and anchored within its environment (for example: the organisation) [→ step 7]).

7) **Place the relation in its environment**

The environment of an expert-apprentice relation is often the organisation in which one or both participants work. Once the matching of expert and apprentice is complete, the relation has to be placed and anchored within its environment. This is a two-way relationship: the expert-apprentice relation has to fit in the organisation, and the organisation has to meet certain conditions for the relation. The fit between the expert-apprentice relation and organisation is largely part of step 4 and step 5, where this matching was observed. However, for the expert-apprentice to function within the organisation, the expert-apprentice relation has some additional demands. The expert and apprentice have to work autonomously within the organisation, that is, they should be able to decide on their relation as much as possible. This also indicates that the expert and apprentice have access to the sources of their knowledge within the organisation. The boundaries of how autonomous the expert-apprentice relation is within the organisation, are set in step 3. However, a condition of the relation that cannot be limited by the organisation is the condition that the apprentice has legitimate access to the working life of the expert. The organisation has to allow the expert and apprentice to conduct their expert-apprentice relation. This requirement can be achieved by giving the expert the authority to decide on the apprentice’s presence. The apprentice’s legitimate access can be acknowledged more easily when the participation of expert and apprentice in their expert-apprentice relation is known throughout the organisation. After the expert-apprentice relation has been placed in its environment, the last step of the Composing stage is reached: checking of the boundary conditions [→ step 8]).
8) **Check the boundary conditions**

Before the expert and apprentice can start the Connecting stage, a last check of the boundary conditions is made as the final step of the Composing stage. The boundary conditions have, for a large part, already been discussed in the previous steps, however because these requirements are a crucial constituent of the expert-apprentice relation there is a final check to see if they have been met. All the following conditions have to be met before entering the connecting stage. Should any of them not have been fulfilled, then the relevant step in the Composing stage should be repeated.

- Expert and apprentice have access to the sources of knowledge;
- There is an infrastructure present;
- Expert and apprentice speak the same language: they ‘understand’ each other;
- The expert’s knowledge is identified as consisting of a large amount of tacit knowledge based on extensive experience and practice and the expertise of the expert is in a specific knowledge domain;
- The apprentice is in the competence stage in the expert’s knowledge domain;
- The expert and apprentice have some mutual, shared knowledge or interests;
- Expert and apprentice have no conflicting interests;
- Expert and apprentice voluntarily participate in the expert-apprentice relation;
- Expert and apprentice are committed to the expert-apprentice relation;
- The working methods of the expert and apprentice match, and the orientations (task – or relation) are similar or not too dissimilar;
- The apprentice has legitimate access to the working life of the expert

There is one boundary conditions that has to be met for the relation to work, but which cannot be fulfilled in the Construction stage: the expert and apprentice have to trust each other. Trust takes time to develop, and therefore this condition is part of the Connecting stage.

Once the boundary conditions have been checked, the Composing stage is complete and the expert and apprentice can begin their expert-apprentice relation. The first phase of the expert-apprentice relation is covered in the Connecting stage, starting with a ‘kick-off’ meeting [→ step 9], which is presented in the next section.

### 7.1.2. Connecting

The Connecting stage of the C4 protocol encompasses the primary phase of the expert-apprentice relation: from its start right up until the knowledge sharing has developed and reached its optimum level – this is when the Culminating Stage begins. All steps in the Connecting stage serve a similar goal. The goal of the Connecting stage is for the expert and apprentice to develop their relation to such a level that they are able to share and develop their knowledge at an optimal level. In order to achieve this goal, the expert and the apprentice have to get to know each other in the Connecting stage, both socially and
professionally, and develop a social – trusting – relationship. The steps that are part of the Connecting stage are listed in Figure 4 and are subsequently presented in more detail.

**Figure 4 The steps in the Connecting stage**

9) **Manage expectations and make agreements in a kick off meeting**

The first step in the Connecting stage is to organise a ‘kick-off’ meeting for all participants. During this meeting the relation is further explained to the participants and the course is set for the first period of the relation. The relation facilitator guides the meeting and both
expert and apprentice are present. All participants enter the expert-apprentice relation with expectations of how the relation will turn out and what activities make up the relation. In the 'kick-off' meeting the participants express their expectations to each other and to the facilitator. It can be useful for the facilitator to generate high expectations for the relation’s outcomes. When the expert and apprentice have different expectations of the relation or the relation’s outcomes, the facilitator can attempt to adjust these in order to create more similar and realistic expectations.

