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Innovation through process oriented knowledgemanagement in a regional e-cluster system

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"Land Use and Water Management in a Sustainable Network Society"

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Innovation through process oriented knowledgemanagement in a regional e-cluster system (757)

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Abstract:

A regional e-cluster system and its cybernetics are characterised by a high degree of complexity, which requires a comprehensive strategy. The identification of the key components of this e-cluster system and its interrelationships show that the component "knowledgemanagement" is a critical and decisive process in an e-cluster system. ClusterNet builds the strategic frame for a process oriented knowledgemanagement in a regional e-cluster system. The strategy of knowledgemanagement consists of objectives, activities and measures to reach the vision that the resource of knowledge is used effectively in the cluster specific processes. Consequently, this strategy requires the processes of knowledgemanagement to be combined with the cluster processes in a technical and organisational way. The knowledge of an e-cluster can therefore just in time with the cluster processes be identified, acquired, developed, used, distributed and finally stored.

Key words:

Regional e-cluster system, knowledgemanagement, innovation, cybernetics, balanced scorecard

1. Innovation in a regional e-cluster system

A regional e-cluster system consists of independent organisations that strive for economic sustainability. In accordance with the concept of cluster policy of Porter (1990, 1998), the intensity of the interaction of the actors, and not the individual actor has a positive effect on the sustainable development of a regional e-cluster system. So a regional e-cluster is a complex system of interrelationships which initiates and pushes the networking of all participants in a value-added chain which are companies, institutions, such as universities and research institutions, customers, supplying industries, employees, representations of interests and the public sector. In particularly the small and medium sized enterprises can take advantage of being member of a regional e-cluster system. Taking part in the cluster processes like innovation and knowledgemanagement, they are able to improve their innovation processes and finally competitiveness. Consequently, the strategy for a regional e-cluster system aims on cluster building to support regional networks and collaborative processes of competitive and cooperative actors in a cluster.

The innovation potential and e-knowledgement are key drivers for the sustainable development of a regional e-cluster system. Knowing the effects and backlashes of these key drivers, you are able to manage the system.

To provoke effects of employment and growth the acceleration of innovation processes and the increase of innovation potentials is an important objective. The cluster provides for an optimal environment to reach this aim. Following Porter (1998) the spatial proximity allows for an interaction of the cluster actors and consequently for an effective and efficient knowledge transfer. Preissl and Solimene (2003: 5) argue that the information economy enforces these positive conditions for innovation processes so that ‘in the analysis of innovation, the traditional concept of clusters as spatial agglomerations that enhance productivity and growth in a certain region has to be reconsidered taking into account the essential features of knowledgement in an information economy. This implies that the specific technological options offered by advanced communication networks have to be analysed with respect to their role in supporting innovation.’

The collaborative processes of innovation and knowledgement are decisive for the competitiveness of a regional e-cluster system and are therefore in the focus of the following analysis.

Being very knowledge intensive the innovation processes have to be interconnected with the processes of knowledgement. These processes are collaborative and require for an effective process management.

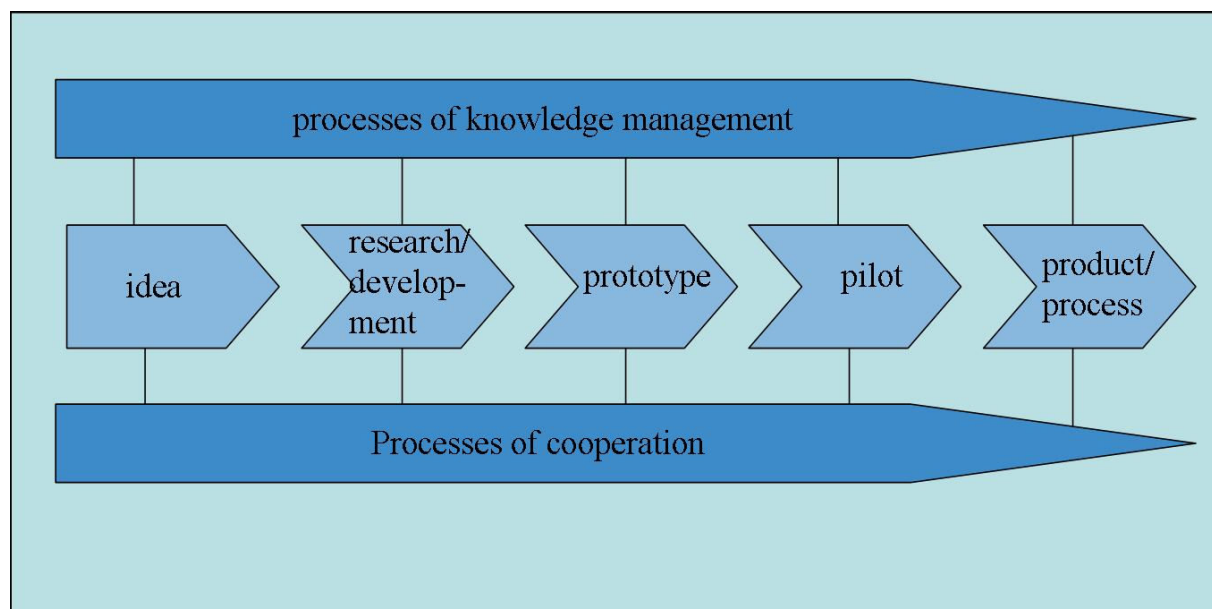


Figure 1: Processes of innovation, cooperation and knowledgement

The interaction between the companies and research institutes can improve significantly the innovation processes. The innovation process includes all activities, which cooperate logically and temporally and contribute to the commercial exploitation of a new product or to the application of a new process through the company. The starting point of an innovation

process is the research and development activities, which should result in a product- or process prototype. Then activities are following to prepare the market introduction or the process implementation in the company. Different organisations of the cluster or of other cluster can take part in these processes: The process of generating ideas can take place in the universities and research institutes. The university can develop this idea in cooperation with a company to produce a process- or prototype. The cluster company pilots this prototype, which can finally realize the market introduction or the process implementation.

