# Realizing Knowledge Management in Value Creation Systems Using Principles of Fuzzy Control

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**Notes:** value creation systems, fuzzy control, knowledge management, inter-organizational knowledge management, industrial cluster, complex value creation systems, systematic knowledge function, complexity

**Abstract:**
The increasing complexity of value creation processes and its surrounding economic environment (e.g. growing granularity of value chains, spatial distribution) gives rise to new challenges for the design and coordination of value creation systems. From a systems theory perspective, inter-organizational knowledge management has the potential to meet these challenges, if it is carefully integrated in general management practices. Based on empirical findings from an industrial cluster in Germany, the authors identified three central conflicts of objectives that may occur during the implementation of knowledge management in complex value creation systems. Consequently, a context-sensitive compensation of the conflict-causing variables is necessary. Based on these premises, a systemic knowledge function has been developed that operates analogously to a fuzzy controller and is able to assess the system performance with regard to an intended system state and finally suggest actions for regulation.

## 1) Introduction

### *1.1) Knowledge and inter-organizational Knowledge Management*

Knowledge is a major competitive resource in the frame of value creation as well as a subject of management practices [5]. From a systemic point of view, it secures the efficiency and viability of cooperative activities [1,10]. There is a great amount of literature on knowledge management (KM) focusing on different aspects and contexts. Despite of the different approaches and modes of explanation, the crucial tasks of KM can be summed up as the development, the distribution and transfer as well as the preservation of knowledge [18,23]. A lot of companies have already begun to establish knowledge management and there is a huge amount of studies that prove the success of internal management practices [33]. However, in view of the present changing paradigms of value creation [24,25,26], its increasing complexity [9] and the fact that value creation takes place in globally distributed processes involving numerous very diverse actors [6,22], the inter-organizational management of knowledge becomes more and more important [24,29]. In comparison to intra-organizational KM, inter-organizational KM poses greater challenges due to various impacts and interdependencies that affect the realization of the KM tasks [21,34]. Moreover, KM can only be successful, if it is carefully adjusted to the objectives of the general management (GM) tasks.

### *1.2) Objectives of inter-organizational knowledge management from a systemic perspective*

A value creation system is characterized by the processes of product development. The single operations of the participating actors form a value chain that involves – depending on the considered system – the development, production and marketing of a product [6,9,30]. In order to integrate these single (often distributed) activities into a viable value creation chain, further **general management tasks** have to be fulfilled.

From a systemic-evolutionary perspective, the management of organizations or networks is considered analogously to the regulation of technical or organic systems. The scientific approach categorizes the general management (GM) into three major tasks: The **coordination** of value creation processes needs to be realized in a way that interfaces between single operations can be used in order to identify and use potentials for synergy within the network (operational management). The **changeability** of the network needs to be ensured by jointly developing existing and future potentials (strategic management). Furthermore, the (social) **cohesion** of the whole system needs to be secured by establishing a normative frame that is based on common decisions and guidelines (normative management) [3,15,28]. The realization of these tasks poses a highly complex challenge due to the complexity of the product development and production process itself (spatial distribution of the actors, complexity of technologies and high degree of modularization of the value chain).

The systemic-evolutionary approach takes the complexity inherent to value creation systems and their control into account and stresses the importance of self-regulating forces through the system elements themselves. Viable systems evolve evolutionary out of the interplay of the system elements, because they are far too complex than they could have ever been entirely created by humans [6,7]. Thus, the control or regulation of the value creation within the system is not the task of single actors, but emerges from the interplay of actions of all participating actors. In order to enable a balanced interplay and, related to that, an efficient management of the value creation processes, a goal-oriented architecture of the system is necessary. The design of a value creation system is determined by the system structure, the architecture of the value creation artifact as well as its processes (see impact spheres in figure 1). The design of these spheres aims at different objectives according to a systemic-evolutionary development of the value creation system. The **structures** of value creation are directed in a way that they foster the self-regulating forces of the participating actors. The **artifact** fosters stigmergy in the course of cooperation. Well-defined interfaces, communication standards and modularization of components make sure, that the development and production of the artifact can be realized in a distributed manner so that no central coordination organ is necessary. The objective of the design of value creation **processes** is to foster the emergence during cooperation. The cooperation between the actors is thereby always aiming at creating an added value that is in its sum higher than the contributions of the single actors [24].