In the second part of the 'kick-off' meeting the course is set for the first period of the expert-apprentice relation. Some expert-apprentice teams may need clear instructions on how to act in an expert-apprentice relation. Together with the facilitator, the expert and apprentice can make up a list of activities and scheduled meetings to serve as a guide for the first period. When all participants agree on the details of the relation, the expert and apprentice can start their joint activities [→ step (10)].

10) The apprentice accompanies the expert
After the 'kick-off' meeting, the first activity in the expert-apprentice relation is for the apprentice to accompany the expert. This implies that the apprentice joins the expert as much as possible in his daily routines: the apprentice accompanies the expert in his field of work and observes him in action. By doing so, the relation’s environment (the organisation) can get used to the new relation between expert and apprentice. The activities that constitute the core of the expert-apprentice relation (see the Culminating stage), can occur in this phase of the relation. However, the goal of this step is the initiation of the relation. The expert and apprentice decide together on how this step is drafted. This depends on the restrictions set by the organisation, and even more so, on the degree to which the expert and apprentice know each other. When the expert and apprentice already know each other and have some form of social relation, this step can be shortened. However, if the expert and apprentice have not acted in these particular roles before, this step is useful for the participants to get used to their roles and to (further) recognise and identify each other’s knowledge domains [→ step 11]). When the expert and apprentice do not know each other, or do not know each other well, the attraction effects occur in this step. Therefore, face-to-face interaction is important in starting up the social relation between expert and apprentice. This step is about the expert and apprentice being in each other’s company. In this period they can get to know each other and find similarities, and shared interests. Also, when expert and apprentice start to get to know each other, this step can be used by the participants to recognize and identify their partner’s knowledge domains [→ step 11]. Once step 11 is completed, step 10 ends as well.

11) The expert and apprentice recognise and identify each other’s knowledge domains
During step 10 (The apprentice accompanies the expert), the expert and apprentice have to recognise and identify each other’s knowledge domains. The knowledge domains serve as
the basis for the knowledge sharing and therefore for the knowledge development of both
the expert and apprentice. The goal is for the participants to know what the other is capable
of and to find out what kind of relevant knowledge is available. Because the expert’s
knowledge consists largely out of tacit knowledge, the knowledge can be hard to explicate.
Explication and mapping of the knowledge can be an outcome of this step, but this is not
the main goal. The goal is for the expert and apprentice to localise overlapping knowledge
(recognise) and to see what knowledge is different (identify). It cannot be expected that the
expert and apprentice get a complete insight in their knowledge domains: the knowledge is
often too complex. In this step the participants can get an overview of the knowledge
domains of their partner. The facilitator may ask the expert and apprentice to make a report
on the knowledge domain of the other. These reports can be used by the facilitator (and the
organisation), but with the reminder that the presented knowledge domains are not
complete.

There are several techniques on how to recognise and identify the knowledge domain. By
watching the other in action (step 10), interviewing, or in conversations. Also, asking
people in the other’s environment can give information about the knowledge domain. The
relevant techniques also depend on the type of relation, i.e. the expert’s knowledge type.

I-, S-, and A-route
The components of knowledge appear in different ways in actions and behaviour. This
implies that the three primary types of expert-apprentice relations should use different
techniques in recognising and identifying the knowledge domains.
The I-dominant relation: The main techniques used in this type of relation in order to
recognise and identify the knowledge domain of the expert and apprentice, are conversation
and dialogue. The knowledge is dominantly in the combination information and
experience. This knowledge will surface during exchange of views and thoughts and less in
behaviour. Observation of (for example) the expert giving a lecture, or the apprentice
explaining an issue can be part of this technique.
The S-dominant relation: The main technique in this type of relation in order to recognise
and identify the knowledge domains of the expert and apprentice is focussed observation.
The dominant skill-factor in this type of knowledge domain surfaces in practice, with one
person observing the other performing his craft. Often it requires a close and detailed look:
watching the hands of the expert at work. Asking questions about the actions will give more
insight in the knowledge domain.
The A-dominant relation: The main technique in this type of relation in order to recognise
and identify the knowledge domains of the expert and apprentice is broad observation. The
dominant factor of the knowledge domain is attitude which will surface in behaviour and
conducts. Often it requires seeing the broad picture of a situation: the person acting and
reacting within a certain environment. Asking questions and observing the reactions of
other people involved in the action are included in this technique.