To examine the role of knowledgemanagement in a regional e-cluster system, the instrument of the balanced scorecard developed by Kaplan and Norton (1997) and the sensitivity analysis of Vester (2002) are the applied methods. The complex, interdisciplinary and dynamic problems of systems and developments need a new method for the processes of planning and decision in the public and private sector. Vester (2002: 203-212) outlines that a strategy has to take into account all sub systems like the social, economic, ecological, technical and cultural ones, their particular system elements, the interaction between these elements and their behaviour over a period of time.

2. Processes of learning and knowledgemanagement

The resource knowledge is an important production factor in the innovation processes. The cluster strategy refers therefore directly to the strategies for innovation and knowledgemanagement. Preissl and Solimene (2003: 5) point out that ‘innovation clusters, finally, rely on excellence in the generation, diffusion and use of knowledge followed by successful implementation of new processes of production or marketing of new products.’

To increase the innovation potential and competitiveness of a regional cluster it is necessary that the cluster system comprehends itself as a learning organisation. The processes of learning belong to the processes of knowledgemanagement. While the objective of knowledgemanagement ist to structure, store and distribute information and knowledge, the processes of learning have the aim to support the internal processes of qualification of the regional cluster. The integration of knowledge and learning management is the condition that the cluster on the one hand can realize the flexible and individual application of learning and training contents and on the other hand an effective skill management. The concepts of ‘life long learning’, ‘training on the job’, ‘organisational learning’ and ‘training on demand’ are the scenarios for the organisation of processes of learning and knowledgemanagement in a regional e-cluster system.

Which requirements a strategy for knowledgemanagement in a regional e-cluster system has to fulfil?

- Knowledgemanagement is a comprehensive approach that accepts implicit and explicit knowledge as a strategic and value creating resource and therefore aims on interconnecting the processes of knowledgemanagement and the business processes of the regional e-cluster system.

- A process oriented knowledgemanagement accelerates and improves the processes of innovation with the repercussion that the process costs decrease and the process quality increases.
- Knowledgemanagement has the aim to use knowledge in such a way, that the objectives of the cluster are reached optimally. A process oriented knowledgemanagement concerns because of the cross-function all parts of the cluster. To make the knowledge just in time in the processes of the company or in the collaborative processes of the cluster available needs an interlocking between the business processes and the knowledgemanagement processes.
- To establish an effective knowledgemanagement there is a need for information, communication and cooperation between all actors of an e-cluster. Especially the implicit knowledge requires the interaction of the cluster partners.
- Being collaborative processes, the processes of knowledgemanagement need an effective management.

Probst et al. (1999: 53-56) define the main processes of knowledgemanagement. They are the knowledge identification, the knowledge acquisition, the knowledge development, the knowledge distribution, the knowledge utilisation and finally the knowledge storage.

The process knowledge identification comprises the analysis and the description of the existing knowledge basis of a cluster. The aim of this process is to receive and improve transparency regarding the existing and available data, the information and competences of the cluster. The process knowledge acquisition has the task to identify sources of knowledge lying outside the cluster. Through the integration of experts or through the cooperation with other clusters the cluster has the opportunity, to use knowledge potentials, which are not available within the cluster. The process knowledge development is a very important one because this process is keyed to develop new competences, new products, better ideas and innovative products. The process of knowledgemanagement development is directly linked with the innovation processes of a cluster. The process knowledge distribution supports the distribution of the knowledge in a cluster and increases so the just in time availability of this important resource. The process knowledge utilisation ensures that the existing knowledge is used effectively in the cluster processes. The function of the process knowledge storage is to avoid that knowledge gets lost to the cluster. The focus of this process is to save and to update the existing and available knowledge basis in the cluster processes.

3. The role of knowledgemanagement in a regional e-cluster system

The following analysis outlines the application of these methods to explain the cybernetics of a regional e-cluster system. Assumed hypotheses are the basis for the development of a model of the complex regional e-cluster system. The model consists of a vision, a mission, of a strategy and components, which are determined in accordance with the requirements of complex systems (Vester, 2002) and of regional clusters (Porter, 1990). The estimations of the cluster actors, empirical research and theoretical research can each or in combination with

each other provide for the valuation of the vision, mission, strategy and components. The objective of the analysis is to focus on the methodical approach, which produces issues to manage a complex system. Following the general research results of Porter (1990), of Preissl and Solimene (Preissl and Solimene, 2004) and of Bröcker, Dohse and Soltwedel (Bröcker, Dohse and Soltwedel, 2003) and developing one exemplary case of the regional e-cluster system you receive a starting point of a dynamic strategic and political process to evaluate the dynamic system behaviour. Consequently, the hypotheses concerning the vision, mission, strategy, components and the interrelationships require a permanent controlling and if necessary adjustments.

Following the system model and sensitivity analysis of Vester (2002: 213-222), the relevant key components have to be identified that push the development of the regional e-cluster system towards vision, mission and strategy. The following table 1 gives an overview of the variables. The variables are changeable values whose interactions outline the sensitivity analysis. For each variable, a description of its indicators is necessary. Besides, each variable should include a valuation to be able to analyse interactions.