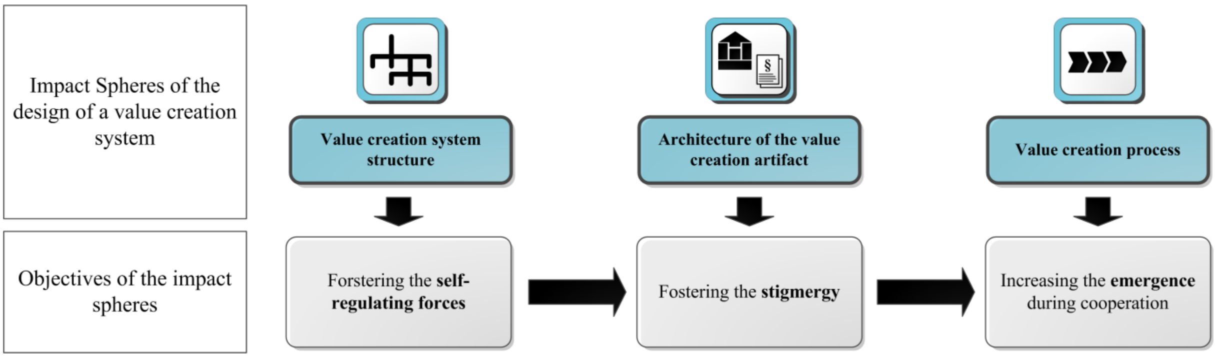


**FIG 1:** Impact spheres and related objectives within value creation systems

An elementary base for the control of a value creating system through its participating actors lies in an efficient management of the resource 'knowledge'. The knowledge of processes, their states, competencies as well as the awareness of possibly lacking competencies (NOT-knowing) enables an efficient **coordination**. These internal system informations have to be adjusted with information concerning developments in the relevant surrounding environment to foster the **changeability** of the system (e.g. changes in the market, availability of external competency carriers, as well as relevant innovations in technology etc.). The common use of the available knowledge, the creation of stable relations between the actors through building trust and the protection of common resources finally ensure the **cohesion** of the system.

In this regard, a knowledge management system contributes to the design and functioning of a value creation system by making an efficient management of the crucial resource 'knowledge' possible. Value creation artifact, system structure and processes are designed in a way that they provide an appropriate frame for the identification, distribution, generation and the use of knowledge. Thus, taking this perspective, the central objective of inter-organizational knowledge management (KM) is to support the control of the value creation system in the fields of operational, strategic and normative management through an efficient common management of knowledge and knowledge flows.

## 2) Research Project: Knowledge Management for the aeronautical cluster HAMBURG AVIATION

At the Laboratory of Production Technologies in Hamburg (Helmut-Schmidt-University, Germany) a knowledge management system (KMS) for the aeronautical cluster in Hamburg has been developed in a BMBF (Federal Ministry of Education and Research) sponsored research project pursuing the described objectives of inter-organizational knowledge management. The KMS supports the actors of the cluster to efficiently manage the common resource 'knowledge' following the overall aim of optimizing the harmonization of value chains as well as fostering collaborative innovation in the cluster.

The regional cluster initiative HAMBURG AVIATION (HA) consists of the core companies AIRBUS and LUFTHANSA Technik, Hamburg Airport, several associations, research institutes and universities, as well as 300 small and medium-sized enterprises (SMEs), which are linked both vertically and horizontally with one another. The recent strategic consolidation of one of the core company's value chains and the related restructuring of supplier relationships resulted in new challenges especially for the local SMEs as well as for the overall organization and coordination of the activities within the cluster [20].

Grasping and mastering the complexity of the various and constantly changing forms of cooperation within a value creation network (i.e. HA) cannot be achieved through a constructivist approach. Instead of order, determinism, deduction and stasis, the analytical framework has to focus on indeterminism, sense-making and the openness towards change [15]. That also means that the solution is not necessarily linked to a series of mathematical conditions, but rather to patterns of emergence, which provoke further changes and give insights into the mechanisms that create these patterns and propagations of change [2].

Based on the exposed premises, the focus of our investigation has been on the systemic analysis of the interdependencies between the system elements and the key impacts on different levels of recursion as well as different management levels. In the following section, the major results of the conducted qualitative systemic analyses will be presented, serving as a base for the following development of a knowledge function.

## 3) Key impacts affecting the realization of the knowledge tasks within the cluster HAMBURG AVIATION

As mentioned above, the overall aim of inter-organizational knowledge management is the control of the value creation system through an efficient realization of the KM tasks. Two central questions arise in this context:

What are the determining impacts on the realization of the KM tasks within the system? Knowing the major positive as well as negative impacts facilitates the creation of context-sensitive courses of action.

What kind of interdependencies (positive as well as negative) occur between the realization of the KM and GM tasks? Since knowledge management practices should be integrated in general management tasks on the operational, strategic and normative level, the knowledge of possible negative interdependencies is crucial.

In order to answer these questions, a qualitative model has been developed based on a method by NEUMANN/GRIMM that describes the interdependencies between context-specific impacts (e.g. level of trust, power asymmetries along the value chain) on the realization of the KM as well as the GM tasks in detail [7,16,32]. The development of the model is based on a qualitative interview study, which has been carried out with experts of the different sectors of the aeronautical cluster [13,31]. Figure 2 shows the three identified spheres of impact as well as the relevant tasks/objectives of the management fields.