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In the expert-apprentice relation the Connecting stage is the stage in which trust is developed and the knowledge domains are identified. To be able to evaluate these processes, the expert-apprentice relation is observed and monitored [→ step 12)].

12) Observe and monitor the relation

In this stage of the expert-apprentice relation, the expert and the apprentice are still developing their roles. Observing and monitoring their relation can serve two purposes: to provide information on the course of the relation and to detect the need for an intervention:
- The organisation gets information on developments in the expert-apprentice relation and the development towards reaching its fruition;
- The participants in the relation receive information on the developments and evolutions in the relation;

Which may lead to interventions (in step 13):
- The participants detect possible obstructions and request an intervention;
- The facilitator recognises possible obstructions in an early phase of the relation, and tries to remove them.

The relation is observed by both the facilitator (external perspective) and by the expert and the apprentice (internal perspective). The facilitator reports on the development of the social relation and on observed actions in the expert-apprentice relation. The facilitator studies the expert’s and apprentice’s reports, if available, and on a regular basis questions the participants about their relation. The observation and monitoring of the relation should be aimed at several specific aspects of the expert-apprentice relation, for example:
- What activities are the expert and apprentice involved in?
- How is the social relation developing?
- Which relational models are used?
- Which methods are used and what are the results of the identification of the knowledge domains?
- What are the views of persons in proximity of the expert and apprentice, for example co-workers?
- What are the views and opinions of the expert and the apprentice?
- What are important aspects of this specific relation?

The organisation can ask the expert and apprentice to keep track of their actions and developments by keeping a logbook or by making a learning portfolio. The advantage of this method is that it gives the facilitator a lot of information. It allows the participants to look back on previous activities and forces them to reflect on themselves and their relation. A disadvantage is that it can be time-consuming to keep a logbook or to make a learning portfolio and some participants may need strict instructions on how to monitor their own development.
The results of the observation and monitoring of the relation can serve as input for the evaluation and possible adjustments of the expert-apprentice relation, which is the final step of the Connecting stage [→ step 13].

13) Evaluate the relation with the expert, apprentice and organisation and intervene when necessary

The Connecting stage ends with an evaluation of the first phase of the expert-apprentice relation. The results of the observation and monitoring of the relation in step 12 serve as input for the evaluation. The evaluation is aimed at answering the question how the expert-apprentice relation is developed in the Connecting stage and if the relation is at an acceptable level to progress to the Culminating stage. The evaluation is done with the expert, the apprentice and (if relevant) a person who represents the ‘taskmaster’ of the relation: the person or representative of the organisation who gave the assignment to install the expert-apprentice relation. If there is no one with that specific role, the evaluation is done with just the expert and apprentice present. The facilitator joins in the evaluations and can facilitate the evaluation. The timing of this evaluation is dependent on the structure of the relation. The evaluation can be planned beforehand at a fixed point in time, or be organised by the facilitator when the expert and apprentice indicate that the Connecting stage has come to an end.

The question to be answered is whether or not the expert-apprentice relation has reached the goal of the Connecting stage. The goal of the Connecting stage was formulated as follows: “the goal of the Connecting stage is for the expert and apprentice to develop their expert-apprentice relation to such an extent that they are able to share and develop their knowledge at an optimal level. In order to reach the goal, in the Connecting stage the expert and apprentice have to get to know each other, both socially and concerning their knowledge domains, and develop a social – trusting – relationship”. Both the expert and the apprentice, as well as the facilitator and the ‘taskmaster’ have to answer this question. If the answer is positive the expert-apprentice relation evolves to the Culminating stage. If the question is negatively answered, the expert-apprentice relation is not at an optimal phase to evolve to the next stage. In that case, the causes of the negative development have to be studied. There are two possible causes:
- The boundary conditions are not fulfilled (see step 8);
- There is an external obstruction.