C1 economic potential
C2 innovation potential
C3 education and competences of the cluster actors
C4 engagement and motivation of the cluster actors
C5 efficient and effective collaborative cluster processes
C6 digitalization of the cluster processes
C7 future oriented cluster policy
C8 effective and efficient cluster management
C9 efficiency and Effectiveness of the infrastructure
C10 image of the cluster
C11 cooperation with other clusters
C12 cooperation within the cluster
C13 e-government
C14 e-knowledgemanagement
C15 structure of the cluster actors
C16 employment
C17 proximity

Table 1: Key variables of the regional e-cluster system

Effects on	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	C14	C15	C16	C17	P
C1		2	1	0	1	0	0	0	0	2	1	1	0	0	1	2	0	418
C2	3		2	1	1	2	1	0	1	2	3	3	2	2	1	1	0	975
C3	3	3		0	0	0	0	0	0	2	2	2	0	3	3	3	0	546
C4	2	2	1		2	0	0	2	0	2	3	3	1	3	0	0	0	504
C5	2	3	0	2		3	0	1	0	2	3	3	3	3	0	0	2	864
C6	2	2	1	1	3		0	1	1	2	3	3	3	3	1	0	3	812
C7	2	2	3	2	2	2		3	3	2	2	2	3	3	3	3	3	480
C8	1	2	1	3	3	3	1		2	3	3	3	0	3	2	2	2	544
C9	3	3	3	0	3	3	0	3		2	3	3	3	3	3	2	3	800
C10	2	2	1	1	0	0	0	0	0		3	3	0	2	3	1	1	608
C11	3	3	1	1	3	3	0	0	2	2		2	2	3	1	1	2	1160
C12	3	3	1	3	3	3	0	1	0	2	3		2	3	2	1	3	1287
C13	2	2	1	0	3	3	3	0	3	2	3	3		3	1	1	2	832
C14	3	3	3	3	3	3	3	3	3	3	3	3	3		3	3	3	2016
C15	3	3	2	1	2	0	0	0	0	2	2	2	1	3		1	3	700
C16	1	1	2	3	0	0	3	0	3	2	0	0	0	2	3		0	440
C17	3	3	3	3	3	3	1	2	2	0	3	3	3	3	1	1		999
PS	38	39	26	24	32	28	12	16	20	32	40	39	26	42	28	22	27	
AS	11	25	21	21	27	29	40	34	40	19	29	33	32	48	25	20	37	
AS/PS	0,29	0,64	0,81	0,88	0,84	1,04	3,33	2,13	2	0,59	0,73	0,85	1,23	1,14	0,89	0,91	1,37	
Q x 100	28,9	64,1	80,8	87,5	84,4	104	333	213	200	59,4	72,5	84,6	123	114	89,3	90,9	137	

Table 2: Matrix of influences

The table 2 represents the matrix of influences and outlines the effects and backlashes of each component in the regional e-cluster system that are measured by the values one, two and three and therefore by a corresponding weak, proportional and strong influence.

E-knowledgemanagement is one relevant component of the regional e-cluster system. To analyse the role of e-knowledgemanagement in the whole system you have to take the cybernetics that means the structure and the processes of the regional e-cluster system into account. The effects and backlashes of each component in the context of the whole e-cluster system determine the strategy to manage and control it. The component ‘e-knowledgemanagement’ is the point of view from where these effects and backlashes are analysed.

The active sums (AS) and the passive sums (PS) of the variables provide for further statements concerning the effects which are caused by each variable. The active sum indicates how the variable affects the regional e-cluster system whereas the passive sum of a variable indicates how it reacts in case of changes of the system.

The component ‘e-knowledgemanagement’ has with the sum of 48 a capitalized active sum of the system. Consequently, a little change of the variable will result in a very intense reaction of the regional e-cluster system. If the active sum is very little, like it is of the variable ‘economic potential’, then a very significant change is necessary to evoke consequences for the development of the system.

The interpretation of the passive sum is different. The variable ‘e-knowledgemanagement’ has also a very high passive sum of 42 that implies that it will react very strongly to system changes. However, the variable ‘future oriented policy’ with a very small passive sum of 12 only reacts in case of very strong changes of the system.

The objective is to give an answer to the question how activities concerning e-knowledgemanagement can manage the regional e-cluster system. To give an answer to this question the indicators of the active and passive sums of the variable ‘e-knowledgemanagement’ are not sufficient. The quotient of the active sum and the passive sum of a variable allows the conclusion whether a variable behaves more actively or more reactively. Another indicator, the product of the active sum and the passive sum of a variable, indicates to what extent it takes part in the processes of the cluster system. The higher the product is the more the variable takes part in the system processes. However, the smaller the product is the less the variable takes part in the processes of the cluster. This interpretation is valid independent of the fact whether the variable itself is more likely active or passive measured by the active and passive sum (Vester, 2003:230-238).