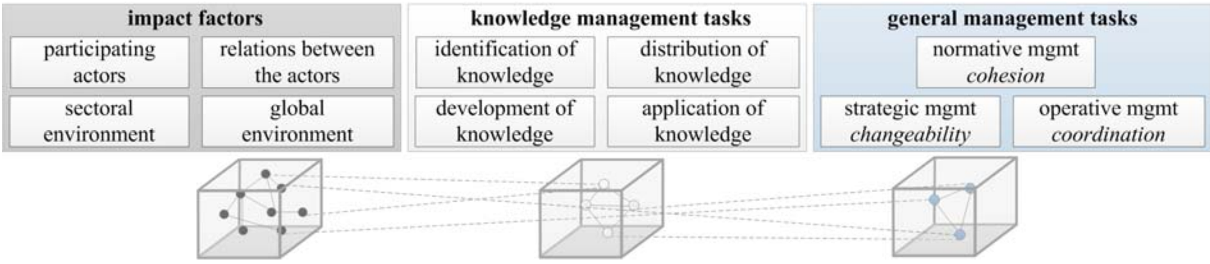


**FIG 2:** Schematic illustration of the interdependencies of different areas of influence, KM and GM tasks

The first column of figure 2 shows three different spheres of impacts. Each sphere contains impact factors that affect the KM and/or GM tasks in a positive or negative way (e.g. level of heterogeneity, level of error tolerance, power asymmetries, relationships of dependency, personal barriers etc.). In the course of the analysis we identified impact factors that affect both - the KM and GM tasks - and examined their interdependencies in order to answer the second question [12,13]. We detected conflicting factors that had a positive impact on a KM, but a negative one on a GM task or vice versa (see figure 3).

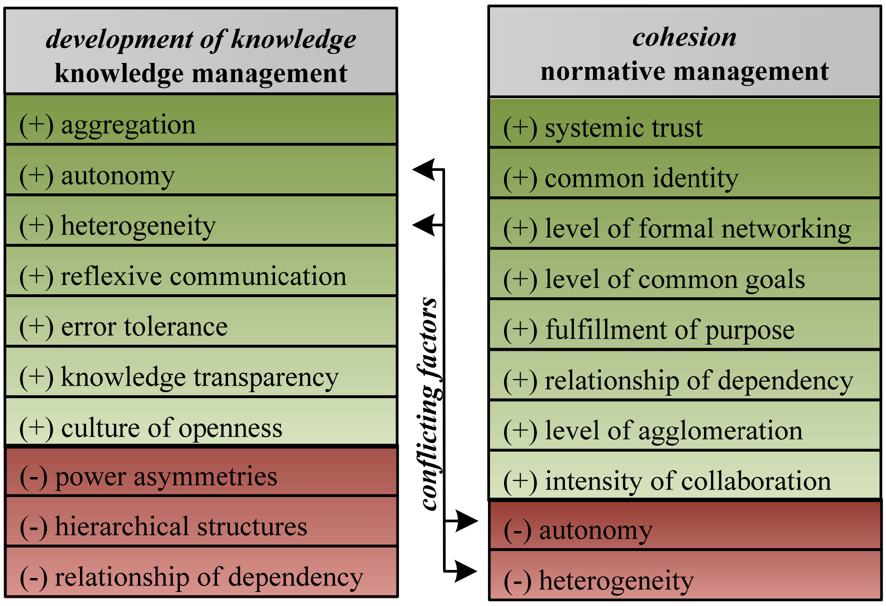


**FIG 3:** Extract of variables that exercise a conflicting/opposing impact on the 'development of knowledge' and the 'coh,kesion' of the system

Based on a comprehensive analysis of the key impacts within these two management fields three central conflicts of objectives (conflict areas) have been identified. Though an entire resolution of these conflicts is never possible and also not aspirated, it is necessary to establish an appropriate, context-specific compensation. Accordingly, three major requirements for the knowledge management were derived (see Fig. 4):

**(1) Compensation between cognitive proximity and distance:** Cognitive distance (resp. proximity) refers to the degree of similarity of mental models, i.e. their structure and content. A high degree of autonomy and heterogeneity usually comes along with a certain cognitive distance between the actors and is the fundament for high problem solving skills of cooperating actors that are not blocked through group thinking and conformity. However,

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these exact factors have a strong negative impact on the cohesion of the system (resp. sub-system), whereas cognitive proximity facilitates an efficient communication and the establishment of a common identity in the long run [17].