If the cause of the negative evaluation is found, the participants and the facilitator can try to solve the problem. For example, it can be the case that the social relation between the expert and the apprentice is not optimal developing and that the boundary condition that the expert and apprentice trust each other has not been fulfilled. To solve this problem, the causes should be analysed. The expert and apprentice may act in the expert-apprentice relation according to different relational models. The expert for example uses the authority ranking model, while the apprentice focuses on equity matching or communal sharing. The
facilitator can try to adjust the models used by making them explicit. Once the problem is solved, the expert and apprentice can either extend their Connecting stage or evolve to the Culminating stage, depending on the cause of their problem. If the problem cannot be solved, the expert and apprentice together with the facilitator and the taskmaster have to decide if the expert-apprentice relation can be continued in spite of the obstruction. If they decide that the expert-apprentice relation is to be ended (→), the expert-apprentice relation continues in the Completing stage and the participants have to round off their activities and agreements (→ step 20). If it is decided that the expert-apprentice relation is to be continued, the expert and the apprentice can extend their Connecting stage (→ step 10) or they can move to the Culminating stage (→ step 14), depending on the nature of the obstruction. In all cases, the expert and the apprentice as well as the facilitator have to state that they are willing to continue the expert-apprentice relation.

When the expert-apprentice relation has evolved to reach a level where the expert and the apprentice are able to share and develop their knowledge in an optimal way, the Culminating stage starts (→ step 14).

7.1.3. Culminating

The Culminating stage of the C4 protocol contains the essence of the expert-apprentice relation: in this stage the knowledge sharing between expert and apprentice reaches its optimum. The steps in this stage range from the expert and apprentice engaging in deliberate observation to the evaluation of the effects on knowledge. This stage encompasses the blooming of the relation and ultimately results in Completing the relation, which is the fourth and final stage. The steps that are part of the Culminating stage are listed in Figure 5 and are subsequently presented in more detail.
14) *Expert and apprentice engage in deliberate observation*

The first step in the Culminating stage is deliberate observation. The expert and the apprentice watch each other at work. This is an intensified version of step 10, where the apprentice accompanied the expert. Observation in this step however, is not about randomly following an expert and observing his actions. It is about *deliberate* observation. In order to achieve optimal learning effects, the expert shows the apprentice good examples, but also provides the apprentice with negative role models. The expert can be asked to use the
thinking aloud method, in which the expert speaks his thoughts aloud, allowing the apprentice to follow every step. When observing the expert or a role model, the apprentice should be aware of the goal and purposes of the observation, in order to achieve to right type of brain activity. The apprentice is instructed not to observe the expert with the sole intention to imitate the behaviour: but to observe the expert with 'critical respect’. The expert and apprentice can either choose their situations for observation while they engage in close proximity, or choose their situations in advance. The expert and apprentice engage in deliberate observation throughout the Culminating stage. Deliberate observation is followed by deliberate practice [→ step 15]).

I-, S-, and A-route
Deliberate observation is an inextricable part of expert-apprentice relations. However, in some types of expert-apprentice relations the act of deliberate observation is more important than in others. In S-dominant expert-apprentice relations as well as in A-dominant relations, deliberate observation is a key element, whereas in I-dominant expert-apprentice relations the emphasis is less on observation. The S- and A-dominant relations focus on actions and behaviour, which can be watched by others in deliberate observation. The focus of I-dominant relations is on the way of thinking, which is more difficult to observe in daily activities.

