6-11-2011

ON THE PERFORMANCE OF CLUSTERS - AN ANALYSIS OF THE IMPACT OF CLUSTER CONTEXT, STRUCTURE, AND FUNCTIONING ON CLUSTER PERFORMANCE

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Recommended Citation
Available at: http://digitalknowledge.babson.edu/fer/vol31/iss14/1
ON THE PERFORMANCE OF CLUSTERS – AN ANALYSIS OF THE IMPACT OF CLUSTER CONTEXT, STRUCTURE, AND FUNCTIONING ON CLUSTER PERFORMANCE

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ABSTRACT

This study examines how different contextual, structural and functioning characteristics of clusters influence their performance. Hereeto, we develop a conceptual framework that identifies potential influencing factors, validate it statistically and estimate the impact of the variables on cluster performance using PLS structural equation modelling. Our results show that important determinants of cluster performance are, among others, long-term planning security and procedural trust between the cooperating firms (contextual conditions), formalized rules and sustainable structures (structural elements) and clear goals and tasks (functioning characteristics). Our results do not only modify general assumptions in cluster research concerning drivers of cluster performance, but also help firms and policymakers to conceptualize successful clusters.

INTRODUCTION

Clusters, or regional networks, are regional concentrations of interconnected firms and associated institutions that operate in similar or related industries (Porter, 2000). They are considered a popular and effective means to enhance the competitiveness of firms and the entrepreneurship activities in a distinct region (Sölvell, 2009). Clusters are supposed to provide an infrastructure that attracts specialized suppliers and high-skilled workers, to enhance technological and knowledge spillovers and to lower transportation costs between regionally concentrated firms (Lublinski, 2003). To purposefully generate these positive cluster effects, public authorities on a regional, national or supranational level spend a large amount of money to initiate and support the setup and management of clusters (e.g., the European Union is spending in total 86 bn. euros from 2007 to 2013 (EU, 2008)). These cluster initiatives do not emerge organically or historically like the Silicon Valley, for example, but are formed by conscious efforts to clone positive cluster externalities in order to promote the regional business environment (Fromhold-Eisebith & Eisebith, 2005). As many clusters have developed in the last decades due to public subsidies, today’s cluster landscape turns out to be very heterogeneous and fragmented. In Germany, for example, more than 2,000 constructs can be found that refer to themselves as clusters or networks (Dostert, 2010). However, neither science nor practice can explain why some clusters succeed and others fail. The performance of publicly initiated clusters often is generally doubted (Su & Hung, 2009), but we have valid evidence that a reasoning based on the mode of cluster initiation takes a too narrow view and that one has to examine the governance elements of clusters to understand why they differ regarding their performance. Thus, in this paper, we adopt a more global perspective on explaining cluster performance and want to figure out how far certain characteristics of a cluster’s governance regime influence cluster performance.

Theoretically, we base our study on N-ew Institutional Theory’s general understanding of an organization’s performance being affected by governance elements related to its context,
structures and functioning mechanisms. The cluster is situated within a certain context which is characterized by resource munificence and path dependencies concerning former experience of cluster actors with cooperation and exchange of information. Trust plays a role as well as norms and culture. Cluster structures are usually set by cluster actors or funding authorities (e.g., the government) and comprise formalized rules, for example. The functioning mechanisms (e.g., the capacity of the cluster management) determine the strategic behavior of the cluster manager, who is employed to coordinate cluster activities and to initiate new cooperation projects. Elements from all three areas seem to be important when trying to explain cluster performance.