With the general criteria, the active and passive sums, the quotient of AS/PS (Q) and the product of ASxPS (P) each variable of the regional e-cluster system achieves a for the whole system relevant characteristic. The tables 3 and 4 show the values of Q and P for each variable and categorise each variable on the one hand in “high active”, “active”, “slight active”, “neutral”, “slight reactive” and on the other hand in “high critical”, “critical”, “neutral” and “slight puffer”.

active ----- reactive	Q
high active	
C7 future oriented cluster policy	3,33
active	
C8 effective and efficient cluster management	2,13
C9 efficiency and Effectiveness of the infrastructure	2,00
C17 proximity	1,37
slight active	
C13 e-government	1,23
C14 e-knowledgemanagement	1,14
C6 digitalization of the cluster processes	1,04
neutral	
C16 employment	0,91
C15 structure of the cluster actors	0,89
C4 engagement and motivation of the cluster actors	0,88
C12 cooperation within the cluster	0,85
C5 efficient and effective collaborative cluster processes	0,84
C3 education and competences of the cluster actors	0,81
C11 cooperation with other clusters	0,73
Slight reactive	
C2 innovation potential	0,64
C10 image of the cluster	0,59
C1 economic potential	0,29

Table 3: Q- indicator of influence

critical ----- puffer	P
high critical	
C14 e-knowledgemanagement	2016,00
critical	
C12 cooperation within the cluster	1287,00
C11 cooperation with other clusters	1160,00
C17 proximity	999,00
C2 innovation potential	975
C5 efficient and effective collaborative cluster processes	864,00
C13 e-government	832,00
C6 digitalization of the cluster processes	812,00
C9 efficiency and effectiveness of the infrastructure	800,00
neutral	
C15 structure of the cluster actors	700,00
C10 image of the cluster	608,00
slight puffer	
C3 education and competences of the cluster actors	546,00
C8 effective and efficient cluster management	544,00
C4 engagement and motivation of the cluster actors	504,00
C7 future oriented cluster policy	480,00
C16 employment	440,00
C1 economic potential	418,00

Table 4: P-indicator of influence

E-knowledgemanagement is a slight active (Q=1.14) and as the only one a high critical (P=2016) variable and plays therefore a very important role in the cluster processes.

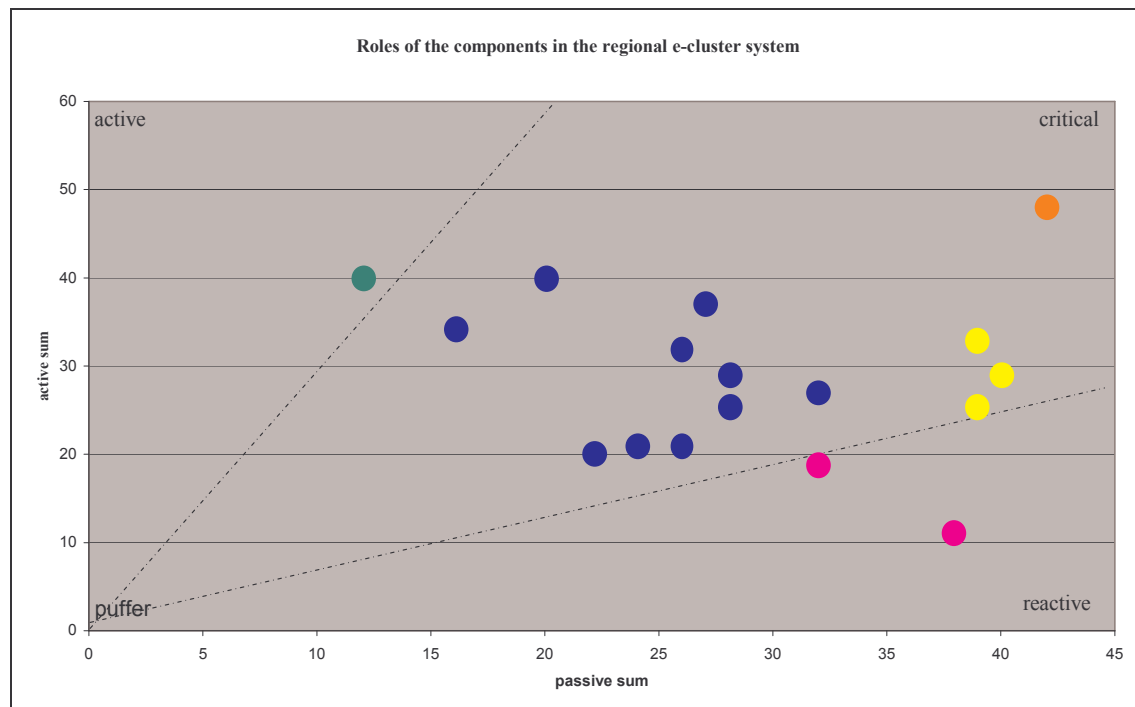


Figure 2: The roles of the variables in the regional e-cluster system

It is striking in figure 1 that the variable C14 ‘e-knowledgemanagement’ is the single component, which is located in the critical area (red point). Consequently, this variable has the function of an accelerator and promoter, which has the capacity to initiate and accelerate significant processes in the system. Nevertheless activities concerning this variable have to be careful because a roll over is possible.

4. ClusterNet - strategy

4.1 Vision, mission und strategy

ClusterNet stands for the strategy of knowledgemanagement in a regional e-cluster system. The starting point of the strategic process is the development of a vision, a mission and a strategy. The strategy shows the way to achieve the objectives.

The actors are often rather hazy about their visions and wishes. In the course of time, these visions become more and more concrete and become a motor for activities. The vision of the balanced scorecard has the task to illustrate the partners of a cluster the long-term objectives. It is valid that the shorter the vision is the more it is accepted and translated into objectives and strategies. The assumed vision of ClusterNet is the following one: the resource knowledge is used effectively and efficiently in the cluster processes!

The mission describes how extern partners or customers should perceive the knowledge based cluster system: innovation through knowledge!

Developing strategies need fundamental decisions. They express how the cluster constitutes its existing and potential strength to meet changing environmental conditions: The processes of knowledgemanagement converge in an organisational and technological way with the cluster processes to identify, acquire, develop, distribute and store just in time the knowledge of the regional e-cluster system.