15) Expert and apprentice engage in deliberate practice
Deliberate observation is followed by deliberate practice. It is not sufficient for the apprentice to observe the expert in his daily routines: in order for the apprentice to develop the skill himself he needs to practise it. The core of the method of expert-apprentice relations consists of learning by experience. The apprentice has to experience how to apply and develop a skill (or way of thinking, or attitude) in different situations. Deliberate practice means that the apprentice and expert deliberately and actively seek out useful training situations. First they have to identify the skill or part of the skill that is to be trained and then they have to look for situations in which that particular skill can be trained. The relevance of a situation depends on the skill level of the apprentice (or expert if the expert seeks deliberate practice). The training is progressive: i.e. the level of competence progresses during this step. Training in expert-apprentice relations is a joint activity: for example, the expert first shows the apprentice how to perform a certain act. The apprentice then asks questions about the whys and wherefores of the expert’s performance. Then the apprentice practises the act. The expert observes the actions of the apprentice and gives feedback. Then the cycle starts again. In this step it is important to take the level of the apprentice into account. The training should neither be too difficult or too simple. In some cases the apprentice practises first in a simulation situation before practising in real-life situations. The apprentice can be asked to assist the expert, in order to be able to see and perform various activities, or the apprentice can be made responsible for the expert’s incoming data in order to learn all aspects of the expert’s profession. By deliberately
practising the skill, the apprentice acquires the necessary experience. It is therefore important to practise a skill in different situations to allow the apprentice to train the skill in various ways. Hereby the apprentice acquires different experiences and in time will be able to differentiate between situations and circumstances. During the cycle of observation and practice, the expert and apprentice engage in deliberate reflection [→ step 16].

I-, S-, and A-route
The type of training and practice that is performed in an expert-apprentice relation is highly dependent on the type relation. In S-dominant relations the skills of the expert are often relatively easy to localise and in some cases a skill can be divided into different parts which can be practised separately. For example, in surgery the procedures can be divided into different parts (from cutting open the patient to stitching him up) which can be trained by the apprentice at different stages of the relation. Deliberate practice in I-dominant relations will take place in conversations or for example when the apprentice is given the opportunity to give a lecture or prepare a presentation. In A-dominant relations relevant practice situations often involve others – for example the expert’s co-workers. In general, the expert’s guidance is important because errors made by the apprentice can have negative effects on other people.

16) Expert and apprentice engage in deliberate reflection
Deliberate reflection, like deliberate observation and deliberate practice, is a repeated step in the Culminating stage. Deliberate reflection is about the expert and apprentice reflecting on themselves, each other, and their relation. Reflection implies that the expert and apprentice discuss their relation on a meta-level: the expert and apprentice analyse their relation and their knowledge sharing, and assess their personal development. Reflection goes beyond evaluation and involves not only an objective evaluation of a situation, but also personal views and emotions. Reflecting results in the expert and apprentice being constantly aware of their expert-apprentice relation. This allows the expert and apprentice to think about their optimal method for knowledge sharing. In the reflection process disappointments as well as the relation’s positive results should be discussed.

The expert and apprentice engage in individual reflection, mutual reflection and discuss – the results of their – reflection with the facilitator. The facilitator can use these results as input for monitoring the relation [→ step 18]). In some expert-apprentice relations reflection comes naturally, in others the expert and apprentice need instructions. The expert and apprentice can be given questions or discussion points to create reflection, or the facilitator can function as a stimulator by initiating a conversation in which the relation is reflected upon. Coaching the expert and the apprentice in their relation can be a method to enhance reflection.
Hitherto, the steps in the Culminating stage are all deliberate and calculated: each step is consciously taken. However, expert-apprentice relations also have an unstructured side. These unstructured activities in the expert-apprentice relation are discussed in the next step [→ step 17].

17) **Expert and apprentice engage in unstructured activities**
Not all aspects of the expert-apprentice relation are structured and planned. The relation needs to be unstructured to some extent. This unstructured nature serves the purpose of allowing unexpected knowledge sharing to occur. The apprentice may have relevant side-knowledge that has not yet been detected, or the expert has an unexpected quality that turns out to have an important effect on his skills. Also, the creation of creative chaos can have positive effects on the knowledge sharing. The nature of the relation (and of the expert and apprentice participating) defines to what extent the expert-apprentice relation is unstructured. Having unstructured activities in expert-apprentice relations means that not all activities have to appear relevant at first sight and that the participants are creative and flexible in designing their relation. Unstructured does not mean ‘wild’ or ‘uncontrolled’; it simply indicates that not all observations, practices and reflections in expert-apprentice relations are deliberate and planned in advance.