First requirement: During the cooperation a dynamic compensation between cognitive distance and proximity has to be assured, which fosters the innovation potential and prevents conformity and group thinking without affecting the cohesion of the whole cooperation system.

**(2) Compensation between dynamics and stability:** Dynamic structures and processes within the value creation system (VCS) are the basis for its changeability and the precondition for the adaptation to changing environments (market conditions, political framework). However, this strongly affects the process of knowledge identification. Stable structures and well-established processes as well as generally accepted standards facilitate the identification of knowledge significantly.

Second requirement: Consequently, there is a need for compensating constant long-term structures as well as dynamic system features in a way that the identification of knowledge can be realized without affecting the dynamic of the whole system.

**(3) Compensation between knowledge transparency and non-disclosure:** The availability of internal expert knowledge and knowledge of internal operations is crucial to the coordination of value creating activities and the emergence of synergies. However, a high level of transparency increases the risk of inadvertent knowledge drain (or industrial espionage), which in turn strongly affects the willingness to share knowledge – an essential precondition for the distribution of knowledge within the system.

Third requirement: There is a need to regulate the availability of knowledge (transparency) in a way that the necessary willingness to share can be raised and competitive knowledge can be protected (i.e. loss risks can be minimized).

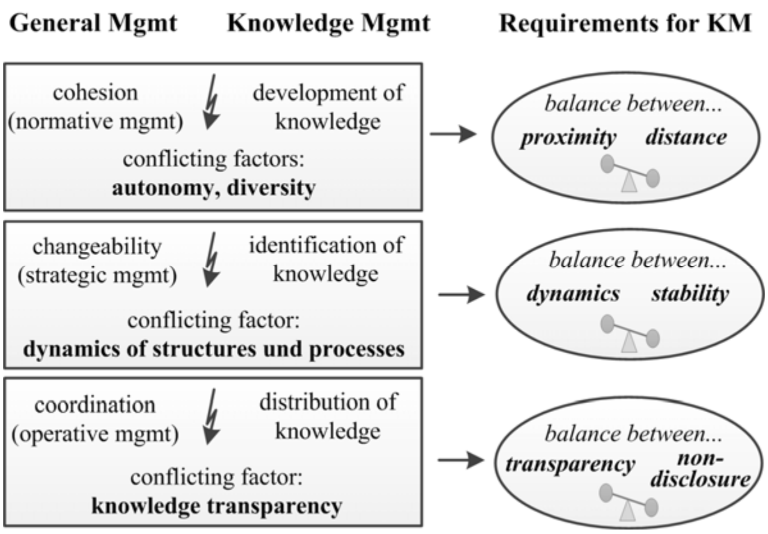


**FIG 4:** The three major conflicts of objectives and the need for their compensation

As already mentioned before, an entire resolution of these conflicts of objectives through an appropriate design of the value creation system is not possible. However, the investigation identified incongruent impacts that have to be taken into account regarding the control of the VCS. The conflict-causing variables have to be compensated in a context-sensitive way. The state of the system and the task that has to be fulfilled by the actors determine in how far a compensation between cognitive distance and proximity, dynamics and stability as well as transparency and nondisclosure is necessary. The state of the system is defined by the stage of development, in which the system (resp. sub-system) is currently situated. According to the life-cycle-model of production networks, four different stages can be differentiated: the stages of initiation, constitution, operation and transition. Each stage requests for a different way of compensating between the conflict-causing variables.

Thus, the design of the structure, artifact and processes of the VCS in terms of an efficient realization of the KM tasks has to ensure an appropriate, context-dependent level of cohesion, changeability and coordination during all the different system stages.

## 4) The missing link: a knowledge function in value creation systems

The compensation of the described conflicts of objectives is a central criterion for the success of inter-organizational knowledge management. A KM system will be only successful and accepted by the participating actors, if it enables an efficient management of knowledge without affecting the overall management of the system in a negative way. We therefore claim the need for a knowledge function in value creation systems that fulfills the following purpose: The knowledge function (KF) is a mechanism that regulates the design of the structure, artifact and processes according to specific contexts in a way that a dynamic compensation between cognitive distance and proximity, dynamics and stability as well as transparency and nondisclosure can be achieved. Thus, the KF supports the changeability and cohesion of the system and contributes to its control.

In the following section, the operational principles of the KF will be described in detail. Since the KF is inspired by the functioning and logic of a fuzzy controller, first of all, the principles of the control of complex systems based on fuzzy information will be explained.

### *4.1.) The control of complex systems using fuzzy information*

The basis for the control of a system is the knowledge of its internal modes of functioning. Only if the expected system behavior is known, one is able to identify deviations from the targeted system state and can develop courses of action in order to vary the system state. In control engineering the behavior of the controlled system (control loop) can be represented in mathematical terms. The knowledge of the underlying mathematical function makes it possible that in case of rule deviations the controller can develop correcting variables and transmit them in the control process (value creation process). If no unexpected disturbances occur and the mathematical function entirely displays the behavior of the control loop, the correcting variable will be developed according to the prior calculations.