4.2 ClusterNet: objectives, indicators and activities

The knowledgemanagement in a regional e-cluster system has to fulfil the following requirements:

- process orientation of knowledgemanagement
- interconnection of the processes of knowledgemanagement and the cluster processes
- support of the processes with innovative information- and communication technologies (ICT)

With respect to different perspectives, objectives, activities and indicators are developed for the knowledgemanagement in a regional e-cluster system. The balanced scorecard for knowledgemanagement consists of the economic perspective, process perspective, the

cooperation perspective, perspective of development, the perspective of organisation and the political perspective.

a) Economic perspective

Objectives	Activities	Indicators
Reduction of the process costs induced by the knowledgemanagement of the regional e-cluster	Implementation of an ICT-supported process controlling	Process costs Frequency of processes
Increase of transparency of the processes of knowledgemanagement in the regional e-cluster system	Implementation of an activity based costing	Process costs

Table 5: Economic perspective

b) Perspective of processes

Objectives	Activities	Indicators
Optimization of the processes of knowledgemanagement Centralization, standardization and integration of the processes of knowledgemanagement	Implementation of an ICT-supported process management	Process quality Process quantities Pass-through-time of processes Demand level
Increase of the quality and quantity of the knowledge base of the regional e-cluster system	Implementation of a knowledge controlling	Satisfaction of the cluster actors that use the knowledge base in the processes Acuality and quality of information and knowledge

Table 6: Process perspective

c) Perspective of cooperation

Objectives	Activities	Indicators
Improvement of the cooperations between the cluster actors and with other clusters	Implementation of an ICT-supported cooperation management	Number of cooperations Number of cluster actors that take part in cooperations
Implementation of a virtual expert organisation	Implementation of a with information- and communication technologies supported expert management	Number of the experts taking part in the knowledgemanagement system Competences profiles of the experts

Table 7: Cooperation perspective

d) Perspective of development

Objectives	Activities	Indicators
Improvement of the application of information- and communication technologies	Implementation of an ICT-knowledgemanagement system	Degree of ICT-supported processes Demand level
Improvement of the competence profile of the regional e-cluster system	Supply of an educational infrastructure	Number of participants Number of lessons Number and quality of certificates Competence profile of the regional e-cluster system Competences of the educational infrastructure

Table 8: Perspective of development

e) Organisational perspective

Objectives	Activities	Indicators
Improvement of the organisational conditions for implementing process management and knowledgemanagement	Establishment of the organisational conditions for the implementation of knowledgemanagement in the regional e-cluster	Number and competences of the employees in the knowledgemanagement organisation
	Implementation and realization of a process management	Number and competences of the employees in the process management
	Implementation of a virtual expert organisation	Number and competences of the experts

Table 9: Organisational perspective

f) Political perspective

Objectives	Activities	Indicators
Improvement of the political conditions for implementing process management and knowledgemanagement	Funding activities	Funding budget Number and quality of funding projects
e-Government	e-Government projects	Number and quality of e-government projects

Table 10: Political perspective

To analyse the effects of ClusterNet on the regional e-cluster system you have to evaluate the relationship between the objectives and activities and the variables of the regional e-cluster

system. Which effects cause the funding activities concerning knowledgemanagement on the innovation potential of the regional e-cluster system?

a) Economic potential (C1)

The objective is to support an optimal and sustainable path of development and growth by increasing the economic potential of a regional e-cluster system in a qualitative and quantitative way. You can measure this objective by the gross value-added, employment, growth rate, structure and number of regional, national and international markets or the number and sort of companies in the cluster specific value-added chains.

ClusterNet influences the economic potential by an expected value of three. Being a very important production factor the resource knowledge can evoke significant economic effects like a reduction of transaction costs 'because information about cluster members, their specific comparative competencies and reliability, and about the goods and services they are able to provide spreads quickly' (Preissl and Solimene, 2003: 45). Porter (1990: 158) elaborates that 'while classical factors of production are more and more accessible because of globalization, competitive advantage in advanced industries is increasingly determined by differential knowledge, skills, and rates of innovation which are embodied in skilled people and organizational routines'.

There exist no empirical or theoretical results, which point out a significant influence of the economic potential of a cluster on the knowledgemanagement. Consequently, following the hypothesis, the economic potential does not affect directly the knowledgemanagement in the regional e-cluster system.

b) Innovation potential (C2)

The aim is to accelerate and improve innovation processes. The measures can be the number of patents, number and quality of new products and processes, expenditures for innovation processes, efficient and effective knowledgemanagement, number of students with a highly qualified degree, infrastructure and applications, competences of the cluster actors, knowledge basis of the cluster system or the number of cooperation projects.

Innovation processes are very knowledge intensive so that a strong effect of three is expected. ClusterNet makes the knowledge just in time in the innovation processes available with the result that they will improve and accelerate.

The innovation potential itself has a proportional effect of two on ClusterNet because innovation processes generate new ideas and wisdom that being stored and distributed will enlarge the knowledge base in a qualitative and quantitative way.

c) Education and competences of the cluster actors (C3)

The education and the competences of the cluster actors, which are employees, research institutes, universities and managers, influence the quality of the value-added-chains. The competences of the cluster actors should be of high quality to reach positive effects on the

process and product qualities of a regional e-cluster system. The objective is to enforce the level of education and the quantity and quality of the competence profile of the regional e-cluster system. This objective can be measured by education and competences of the employees and managers, education and competences of the universities and research institutes, education and competences of the students, number and quality of the supply of training, number of participants of the courses, number of students at the universities or the quality of the skill profile.