Throughout the Culminating stage, the expert-apprentice relation is monitored and the effects of knowledge are evaluated [→ step 18].

18) **Monitor and evaluate the effects of knowledge sharing**
The relation facilitator monitors the expert-apprentice relation throughout the Culminating stage. The facilitator watches the expert and apprentice and both expert and apprentice report on their activities, in conversations or by keeping log books. The monitoring has two purposes: the first is to be able to evaluate the relation (see step 13). The monitoring provides information about the social relation between expert and apprentice and about their relation’s development. The second goal of the monitoring is to be able to evaluate the effects of knowledge sharing, the learning outcomes, of the relation. The expert and the apprentice are asked to evaluate the changes in their knowledge domains while their human environment is also asked to evaluate the knowledge changes of expert and apprentice as well. In order to evaluate the effects of knowledge sharing, three situations have to be compared: a) the starting knowledge (see step 6), b) the current knowledge, and c) the knowledge goals (identified in step 3). The knowledge sharing in the expert-apprentice relation results in different outcomes for expert and apprentice. The apprentice’s knowledge is expected to grow in the expert’s knowledge domain. The expert’s opinion on the apprentice’s development is therefore an important aspect of the evaluation. In evaluating the learning outcomes of the apprentice, the sharing of tacit knowledge should be included. However the sharing of tacit knowledge is hard to evaluate, because this knowledge is hard to express. Observation of the apprentice can provide indications for this evaluation.
expert’s knowledge can change in three different ways, depending on the apprentice’s relevant side-knowledge. In evaluating the effects of knowledge sharing, the identification of relevant side-knowledge is therefore an important factor. There are three possible types of learning outcomes for the expert: an increase of the knowledge domain, the acquiring of new synergetic knowledge, and the acquiring of new non-synergetic knowledge. In evaluating the knowledge sharing, the following aspects should be included:
- The expert and apprentice are receptive to unintended but relevant knowledge sharing;
- The expert is receptive to the (side-)knowledge of the apprentice and avoids the pitfall of rigidity.

The evaluation of the effects of knowledge sharing can have three possible outcomes:
- The expert-apprentice relation is not meeting the relation’s goals, and is not expected to do so in the future. The relation is to be ended [→ step 20];
- The expert-apprentice relation has not met the relation’s goals, but it is expected that the goals can be reached in the future. The Culminating stage is to be continued [→ step 14];
- The expert-apprentice relation has met the relation’s goals. The Culminating stage is complete and the relation is to be continued in the Completing stage [→ step 20].

The steps of the Culminating stage together form the *culminating cycle*. This is a continuous cycle, which can be interrupted when the need to end the expert-apprentice relation is observed. When the need to end the relation is observed, the Culminating stage is finished and the relation continues in the Completing stage [→ step 19].

7.1.4. Completing
The last stage of the C4 protocol is the Completing stage. The Completing stage is concerned with ending the expert-apprentice relation. The steps in this stage range from observing the need to end the relation to the official termination of the relation. The goal of this fourth stage is for the expert and apprentice to complete their relation with each other and for the organisation to conclude upon the relation. The steps that are part of the Completing stage are listed in Figure 6 and are subsequently presented in more detail.
19) Observe the need to end the relation

The expert-apprentice relation ends. The bond between expert and apprentice that grew in the expert-apprentice relation may result in a long-term social relation, but the ‘official’ learning process has ended. The duration of an expert-apprentice relation depends on the relation’s goals and on the quality of the relation between expert and apprentice. According to the protocol the expert-apprentice relation can end in three ways:

- **End naturally**
  
  Expert and apprentice, as well as the relation facilitator, conclude that the learning process between expert and apprentice has finished and/or the goal of the relation has been achieved. An expert and an apprentice end their relation in this way after a positive evaluation in step 18.
- Expiration of an earlier appointed period
When the expert-apprentice relation has an appointed ending date, the relation ends at that fixed point in time. By determining the duration of the expert-apprentice relation beforehand, possible misunderstandings are avoided (the duration is determined in step 3 and step 9).