Since the considered system of cooperating actors in the aeronautical cluster HAMBURG AVIATION is a highly complex socio-technical value creation system, the variables and elements that determine its behavior are fuzzy and remain partly unknown. Furthermore, the interdependencies between the system elements are not completely known and hardly quantifiable. Consequently, there exist no mathematical functions that entirely display the way actors are cooperating and exchanging knowledge in the cluster. Therefore, the control of the system through the knowledge function can neither be based on a series of mathematical conditions nor can it be realized in terms of an exact calculation.

Nevertheless, there are procedures that deal with the modelling of fuzziness in a systemic context. One way of handling the fuzziness of complex systems and their environmental embedding lies in the use of the principles of fuzzy logic. The fuzzy-set theory developed by ZADEH makes it possible to display the fuzziness of the affiliation of objects [36]. “A fuzzy set is a collection of objects without clear boundaries. In a fuzzy system, there is a transition area where things can belong to either opposite.” [14] In contrast to the bivalent Aristotelian logic, fuzzy logic focuses on polyvalence, thereby, addressing the fact that “systems are fuzzy per se” [14]. The aim of this approach is to grasp the fuzziness of the system and make it describable in order to develop a model of the system behavior that serves as a basis for its control [8,27]. Fuzzy controllers are based on the premises of the fuzzy-set theory and are consequently used when the mathematical model of the control loop is unknown or very hard to derive [27]. The control of fuzzy systems that cannot be displayed mathematically is usually done by humans. On account of their immense cognitive capacities and experiences they are able to control such complex processes. If an expert, for instance, makes a decision (consciously and unconsciously) it is based on his experiential knowledge and cognitive capabilities. He has no complete information of the systems’ internal interdependencies. However, based on his experience the expert is able to interpret the system performance and to draw conclusions for future system states and possible manipulations.

Consequently, the fuzzy controller aims at grasping and representing the decision making competencies of the expert instead of representing the mathematical model of the whole complex process [37]. In order to grasp this experiential knowledge about the regulated process, it is collected in so called linguistic statements and further developed into a set of rules. The following example of operating a steam machine illustrates this procedure.

The operator of the steam machine does not entirely know the mathematical connections of the processes that take place in the steam boiler. However, he knows that he has to raise the temperature significantly and not only a bit, if the steam pressure drops.

Derived rule: IF the steam pressure drops strongly, THAN the temperature has to be raised significantly [27]. Based on the experiential knowledge of the expert these kinds of rules are developed for all the relevant system states.

The given example illustrates that the principles of fuzzy controlling suit the requirements for inter-organizational KM very well. Even hardly tangible knowledge that is based on the experiences of single experts can be integrated in the control of the value creation system. Without taking the fuzzy variables into account, the representation of the system and its behavior would be insufficient and the derived courses of actions might be based on wrong premises. Thus, a fuzzy controller is based on the experiential knowledge of humans that is fixed in a rule base (rule algorithm) in order to enable a control that is based on a preferably broad display of real conditions.

The fuzzy control mechanism involves three steps. First of all, the system input *e* (i.e. information on the system performance) needs to be fuzzyfied and transferred into linguistic statements (fuzzyfication). In a second step, the inference mechanism analyzes the system state using the rule base and derives appropriate courses of actions. In a final step, the derived courses of action (e.g. variation of a factor) are transferred into correcting variables *u* and transmitted to the control process (defuzzyfication). Figure 5 shows schematically the steps of fuzzy control.

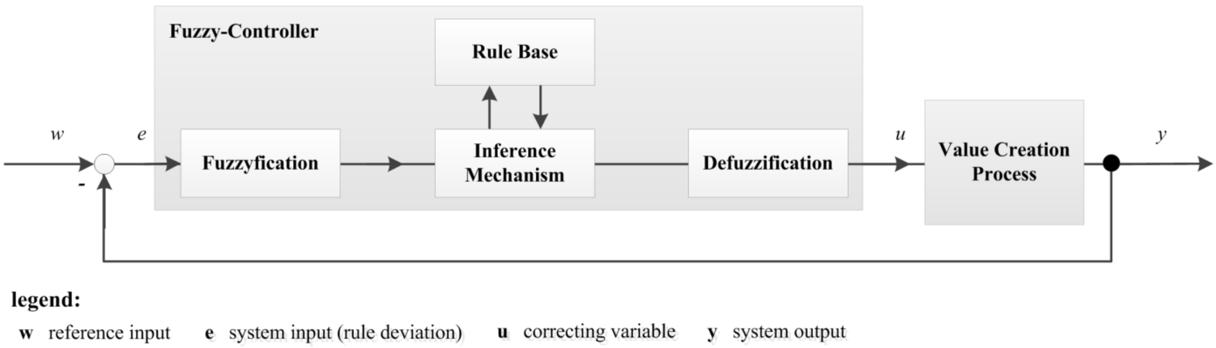


**FIG 5:** Schematic representation of a fuzzy controller

The presented operational principles of a fuzzy controller that serve to control technical systems are in the following used as an analogy for describing the mechanisms of the knowledge function. The single steps of control have been adapted to the specificities of a complex socio-technical system that of course differs essentially from technical systems in being far less predictable.