In the existing literature, authors dealing with determinants of cluster or network performance have varying explanatory approaches for this phenomenon. Addressing the context conditions of a cluster, Mesquita (2007) develops a conceptual framework on the importance of trust and trust-facilitating mechanisms to generate competitive advantages for the member firms in the competitive cluster environment. Several studies focusing on cluster structures use social network theory to explain the emergence and the success of clustering phenomena. Eisingerich, Bell and Tracey (2010), for example, argue that network strength and network openness have a positive impact on cluster performance. Including external contingencies in their analysis, they find that higher environmental uncertainty reduces the positive effects of strong network ties, but increases the positive effects of network openness on cluster performance. Referring to the management of the cluster, Howells (2006) illustrates in a case study that intermediaries or brokers are necessary to provide services in the fields of consultancy, knowledge or technology brokerage. These brokers are employed as cluster managers and, as Kirkels and Duysters (2010) find out, the most influential brokers have network and technology knowledge and a lot of relevant professional experience. In the context of public network research, Meier and O’Toole (2010) find that the positive impact of managerial networking activities on network performance increases as the management capacity of the network managers increases. Another study, that is valuable for getting a more holistic view of network performance or network effectiveness, is from Turrini et al. (2010). The authors review and classify previous studies on the determinants of network effectiveness and develop an integrative conceptual framework proposing that network effectiveness is influenced by contextual, structural and functioning characteristics. This brief overview of the existing literature shows that, up to now, research on cluster and network performance is advanced either by conceptual and case studies or by studies pursuing a selective approach of identifying single drivers of cluster performance. However, although clusters recently gained popularity in academic literature and in policy-making programs, there are no quantitative studies that focus on the cluster as a whole and that deliver generalizable results on the main determinants of cluster performance. Therefore, we use the conceptual study of Turrini et al. (2010) as a starting point to figure out how certain contextual, structural and functioning characteristics influence a cluster’s performance. We contribute to cluster research and practice in various ways: Our results modify general assumptions in cluster research concerning key success factors of clusters. Cluster managers might appreciate these results as they can use them to adapt the governance regimes of their clusters. Furthermore, policymakers can use our knowledge, e.g. on the impact of consistent goals, for conceptualizing successful clusters, which allows them to invest public funds more efficiently.

The remainder of this paper is structured as follows: In the next section, we briefly present the theoretical background of our study. We state that different contextual, structural and functioning characteristics might be important determinants of cluster performance. Thereafter, we explain the research design and the applied method to estimate the impact of the variables on cluster performance. We use data on German, Austrian and Swiss clusters that we collected in an online survey and analyze it using factor analysis and PLS structural equation modelling. Then we
elaborate the results and discuss them in detail. In the last section, we propose some implications of our study for researchers as well as for cluster managers and policymakers.

**Theory: Cluster Context, Structure, and Functioning**

Explaining cluster performance is a key challenge in cluster research. Cluster performance is often conceived either by means of efficiency (e.g., patent citations in clusters) or effectiveness criteria (e.g., satisfaction of firms, goal attainment). Cluster effectiveness offers interesting insights into the cluster’s ability to reach stated goals not only on the firm-, but also on the cluster-level (Turrini et al., 2010). If a cluster attains the stated goals, we can draw conclusions on its capacity to foster innovation and to survive and on the quality of provided goods and services. Thus, goal attainment is considered an adequate indicator of performance (Kenis & Provan, 2009).