Being the output of learning processes, the education and competences of the cluster actors refer directly to the processes of knowledgemanagement. Consequently, ClusterNet influences the education and competences by a value of three. The just-in-time-availability of knowledge in the processes of the cluster will ensure a life-long-learning and therefore a corresponding skill profile. The education and competences of the cluster actors also have an effect of three on the knowledgemanagement. The quality of ClusterNet depends on the knowledge base of the cluster and therefore on the input of the cluster actors or experts.

d) Engagement and motivation of the cluster actors (C4)

The building up of a regional e-cluster system depends on the engagement and motivation of the cluster actors to take part in the cluster, to support the process of cluster building as well as to follow the marketing strategies. The objective is to enforce the engagement and motivation of the cluster actors for the acceleration of the process of cluster building. To measure this aim, indicators like membership in the cluster, satisfaction of the cluster actors or the degree of networking help.

ClusterNet has an impact of three on the engagement and motivation of the cluster actors. ClusterNet is a collaborative system, which evokes a self-sustaining and self-motivating process generating win-win-situations for all participants. Especially for the collaborative processes and for the processes of knowledgemanagement, which require a sharing of wisdom and experiences, the engagement and motivation of the cluster actors are decisive. Therefore, this component influences the knowledgemanagement by a value of three.

e) Efficient and effective collaborative cluster processes (C5)

The actors of an e-cluster system are able to realize positive cost effects because of the optimization of their processes. On the one hand, they can produce increasing economies of scale. On the other hand, the standardization of the processes allows for a business-process-outsourcing. The partners in an e-cluster system are so able to concentrate on their main competences to accelerate the innovation processes and to increase the competitiveness. The e-cluster produces therefore economies of specialization that result in positive effects on productivity and innovation capacity of the cluster actors and therewith of the whole cluster. To measure these effects indicators like process costs and process qualities are appropriate.

The integration of the processes of knowledgemanagement and the cluster specific processes means that the collaborative processes, being very knowledge intensive, improve.

Consequently, there is a positive effect of three of knowledgemanagement on the efficient and effective collaborative processes. On the other hand, efficient and effective collaborative cluster processes facilitate the implementation of a process oriented knowledgemanagement so that an impact of three is assumed.

f) Digitalization of the collaborative cluster processes (C6)

The effective and efficient support of the cluster processes with innovative information- and communication technologies will result in product and process innovation and finally in the development of an e-cluster. To measure these effects indicators like availability and application of cluster information systems and of groupware-applications, communities, cluster specific web-services, users of communities or the degree of processes that applications support.

Besides the geographic proximity in a regional cluster is an important source of improvement and innovation, the information- and communication technologies are a driving force for innovation processes. These technologies, developing rapidly and causing innovations in all industries, are an important motor for the change of the industrial into the information society. The process of digitalization pushes the convergence of different media, information technology and telecommunication industries. Changing business processes, new integrated value-added chains, different organised structures and innovative products will result in positive effects on the sustainability of a regional e-cluster system.

To explain the interrelationship between the regional clustering and the information- and communication technologies it is necessary to consider their specific cybernetics. The geographic proximity of a regional cluster produces face-to-face-interactions of the cluster actors that result in trustful and collaborative cluster processes. As Hansen (2004) points out, the digitalization of these collaborative processes with information- and communication technologies and –applications provide for a technical proximity and therefore can reinforce trust building in a virtual cluster, namely the regional e-cluster system.

The interrelationships between regional clustering and the application of information- and communication technologies means on the one hand that the process of cluster building is enforced by the information- and communication technologies and on the other hand that the regional clustering facilitates the implementation of applications.

The information- and communication technologies provide for new technological possibilities to support the process of cluster building. Independent of time and location the actors of a regional cluster are able to take part in processes of information, communication and transaction with internal or external collaborates of a cluster. Whether the cluster is competitive can depend on its capacity to digitalize the internal cluster processes and the processes between different clusters.

Especially for small and medium sized enterprises, trustful relationships are a condition to take part in collaborative processes, which applications support. If a company belongs to a regional cluster, the trustful environment caused by geographic proximity will enforce its willingness to become a participant in with information- and communication technologies

supported cluster processes. The infrastructure of a regional e-cluster system consists of broadband, security, platforms and broadband-applications. The objectives of a cluster are the improvement, the standardization and the integration of the infrastructure of a regional cluster. The main processes of the cluster are collaborative processes so that the support of them by technologies will generate a benefit for the cluster actors and for the cluster as the whole.

The digitalization of the cluster processes enforces the competitive advantages of a regional and therefore local cluster building. The concept of e-clustering (Hansen, 2004) enlarges the concept of local and geographic clustering.

The component of e-knowledgemanagement has an influence of three on the digitalization of the collaborative cluster processes because the ICT-supported processes of knowledgemanagement can push the digitalization of the collaborative and knowledge intensive processes of the regional e-cluster system. The digitalization of the collaborative cluster processes has also an influence of three on the e-knowledgemanagement in the e-cluster system because they generate information and wisdom in a digital form that can be transferred to the system of e-knowledgemanagement.

g) Future oriented cluster policy (C7)

It is very important to reach a consensus of the political strategy because the cluster policy depends on a balanced system of objectives. The objective is to support the process of cluster building by a comprehensive and future oriented cluster policy. The political activities like legislation, funding programs or education infrastructure influence the whole cluster system intensely.