### *4.2) The mechanism of the knowledge function*

The basic task of the knowledge function is to achieve an accurate compensation between the conflicts of objectives in order to realize the tasks of KM and GM successfully. In this sense, the knowledge function makes a contribution to the control of value creation systems and is conducive to its goal-oriented design. Fig. 6 illustrates the control mechanism of the knowledge function. The control process corresponds to the common value creation process of the actors. Furthermore, the figure shows the modes of control that consist of three successively steps. First of all, the relevant system input (qualitative information on the system) are assessed and transformed into standardized linguistic statements (step 1). Within the second step, the inference mechanism assesses the system state based on a rule base that corresponds to a rule algorithm. In a final step, the variation of correcting variables is derived resulting in a context-sensitive design of the system through the knowledge function. In the following sections, the single steps of control are explained in more detail.

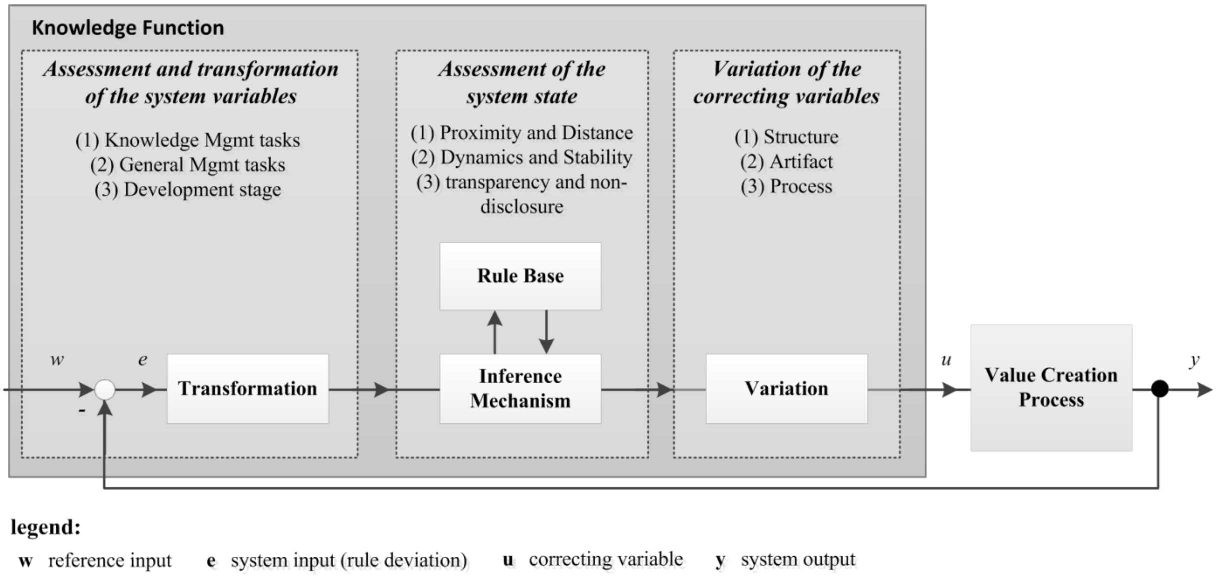


**FIG 6:** Schematic representation of the control mechanism of the knowledge function

### *4.2.1) Assessment and transformation of the system variables*

Within the first step of control the qualitative system variables (fuzzy system input) are assessed with regard to their peculiarity and transformed into a standardized linguistic description (i.e. high – medium – low). Corresponding to figure 2, those include relevant impact factors that are determined by the features of the participating actors (e.g. institutional embedding), the relations between the actors (e.g. power asymmetries along the value chain, level of trust), sectoral impacts (e.g. duration of the product development process) as well as impacts resulting from the global environment (e.g. demographic change). Depending on the peculiarity of the single factors, the system input is further evaluated with regard to the following dimensions:

- KM tasks (qualitative assessment of the level of realization)
- GM tasks (qualitative assessment of the level of realization)
- Development stage (determination of the development stage of the system resp. sub-system)

### *4.2.2) Assessment of the system state*

In order to fulfill the system's purpose (e.g. creating value by manufacturing an airplane) it is inevitable to ensure the viability of the system [4]. It has been already pointed out that a system will be viable, if appropriate levels of cohesion, changeability as well as coordination skills are given. However, that does not mean that a maximization of the single system characteristics should be aspired. Due to conflicts of objectives concerning the knowledge management as well as different system stages that require different levels of, for instance, cohesion there is no universal optimal level. It always depends on the respective context. Consequently, within the second step of regulation the knowledge function assesses in how far the value creation system has appropriate levels of cohesion, changeability and coordination with regard to a specific situation and whether there is an appropriate balance between the KM and GM tasks and the related conflict-causing variables.