Comparable to the performance of organizations or of interorganizational cooperation (Ren, Gray, & Kim, 2009), the performance of clusters is influenced by different factors originating from cluster context, cluster structure and cluster functioning mechanisms (Turrini et al., 2010). The contextual conditions of a cluster describe the framework conditions and the environment in which the cluster is embedded. Environmental or planning security is one of these conditions that ensure system stability and characterize the setting of decision-making. Planning security is particularly reflected in the security of regulatory and political conditions as well as in financial resource munificence (David & Han, 2004; Turrini et al., 2010). As a cluster’s financial resources ordinarily stem from contributions of public funding authorities and of private firms, the cluster management has to convince these stakeholders to ensure financial planning security (Jungwirth & Mueller, 2010). If planning security is lacking, neither the cluster managers nor the member firms have incentives to actively engage in the promotion of the cluster as they fear sunk costs in case of cluster failure (Bell, Tracey, & Heide, 2009). Therefore, it can be regarded as a contextual condition that positively influences cluster performance. Another factor that creates a favorable context for cooperation is the existence of procedural trust. A responsible, fair and trustworthy cooperation atmosphere between firms in the region facilitates negotiation processes and cooperation activities (Luo, 2008). Besides, regional proximity often is outlined as a prerequisite to generate positive cluster effects, like a pool of high-skilled workers or reduced transaction costs, for example. Scholars from New Economic Geography argue that spatial proximity of firms produces agglomeration economies and knowledge spillovers, which increase the cluster’s performance (e.g., Audretsch & Feldman, 1996) whereby other scholars argue that spatial proximity can even cause agglomeration diseconomies, which have the potential to offset the benefits attainable from the cluster. These diseconomies may result from congestion costs which occur with an increasing concentration of firms within a certain region (McCann & Folta, 2008). Contextual conditions also are shaped by path dependencies and the firms’ cooperation history. Based on the theory of path dependencies, we can propose that an intense and successful cooperation history of firms in a certain region increases the likelihood of successful cooperation in the future. As path dependencies in cooperation activities enable firms to develop absorptive capacity in inter-firm cooperation, a positive cooperation history might prevent cluster failure and can enhance cluster performance (Sydow, Schreyögg, & Koch, 2009).

The structural characteristics of a cluster are usually set by the cluster management and the cluster stakeholders (e.g., firms and public funding authorities). They determine processes in the cluster and regulate the relationships between the cluster actors themselves as well as between the cluster actors and the cluster management. An important structural element in a cluster is the degree of formalization. Formal, fixed rules regulate the cluster relationships and formalized
decision-making procedures allow the cluster manager to make transparent decisions based on stated and objective rules (Jansen, Van Den Bosch, & Volberda, 2006). Formalization also supports the codification of best practices and their implementation (Zander & Kogut, 1995). Thus, we assume that formalization positively influences cluster performance. Another structural characteristic of a cluster is the sustainability of its structures, which is necessary to ensure inner stability. In particular, inner stability can be achieved by a long-term structural embedding of the cluster managers in the cluster. The higher the tenure of the cluster managers, the easier they can generate trust and continuity (Gonzalez Juenke, 2005), which is supposed to have a positive impact on cluster performance. Beyond that, the integration of firms’ interests and the exchange with firms in coordinated interactions can also be seen as a structural determinant generating synergies and thereby enhancing cluster performance (Turrini et al., 2010). The integration of firms’ interests can be realized via mechanisms and tools supporting their institutional integration in cluster management structures, e.g. by the participation in a cluster management board.