ClusterNet provides for more and better information about the e-cluster system so that the political decisions concerning the cluster will improve. The influence is assumed to have the value three. The other way round, a future oriented cluster policy will have an effect of three on the e-knowledgemanagement. The public sector is one of the biggest suppliers of information so that consequently a future oriented policy will provide for future oriented information and will support the development of competencies in the cluster.

h) Effective and efficient cluster management (C8)

The actors of a regional e-cluster system cooperate in processes with the consequence that external economies occur. Positive externalities of cooperation and of networking emerge from the increasing value of a good the much more it is used. The externality can be direct, for example resulting from the use of the knowledgemanagement, or it can be indirect because of increasing economies of scale.

The cluster management as a public-private-partnership includes the following activities: the strategic process, the establishment of an organisational unit, the financing, the establishment of the technological infrastructure, the implementation of the process management, the acquisition of cluster actors and members, creation of a cluster profile through marketing and

public relations and the networking. In consequence, a strategic and operative cluster management, a process management, a skill management, a cooperation management, an event management, information and communication management and finally a knowledgemanagement will ensure an effective and efficient cluster management. The indicators of events and workshops, satisfaction of the cluster actors, number of cluster members, number of users of the information and communication platform and web-services can help to evaluate the objective to build up and ensure an effective and efficient cluster management.

ClusterNet influences by assumption strongly the effectiveness and efficiency of the cluster management. The organisation of the e-knowledgemanagement system is one decisive task of the cluster management. The successful management of the cluster needs a transparency of the competencies, processes, interrelationships and structures. The effective and efficient cluster management will either influence ClusterNet strongly, because ClusterNet requires a professional management.

i) Efficiency and effectiveness of the infrastructure (C9)

An effective and efficient infrastructure like information and communication platforms or the existence of competence centres can improve the process of cluster building. A further positive effect results on the one hand from the possibility to use a common supply of resources, like information and communication platforms or learning institutions, and on the other hand from the opportunity to bundle the demand of the actors. Preissl and Solimene (2003: 46) draw the conclusion that ‘one of the essential features that make clusters attractive is the sharing of resources and the aggregation of demand for resources. This affects infrastructures, such as traffic systems, schools and universities, energy and water supply systems as well as telecommunication facilities that are used jointly by many firms and organisations’.

The demand of an e-cluster system for infrastructure can be bundled and therefore increased. The supply can be on the one side public or private. On the other side, the provision can be organised by the regional e-cluster system itself. The objective is to improve the efficiency and effectiveness of the infrastructure. The indicators for measurement are the availability of information and communication platforms, sufficient web-applications for collaborative processes, research institutes, universities, competence centres for applications, availability of broadband infrastructure, institutions of education and the quality of the networking infrastructure like associations.

The strong effect of the e-knowledgemanagement on the efficiency and effectiveness of the infrastructure results from the assumption that the organisational as well as technical infrastructure of ClusterNet will produce for example positive effects on the availability of broadband, of web-applications and of a networking infrastructure because of the virtual expert organisation. The existence of broadband, information and communication platforms, of competence centres will on the other hand facilitate the establishment and operation of ClusterNet.

j) Image of the e-cluster system (C10)

The image of the e-cluster system is important for the market position. The image relates directly to the mission of the e-cluster system. A positive cluster image facilitates the cooperation within the cluster and with other clusters. Besides, a positive image contributes to a good market position of the cluster actors and finally of the whole cluster. Consequently, the goal is to build up a positive image for the regional e-cluster system. Positive acceptance and identification of the cluster actors positive acceptance of the customers, how the cluster actors use the cluster brand for their own marketing activities or the ratings of the entrepreneurs who want to launch a company can be the indicators of this component.

ClusterNet allows for using “knowledge-based regional e-cluster system” as a positive image. Consequently, ClusterNet will produce strong effects on the process of image building. Having an image of a knowledge-based cluster the e-knowledgemanagement will profit by assumption because the cluster actors will have an increased willingness taking part in the system by sharing wisdom.

k) Cooperation with other clusters (C11)

The management of a regional e-cluster system plan, initiates, and controls the cooperation and networking to bundle all innovative potentials and competences of the actors in the value-added chains. On the one side, a networking within the cluster is necessary for improving the competitiveness. On the other side, the networking of different clusters contributes to the acceleration of the innovation processes. Bröcker, Dohse and Soltwedel (2003: 2) ascertain that ‘moreover, not only is it important to develop and maintain links within clusters but likewise between clusters and the outside world’.

Especially for a regional cluster, which is innovative and therefore knowledge intensive, the cooperation with other clusters will generate spillovers of knowledge, which are a benefit for the innovation capacity. Through cooperation with other clusters in the global markets, a regional e-cluster and therefore the small and medium sized enterprises have the chance to develop their strength and to open up new markets. The internationalization of cluster relations results in effects on the innovation capacity and on the competitiveness.

The application of information- and communication technologies improves the internationalization of the economic and cluster relations. The coordination and control of these collaborative processes are the challenge and the potential of success for a regional e-cluster system.

To intensify the cooperation with other clusters in order to open markets and accelerate innovation processes is the objective of this component. The indicators cluster overlapping processes, benchmark with other clusters and cooperation with other clusters show how the success is.