The appropriate situational peculiarity of the system characteristics can be derived from a development stage model for value creation systems [11,35]. Four different stages can be differentiated: the initiation, the constitution, the operation and the transition. The single stages correspond to different situations the value creation system passes through. Each of them is marked through a different set of tasks: idea generation concerning the development of a value creation artifact (initiation); development of a business model regarding the commercialization or use of the artifact (constitution); developing and manufacturing the artifact (operation) and finally the transition of the value creation system based on changes of the systems environment (transition). Fig. 7 shows the relation between different development stages and an appropriate level of cohesion.

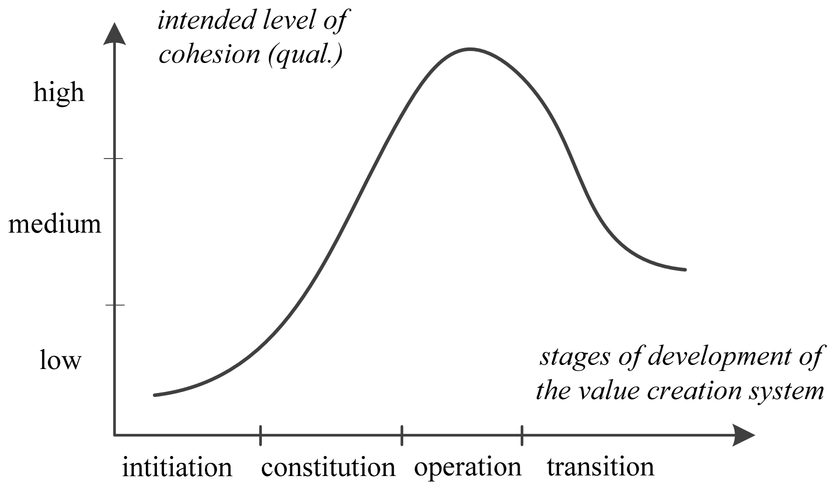


**FIG 7:** Different stages of development and its required level of cohesion

The **stage of initiation** of a VCS is characterized by the process of a common idea generation. It involves the development of the future value creation artifact that also affects future tasks and the depth of cooperation. During this stage, structures and processes are designed ad hoc and in an open way in order to take different heterogeneous perspectives regarding the direction of the common value creation into account. Since the prospect of economic and social benefits has not been determined during this stage, actors are only investing limited resources in the cooperation. During this early stage, the cognitive distance between the actors should be high in order to increase the group's creative potential, which is usually correlating with a low level of cohesion. A group identity and common norms have not been developed so far.

Within the **stage of constitution** the business model of the cooperating actors becomes more concrete [19]. The artifact and its prospective use and commercialization are defined. Furthermore, structures and processes of the future value creation are established and fixed in a common letter of intent. Cohesion increases during this stage up to a medium level. The common letter of intent (e.g. business model, common research proposals) fosters the social cohesion. Processes and structures evolve that form a first framework for the future cooperation. Common goals and visions also increase the (cognitive) proximity between the actors.

The **stage of operation** corresponds to the actual realization of the artifact, which has been defined and planned in the previous stages. The different tasks have been further differentiated and are successively being realized. Actors are investing resources (time, money, knowledge, human resources, technologies) in order to achieve the common goals. The cohesion rises up to a high level in order to fulfill the system's purpose and create a return of investment for each single actor. The complexity of the task and the coordination of the single activities now requires for standardized processes, structures and common norms. Consequently, the cognitive proximity between the actors rises and facilitates the communication.

However, changes in the system's environment may demand for variations of already established features of the artifact, structures or processes leading to a possible **stage of transition**. The high level of cognitive proximity that evolves during the stage of operation should be only aspired, if the environment the system is embedded in is quite stable. Changes in the system's environment force the system to adapt to these changes. High-problem solving skills are required in order to do so and thus a higher level of cognitive distance (i.e. a high level of diversity among the actors) is needed. This activates the creative potential of the actors and fosters a controversial debate and decision-making processes. The aspired cognitive distance among the actors rises in this stage in order to widen the perspective and provide the necessary openness in the course of redesigning.