Cluster functioning characteristics encompass aspects determining the strategic and operational behavior of the cluster manager. A fundamental element is the clarity of goals and tasks. Csikszentmihalyi (2000) states in his psychological theory on flow, which is defined as the mental state of a person fully immersed in and focused on an activity, that clear goals and clear tasks are prerequisites to experience the energizing feeling of flow in work. Hence, the goals and tasks in a cluster have to be discernible, attainable and complementary to enable the cluster manager to carry out his/her job and to formulate and implement a consistent cluster strategy (see also Provan & Kenis, 2008). Consequently, we assume that the clarity of goals and tasks positively influences cluster performance. In consideration of the variety of goals and tasks, a cluster manager has to manage time and priorities efficiently in order to prevent exhaustion or overload (Örtqvist & Wincent, 2010). Setting priorities can help the cluster manager to organize and structure the work that has to be done, which can result in an increased individual performance. Therefore, time and priority management can have a positive effect on overall cluster performance. A functioning characteristic that is supposed to have a negative impact on cluster performance is the management of conflicts. Due to conflicting interests and incompatible demands of the main stakeholders, the cluster manager has to deal with role conflicts: Firms want the cluster manager to adopt measures that increase their productivity, while public actors require them to enhance the attractiveness of the location (Jungwirth & Mueller, 2010). Thus, the cluster manager perceives conflicts in the expectations concerning his/her role, which can hinder him/her in decision-making and strategic planning activities and thereby can reduce cluster performance (Rizzo, House, & Lirtzman, 1970; Örtqvist & Wincent, 2010). Furthermore, the development of transformational leadership capabilities can help the cluster manager to enhance the firms’ involvement in the cluster. Instead of leading by hierarchical decisions, the transformational leader focuses on motivating the members of the work group and on generating commitment for the organization and its goals by communicating its vision (Podsakoff, MacKenzie, & Bommer, 1996). The generation of commitment reduces the threat of opportunistic behavior, lowers the transaction costs associated with cooperation and thereby enhances interorganizational performance (Ren, Gray, & Kim, 2009). The strategic and operational behavior of the cluster manager also is determined by the need for “customizing” the approach of managing the cluster. To ensure the survival of the cluster and to satisfy the members, the cluster manager has to adopt a cluster- and member-specific management approach. He/She should accumulate cluster-specific human capital and manage the cluster according to its specific characteristics (e.g., the firms’ position in the value chain) (Poppo & Zenger, 1998). Investments in a specific management approach can promote a sustainable cluster performance as firms and institutions will be willing to pay for goods and services provided by the cluster manager if they are tailored to their concrete needs (Jungwirth & Mueller, 2010). Another factor influencing the
behavior of cluster managers is the incentive system. Incentives aim to achieve goal-directed behavior by inducing the cluster manager to make value-enhancing decisions (Brickley, Smith, & Zimmerman, 2009). To grant the cluster manager individual incentives (e.g., bonus plan, permanent contract) can be an effective means to enhance his/her motivation and commitment, which can have a positive effect on the overall cluster performance.

**Research Design**

Sample and Procedure

At the beginning of 2011, we asked 614 cluster managers in Germany, Austria and Switzerland to participate in our web-based survey on the determinants of cluster performance. We obtained their contact addresses by searching in databases from the European Cluster Observatory (www.clusterobservatory.eu) and a German cluster initiative (www.kompetenznetze.de) combined with an intense online search. Next to some questions on personal and cluster data, we asked the participants to assess several items on performance and on cluster context, structure and functioning variables on a 7-point Likert scale. The questionnaire has been pretested by six cluster managers and 13 scholars experienced in quantitative and cluster research.

After six weeks of field time, 238 cluster managers have participated in the survey, allowing us to achieve a response rate of 38.8%. Due to very incomplete answers, we had to exclude two questionnaires, so the final sample consists of 236 cases. In the final dataset are 178 clusters from Germany (75.4%), 36 from Austria (15.3%) and 22 from Switzerland (9.3%). 115 (48.7%) of the clusters have been initiated top-down by public actors, while 113 (47.9%) have been initiated bottom-up by firms. In terms of the type of cluster management, 187 clusters (79.2%) are managed by an independent cluster management organization, compared with 39 (16.5%) clusters that are managed by a lead-firm. On average, the clusters in our dataset are equipped with 3.5 full-time equivalents to manage the cluster. The industries that are most high in number are the life sciences industry (incl. pharmaceutical and biotechnology) and the IT industry. The majority of the participating cluster managers is male (78.2%), only 21.8% are female. On average, they are 43.7 years old, whereby the youngest is 24 and the eldest 72. They have 17.4 years of professional experience, thereof four years in their current position as cluster managers.

In a first step of data analysis, we group the items into variables using a factor analysis to revise our theoretical considerations. The factors and the respective measures are presented in the next section. Afterwards, we estimate the impact of the identified variables on cluster performance applying PLS structural equation modelling.