The digitalization of processes of knowledgemanagement facilitates the integration of experts and therefore wisdom of other clusters into the system of ClusterNet. E-knowledgemanagement produces a strong effect of three on the variable of cooperation with

other clusters. The cooperation with other clusters will affect ClusterNet strongly because the collaborative processes produce wisdom, which ClusterNet can make available for the regional e-cluster system. Furthermore, experts outside the cluster taking part in the collaborative processes will be motivated to become member of the virtual expert system.

l) Cooperation within the cluster (C12)

The regional e-cluster system is organised by collaborative processes, so that cooperation between the actors is stimulated. According to this effect in an e-cluster system positive competitive situations develop. Preissl and Solimene (2003: 50) describe this phenomenon such as that 'clusters are ideal incubators for innovation. Close cooperation in technological development stimulates the creation of the next generation technology. Competition pushes technological inventions towards product and process innovation'.

The cluster actors, especially the companies, the universities, the research institutes, the public institutions, organise themselves in network and in cooperation because they want to bundle and therefore increase their potentials and competences. The objective is to intensify the cooperation in the regional e-cluster system. The number and quality of cooperation projects and the intensity of the interaction (contacts, processes) of the cluster actors can measure this objective.

The digitalization of processes of knowledgemanagement facilitates the integration of experts and therefore wisdom of the cluster into the system of ClusterNet. E-knowledgemanagement produces a strong effect of three on the variable of cooperation within the cluster. The cooperation within the cluster will produce a strong effect on ClusterNet because the collaborative processes produce wisdom, which ClusterNet can make available for the regional e-cluster system.

m) E-government (C13)

Many processes of information, communication and transaction between the public and private sector exist. The companies have to comply with many requirements of the public sector. Especially taxation produces processes between government and companies. Furthermore, the public sector is a very important supplier of information and knowledge. In addition, the public sector orders services of the companies and subsidies them by funding activities. E-government-strategies have the objective to organise the public services as processes and to support them with information and communication technologies.

The digitalization of the government processes is a competitive factor for a regional e-cluster system. It is necessary to identify the cluster specific government processes and to integrate them in a regional e-clustering strategy. In this way, it is possible to integrate e-business- and e-government-applications in a regional e-cluster system and to produce positive competitive effects.

The objective is to optimize the processes between the public and private sector in a qualitative and quantitative way. The pass-through-time of processes, the process qualities and quantities or the process costs can be indicators.

E-knowledgemanagement influences e-government strongly because an effective and efficient knowledgemanagement of a regional e-cluster system provoke a pressure on the public sector to organise the resource knowledge and make it just in time available in the cluster processes. E-government affects e-knowledgemanagement in a strong way because the public sector disposes of information that is important for the decision processes of the cluster actors. E-government-solutions support the information and communication processes of the public sector and therefore e-knowledgemanagement is improved.

o) Structure of cluster actors (C15)

The availability of competences and processes in the value-added-chains are important for the profile and development of a regional e-cluster system. The supplying industries, the competences of the universities and research institutes, the qualification of the employees, the structure of the companies should fit with the requirements of the value-added-chain of a regional e-cluster system. The objective is to ensure that the cluster actors like universities and companies cast the whole value-added-chains of a regional e-cluster system.

E-Knowledgemanagement will strongly affect the structure of the cluster actors because providing for transparency of the value-added chains of a regional e-cluster system ClusterNet supports the availability of competences and processes in the value-added-chains. The structure of the cluster actors influence also strongly the quality of the e-knowledgemanagement system, because the cluster processes produce wisdom and information so that missing processes and competencies in a regional e-cluster system can result in gaps of ClusterNet.

p) Employment (C16)

The sustainable development of a regional e-cluster system requires that employment in the regional e-cluster system is ensured and increased. The indicators can be employment, competences and qualification of the employees, education infrastructure or public programs to ensure and increase employment.

ClusterNet will, following the assumption, influence employment in the regional e-cluster system in a strong way. The effect of employment on knowledgemanagement is a proportional one. Capellin (2003: 68) points out that in a cluster 'the movement of labor between firms allows an efficient transfer of knowledge and technology between firms, and facilitates learning, innovation and faster development of new products and processes'.

q) Proximity (C17)

Proximity in a spatial, technological and organisational perspective supports decisively the process of cluster building. Bröcker, Dohse and Soltwedel (2003: 1) explain this relevant component of a regional cluster system that ‘in spite of the differing foci in the respective approaches the common feature is that the spatial proximity offers opportunities for intense collaboration and frequent exchange of knowledge and experiences. “Face-to-face” contacts are important for exploiting synergies arising from the rapid diffusion of new ideas and tacit knowledge among innovating firms, research institutions, and the local policy sphere’. However, Preissl and Solimene (2003: 61) ascertain that ‘the strict orientation towards a geographical or spatial dimension of clusters seems obsolete in an information-based and knowledge-based economy’. Consequently, the component of ‘proximity’ is of high importance either in its spatial, technological or organisational dimension. Indicators that refer to the process of digitalization and to the implementation of collaborative processes should complete the indicators concerning the spatial proximity.

ClusterNet provides for an organisational and technical proximity so that an influence of three is expected. Proximity itself supports the process of sharing wisdom so that in addition to the organisational and technical proximity the spatial proximity influences ClusterNet by a value of three.

5. Summary

The strategic approaches of the balanced scorecard and the sensitivity analysis provide for results and statements that are relevant for managing a complex system like a regional e-cluster system it is. The political processes of decision should take into account which variables are relevant for an e-cluster system and how they behave in the whole system. The variables that refer to processes and the application of information- and communication technologies play a dominant role in the regional e-cluster system as the variable e-knowledgemanagement does. ClusterNet builds the strategic frame for the e-knowledgemanagement system and stands for a process oriented knowledgemanagement. Consequently, e-Knowledgemanagement has the function of an accelerator and promoter, which has the capacity to initiate and accelerate significant processes in the system.

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