Finally, the assessment of the system state can be realized according to a specific evaluation table. On the basis of the information on the peculiarity of the systems' cohesion, changeability and coordination performance and the current development stage of the system, the assessment of the system state is now possible. In this context the following question is of interest: is there an optimal balance between cognitive distance and proximity, dynamics and stability as well as transparency and nondisclosure that is suitable to the specific development stage of the system? The fundament for the evaluation is a rule base using simple boolean operators. Depending on the peculiarity of the level of cohesion, changeability and coordination as well as the system's development stage options for the variation of the conflict-causing variables are proposed. Table 1 shows an extract of the evaluation table for different levels of cohesion in the initiation stage.

| Stage of development | Level of Cohesion | Variation of the ratio between cognitive distance and proximity |
|---|---|---|
| initiation | none | ↑ *proximity* *distance* ↓ |
| | low | → *proximity* *distance* → |
| | medium | ↓ *proximity* *distance* ↑ |
| | high | ↓↓ *proximity* *distance* ↑↑ |
| | very high | ↓↓ *proximity* *distance* ↑↑ |

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**TAB 1:** Evaluation table for different levels of cohesion in the initiation stage

### *4.2.3) Variation of the correcting variables*

During this step of control, the knowledge function needs to modify those impact variables that cause the imbalances between KM and GM objectives with regard to the specific stage of the value creation system. These correcting variables have been already identified in the qualitative interdependency model developed within this research project. They can be deducted from the key impacts on the conflict-causing variables ‘autonomy’, ‘heterogeneity’, ‘dynamics’ and ‘transparency’. Table 2 shows an extract of the identified correcting variables that can compensate the conflicts of objectives. They are categorized according to the following spheres: value creation system, artifact and process. By varying the peculiarities of these impact variables, the structure, process and artifact can be modified by the knowledge function in order to achieve the compensation appropriate to a specific context.

| | **proximity and distance** | **dynamics and stability** | **transparency and non-disclosure** |
|---|---|---|---|
| **structure** | cooperation structure | cooperation structure | communication culture |
| | inter-organizational coordination | inter-organizational coordination | formal network |
| | regional agglomeration of the actors | adaptability | informal network |
| **process** | width and depth of cooperation activities | level of dependency | depth of cooperation activities |
| | power asymmetries, level of dependency | culture of error tolerance | conflict culture |
| | common objectives | technological changeability | trust |
| **artifact** | granularity of the common task | modularity | granularity |
| | scope of service | | property rights structure |

**TAB 2:** Impact variables to compensate the three conflicts of objectives

## 5) Conclusion and Outlook

An efficient management of knowledge in value creation systems is the basis for its control through the participating actors. An efficient use of the common knowledge resources can be considered as crucial for enabling actors to coordinate spatially distributed value creation processes, adapt to changing environments as well as ensure the (social) cohesion of the system as a unit. From a systemic-evolutionary perspective, knowledge management is therefore a central element of a successful management of the entire value creation system. Though, conflicts of objectives between KM and GM tasks may occur on very different levels of the value creation system. The compensation of these conflicts is of major importance, if the knowledge management aims at fostering the viability of the system instead of hindering it. The implementation of knowledge management practices in the design of the value creation artifact, its system structure and processes have to be carefully and dynamically adjusted to the specific context the value creation system is situated in. Value creation takes place in spatially distributed processes and across organizational boundaries; only a holistic perspective on the whole system can cope with the growing complexity and interweaving of the internal system elements as well as its surrounding environments. In meeting these needs, a system internal knowledge function has been developed following the operational principles of a fuzzy controller. The knowledge function ensures a context-sensitive compensation of the conflicts of objectives between KM and GM tasks, thus contributing to the viability of the value creation system. Through a qualitative systemic analysis, the fuzziness of the system and its elements could be captured and transformed into standardized qualitative assessments of the system state. The assessment of the system state is conducted by a rule base that has been developed based on expert interviews and a heuristic analysis of relevant literature. The control of the system is finally realized through the variation of the correcting variables that affect the conflict-causing factors. These correcting variables function like adjusting screws that serve to context-sensitively compensate the conflicts of objectives.

However, further research is necessary regarding the realization of the KF in value creation networks. How can the theoretical findings be operationalized into organizational aspects within a network? One possibility is the creation of new roles in the network, for instance, intermediaries that implement the knowledge function. These neutral intermediaries are not part of the primary value creating activities and can therefore take a holistic independent perspective on the overall system. They accompany the actors of the network by passing the different development stages and support them by dynamically adapting artifacts, structures and processes to changing environments. They permanently analyze the network (first step of regulation), evaluate the cooperative activities with regard to the compensation of the conflicts of objectives (second step of regulation) and finally develop specific courses of action in order to conduct necessary variations of conflict-causing variables.

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