Measures

Since there are no quantitative studies on the determinants of cluster performance from which we could adopt the items for the variables on cluster context, structure and functioning, we chose the following proceeding to generate our items: (1) We transfer items from related research fields (e.g., alliances, interorganizational cooperation) to our research context and (2) if necessary, we build new items on the basis of our previous qualitative research encompassing 81 in-depth interviews with cluster managers from Austria, Germany, Switzerland, the UK and USA. Before reporting the resulting factors and their items, we have to state that all assumptions to run a factor analysis are fulfilled (Fabrigar et al., 1999): Our correlation matrix shows a large share of significant correlations, the Kaiser-Meyer-Olkin measure of sampling adequacy is .752, which can be considered “middling” (Kaiser & Rice, 1974), and the anti-image covariance matrix contains less than 25% (namely .15%) of absolute values greater than .09. As method of extraction we use
Principal Component Analysis and we base our decision on the number of factors on the displayed screeplot. All extracted factors have been checked for unidimensionality (Hulland, 1999).

As a result, we can state that factor analysis confirms all our theoretical considerations except for the aspect of integrating firms’ interests in the cluster structures, which will be reported below. We receive 13 unidimensional, exogenous variables influencing one endogenous latent variable, which is Cluster performance (see table 1 for an overview of the variables and their indicators). With regard to the measurement models, only the two variables Planning security and Incentive system are specified formatively. They are composed of not necessarily highly correlated indicators each representing a distinct aspect of the variable (Diamantopoulos, Riefler, & Roth, 2008). The other variables are specified reflectively, which means that the items of a variable are interchangeable and each item represents a reliable reflection of the respective construct (Hair, Ringle, & Sarstedt, 2011). The variables related to cluster context are Planning security, Trust, Proximity and Cooperation history. Planning security is formed by three indicators describing the financial security guaranteed by cluster actors and the security of clusters being an important element of regional policy. We know from our qualitative research that cluster managers consider planning security as crucial for the formulation of sustainable strategies, and also literature shows us that an uncertain environment hinders individuals or organizations in decision-making (David & Han, 2004). Based on Pavlou and Gefen (2004) and Luo (2008), the items of the variable Trust reflect the perceived level of fairness and trust between firms in a certain region. Proximity has been operationalized by developing two items that reflect the importance of regional proximity for cluster activities. The variable Cooperation history addresses path dependencies of cooperation between firms. For this construct, no scales exist (Vergne & Durand, 2010). After discussing with an expert in path dependency research, we decided to develop items that describe cooperation and specialization in the value chain as well as the cooperation experience.

The variables related to cluster structure are Formalization, Sustainability and Participation. To measure Formalization, we used a three-item scale based on constructs by Jansen, Van Den Bosch and Valberda (2006) and Örtqvist and Wincent (2010). The variable Sustainability is measured by three self-developed items that describe the inner stability in terms of a sustainable embedding of a cluster management. Participation is a variable newly emerged from factor analysis. It groups items that reflect the active participation of the members in setting goals, fixing rules and taking decisions by being institutionally part of the cluster management board. This variable captures and extends the idea of the integration of firms’ interests in cluster structures.

The variables related to cluster functioning mechanisms are Clarity, Time management, Conflict management, Commitment, Customizing and Incentive system. The variable Clarity encompasses clarity of cluster goals (see hereto the construct of goal similarity (Yeheskel et al., 2001) and the reverse-scaled construct of goal ambiguity (Pandey & Rainey, 2006)) as well as clarity of the cluster manager’s role and tasks (Örtqvist & Wincent, 2010). As an effective time and priority management is considered the best strategy to prevent overload, Time management is operationalized as a three-item construct that Örtqvist and Wincent (2010) use reversely-scaled to measure role overload. To measure Conflict management, we draw on Örtqvist and Wincent’s (2010) and Rizzo, House and Lirtzman’s (1970) items expressing role conflicts. The items for the variable Commitment, that contain the cluster manager’s function to activate the members and to ensure their involvement, have been developed based on Podsakoff, MacKenzie and Bommer’s (1996) understanding of transformational leadership capabilities. The variable Customizing is reflected by two self-developed items that illustrate the importance of a cluster- and firm-specific management approach to the cluster manager (Poppo & Zenger, 1998). Incentive system is a variable that
we built based on our extensive interviews with cluster managers encompassing long-term job perspectives, decision-making freedom and incentive payment.