- The relation ends prematurely
As a result of negative evaluations in step 13 or step 18, the expert-apprentice relation ends prematurely, without meeting the goals of the relation. It is important not to continue the relation when one or both participants evaluate the relation negatively. Only when the participation of the expert, apprentice and organisation results in the – intended – learning outcomes, is the continuation of the relation justified.

When the need to end the expert-apprentice relation has been observed, the expert and apprentice have to round off their running activities and agreements [→ step 20)].

20) Expert and apprentice round off running activities and agreements
The activities in the expert-apprentice relation can be of long duration. For example, the apprentice accompanies the expert to meetings throughout a long-term project. When it is decided to end the expert-apprentice relation, these activities have to be rounded off. The apprentice has to complete his individual activities if possible or transfer these to the expert. The tasks that the expert and apprentice are mutually responsible for have to be completed or transferred as well. Besides completing the expert’s and apprentice’s tasks, social relations have to be informed. There are often more persons involved in the relation than just the expert and apprentice themselves. For example, co-workers or customers have built up social relations with the expert and the apprentice and are accustomed to their particular roles in the expert-apprentice relation. The persons that are present in the relation’s environment therefore have to be informed of the relation’s termination.

When the expert and apprentice have completed their activities and communicated the ending of their relation to relevant social relations, the expert, apprentice, facilitator, and organisation can all evaluate and conclude upon the relation and, if relevant, determine future actions [→ step 21]).

21) Evaluate the relation and determine future actions
The expert-apprentice relation is evaluated with the expert and apprentice individually. The organisation also evaluates the expert-apprentice relation. This evaluation is the concluding part of the evaluations that preceded the ending of the relation (step 13 or step 18). When the expert-apprentice relation evaluation did not precede this step, the relation is first evaluated as a whole (depending on the phase of the relation, according to step 13 of step 18) before commencing with this concluding evaluation. The evaluation consists of a
judgement of the expert-apprentice relation as a whole as well as an evaluation of the process regarding how the relation was designed and facilitated.

In some cases, the concluding evaluation results in acting points. For example, the expert and apprentice can decide to continue their relation in a less intensive manner, or the organisation sees the need to implement changes in order to enhance knowledge sharing in the future. Also, the need for a new expert-apprentice relation may be observed \(\rightarrow\) step 1\). The relation facilitator needs to make sure that all relevant parties (expert, apprentice and the organisation) evaluate the expert-apprentice relation. The facilitator documents the evaluations and hands them over to the organisation. The evaluations can include personal opinions or information that is private to the expert or apprentice. The expert and apprentice have to give their permission to the facilitator to use this information and to pass it on to the organisation.

The handing over of the expert-apprentice relation evaluation to the organisation and participants, leads to the final step of the design: officially terminating the expert-apprentice relation \(\rightarrow\) step 22\).

22) **Officially terminate the expert-apprentice relation**

The final step of the C4 protocol is to officially end the expert-apprentice relation. The organisation, facilitator, expert, and apprentice all announce the end of the relation and the (positive) results of the knowledge sharing. The task of the facilitator is finished. The social relation between expert and apprentice can continue to exist, and the relation between the organisation and the expert, and between the organisation and the apprentice can be extended, but in a new framework: the expert and apprentice have to determine new roles in the organisation.

When the expert-apprentice relation is officially ended, the protocol is finished. To summarise, the 22 steps in the four stages that together form the C4 protocol for expert-apprentice relations are put in chronological order:

**COMPOSING**

\(\rightarrow\) 1) Identify the need for an expert-apprentice relation \(\leftarrow\)

\(\rightarrow\) 2) Select the expert-apprentice relation as a suitable problem solving method \(\leftarrow\)

\(\rightarrow\) 3) Define the goal(s) and limitations of the relation

\(\rightarrow\) 4) Define the participating expert and participating apprentice

\(\rightarrow\) 5) Identify the type of relation

\(\leftrightarrow\) 6) Select and match expert and apprentice \(\leftarrow\)

\(\rightarrow\) 7) Place the relation in its environment

\(\rightarrow\) 8) Check the boundary conditions
The C4 protocol has been constructed in order to facilitate expert-apprentice relations in organisations. In some contexts the protocol is more relevant and appropriate than in others. The next paragraph elaborates on the indications and contraindications of the C4 protocol.