For the model’s outcome variable, we conceptualize Cluster performance in terms of goal attainment of the cluster members, the cluster manager and the funding authorities. This operationalization is common in research on public networks (Mandell & Keast, 2008) as well as in research on estimating alliance outcomes (Schilke & Goerzen, 2010). As control variables, we integrate Size in terms of number of cluster members and dummy variables for Industry in our model.

**Method and Results**

**Method**

To estimate the impact of the exogenous latent variables on cluster performance, we apply PLS structural equation modelling (Chin, 1998) using the software application SmartPLS (Ringle, Wende, & Will, 2005). We prefer PLS-SEM for this research project as it is suitable for complex models with many latent variables as well as for exploratory research with the objective of theory development (Hair, Ringle, & Sarstedt, 2011). Moreover, it allows an easy integration of formative measurement models (Hair, Ringle, & Sarstedt, 2011).

**Measurement Model Evaluation**

To evaluate the reflective measurement model, we can state that the loadings of all items on the respective constructs are significant (p<.01) and most of them are above the suggested threshold value of .7, which ensures good indicator reliability. The items with loadings below .7 have been retained in the model as they contribute to content validity and as values below .7 are considered acceptable in early stages of research (Hair, Ringle, & Sarstedt, 2011). With values for composite reliability ranging from .73 to .92, we can state that all constructs exhibit satisfactory construct validity, meaning that the measures consistently represent the same construct (Nunnally & Bernstein, 1994). Convergent validity, which indicates whether the items are sufficiently related to the construct, is ensured by values for the average variance extracted (AVE) above .5 (except for Cooperation history with a value of .49) (see table 1 for all exact values). Furthermore, we analyze whether the variables in the PLS model really are distinct and therefore check for discriminant validity by interpreting the cross loadings and the criterion of Fornell and Larcker (1981). The evaluation of the cross loadings shows that the loading of each indicator with the assigned construct is higher than its loading with all other constructs, which supports discriminant validity. Fornell and Larcker’s criterion requires each latent variable to share more variance with its indicators than with each other variable (Hulland, 1999). In statistical terms, the AVE of each variable has to be greater than the highest squared correlation of this variable with any other latent variable. As we show in table 2, each of the variables meets Fornell and Larcker’s criterion.

In the formative measurement model, the weights of the indicators are higher than .2 except for one of the construct Planning security that deals with the firms’ role in ensuring financial security. They are significant (p<.1) besides the mentioned indicator of Planning security and two indicators of Incentive system describing the decision-making freedom of the cluster manager. However, as these indicators theoretically are important and as their loadings, which indicate their absolute importance, are significant (p<.05), they are retained in the model (Hair, Ringle, & Sarstedt, 2011). Multicollinearity does not seem to be a problem as each indicator’s variance inflation factor is less than 1.943, which is clearly below the critical value of 10 (Diamantopoulos, Riefler, & Roth, 2008). The validity of the indicators also is guaranteed by expert and face validity as we can prove the importance of the indicators drawing on 81 interviews conducted with cluster managers and on numerous pre-tests that we combined with extensive discussions on the model.
Finally, since all our data comes from a one-time survey addressing cluster managers as key informants, we have to discuss whether common method variance influences the relations in the PLS path model (Podsakoff et al., 2003). In interorganizational research, where cluster research can be included, secondary data often are missing, so researchers tend to survey key informants to gather data. Pre-tests as ours are necessary to ensure that the key informants, in our case the cluster managers, are competent enough to answer the questionnaire (Kumar, Stern, & Anderson, 1993). In the procedures of study design, we tried to control for common method bias by carefully formulating the items, by randomizing them and by guaranteeing anonymity to the respondents. To statistically test for a potentially existing common method bias, we applied Harman's (1976) single factor test. As the first factor accounts for only 18.0% of the overall variance, we can assume that common method variance does not affect our results (Podsakoff et al., 2003).