7.2. Indications and contraindications for using the C4 protocol

Like every procedure or process, the C4 protocol has indications and contraindications on how and when it is to be used. In general, an indication is a valid reason to use a certain test, medication or procedure, while a contraindication is a condition or factor that prohibits the use of a particular test, medication or procedure or that increases the risks involved in using that particular test, medication or procedure. In the C4 protocol indications are described as situations in which the design is valid, while contraindications refer to situations when using the C4 protocol will not result in optimal knowledge sharing.

Expert-apprentice relations are designed to produce learning effects through knowledge sharing between a senior and a junior participant in a certain knowledge domain. As was described in step 2, there are some basic conditions that have to be met to enable an expert-apprentice relation to function. These conditions are concerned with the nature of the knowledge sharing. An indication for the use of the C4 protocol is the existence of a specific type of knowledge problem within an organisation which the organisation wants to solve. The existence of several types of knowledge problems can be qualified as indications for the use of the C4 protocol:
- The existence of a large amount of tacit knowledge within an organisation;
- An organisation’s crucial knowledge is held by just one or a few employees;
- The organisation depends for a large part on (tacit) knowledge which can not easily be replaced or transferred;
- The half-life of expert’s knowledge within the organisation is shortening;
- The absence of relevant (side-)knowledge;
- An expert with crucial knowledge is intending to leave the organisation, the organisation wants to preserve the knowledge within the organisation;
- There is (are) (a) new employee(s) within the organisation who has(ve) to acquire specialised knowledge;
- Existing employee(s) need training and development;
- The organisation wants to create new knowledge, the organisation wants to innovate.

All the above knowledge problems have in common that the existence and use of tacit knowledge is an important factor. The knowledge problems involve people. An important indication for the use of C4 protocol is the presence of an expert or expertise within the organisation. If the knowledge problem concerns expertise or the development of expertise, then the C4 protocol can be useful.

Another indication for the use of the C4 protocol is the presence of a competent relation facilitator. The facilitator should be a professional in the field: a person who has some experience in selecting and matching and in the coaching of social relations.

In addition to indications which support the use of the C4 protocol, there are contraindications which can indicate that the protocol is not an effective instrument in a specific situation or that the C4 protocol cannot be used optimally. Contraindications for the use of the C4 protocol are:
- The knowledge problem of the organisation can be solved through formal learning or by acquiring or buying knowledge from outside the organisation;
- The organisation is not willing to spend time on the relation and the knowledge problem;
- There is no competent facilitator available to facilitate the expert-apprentice relation;
- The apprentice has no legitimate access to the working life of the expert, for example when the expert has customer contacts who do not approve of the apprentice’s presence;
- The problem can-not be solved by two individuals, or multiple expert-apprentice relations;
- The knowledge problem is urgent and needs a short-term solution;

The above contraindications have in common that the knowledge problem of the organisation is either largely concerned with explicit knowledge or that the organisation is not equipped to install an expert-apprentice relation according to the C4 protocol for expert-apprentice relations.
In general for the protocol to function, the boundary conditions of the protocol have to be met. The use of expert-apprentice relations furthermore implies that:
- The organisation’s knowledge problem can be solved using two individuals;
- There is already an expert present within the organisation, or an expert can be selected for the task;
- There is already an apprentice present, or an apprentice can be selected for the task;
- There is enough time available to implement the expert-apprentice relation;
- The organisation is supportive of the expert-apprentice relation;
- There is an infrastructure present, which can be used by the relation participants.

The above list is not a complete list of indications and contraindications, however general conclusions can be drawn: the C4 protocol is particularly useful in organisations with knowledge problems concerning the tacit knowledge of experts, or the development of expertise, in which the organisation is equipped to fulfil the boundary conditions of the expert-apprentice relation and a competent facilitator is available. When the organisation’s knowledge problem fits the above descriptions and the organisation can fulfil the boundary conditions, then this indicates that the C4 protocol for expert-apprentice relations can be used.

In this chapter the C4 protocol for expert-apprentice relations was presented. The protocol was developed through twenty field cases. In four additional cases the C4 protocol was tested. The next chapter discusses the results of the four test cases.