Structural Model Evaluation

The PLS path model estimation provides a $R^2$ value for the endogenous construct Cluster performance of .46, so the model has moderate (Chin, 1998) or even strong explanatory power (Amoroso & Cheney, 1991). By applying a nonparametric bootstrapping procedure in Smart PLS, the significance of the path coefficients can be evaluated. As a result, we can state that variables from all three fields (cluster context, structure, and functioning) significantly influence cluster performance (see path estimates and t-values in figure 1). Referring to cluster context, we get positive significant path coefficients for the constructs Planning security and Trust and, surprisingly, a significant but negative path coefficient for Proximity. The construct Cooperation history has a positive, but not significant impact on Cluster performance in our sample. In the domain of cluster structure, Formalization and Sustainability influence Cluster performance positively and significantly, whereas no relation between Participation and the endogenous construct can be proved. Concerning cluster functioning mechanisms, a positive and significant impact of Clarity, Time management, Customizing and even of Conflict management could be found. However, the generation of Commitment and the Incentive system of the cluster manager do not significantly influence Cluster performance. Integrating the control variables Size and Industry in our analysis, we see that they do not significantly relate to the explained variable.

Using the blindfolding procedure in SmartPLS, we can estimate the Stone-Geisser’s $Q^2$ (Geisser, 1974; Stone, 1974) of the model, which indicates its predictive relevance. In our model, the $Q^2$ value of the endogenous construct Cluster performance is .261, therewith it is above zero and the predictive relevance of the model is proved (Hair, Ringle, & Sarstedt, 2011).

Discussion

As a result, we can state that all three areas (cluster context, cluster structure and cluster functioning) are important when trying to explain cluster performance. Regarding the cluster context, we see that a trustworthy, fair and open-minded cooperation atmosphere between the member firms has a substantial and beneficial effect on a cluster’s ability to reach stated goals. Procedural trust can reduce barriers to cooperation and thus to innovation. It either can be an inherent condition of the cluster because the firms already know and trust each other due to former cooperation projects or it can be consciously stimulated by trust-building measures, e.g. by organizing open days in member firms and visits of firm plants. By implementing trust-fostering measures, the cluster managers can incite the firms to cooperate and therewith can significantly increase the cluster performance. Planning security is also a contextual condition that the cluster management should consider as it significantly enhances cluster performance according to our results. In particular, political and financial planning security can create stable and sustainable conditions
THE ORGANIZATION AND NETWORKS

for clustering and networking activities. Therefore, it is an important task of the cluster management to agree with policymakers on the framework conditions as well as to negotiate long-term financial commitments on the one hand and to provide goods and services for the firms on the other hand, for which they are willing to pay. In this way, the cluster management can ensure financial planning security. A surprising result is that, in our sample, regional proximity negatively influences cluster performance. An explanation of this result could be found in the composition of the sample because it contains a number of clusters and networks that have a supra-regional or national focus and that are successful anyhow. Cluster managers of these clusters might not consider spatial proximity as decisive for cluster performance. One could also argue that these clusters want to evade a small radius of action as they fear negative effects of intense competition. However, cooperation history, another contextual factor, does not show any significant impact on cluster performance. Indeed, plausibility considerations suggest that positive cooperation experiences reduce the probability that the collaboration in a cluster could fail.

Examining the results for the structural characteristics in detail, we see that the cluster managers confirm the supposed positive impact of formalization on cluster performance. Thus, formal and fixed rules, which regulate the relationships between the members, enable the cluster management to make transparent, comprehensible and sustainable decisions based on a defined set of rules. The sustainability of structures, particularly a long-term embedding of the cluster management, is another structural characteristic significantly enhancing cluster performance, which creates inner stability. In the sense of “A face that you know and recognize is key” (Ferlie & Pettigrew, 1996, p. 95) a high level of integration of the cluster management in the structures promotes the generation of trust and continuity in the relationships between the members themselves and between the members and the cluster management. This can foster knowledge diffusion and therewith enhance cluster performance. Contrary to this significant result, we are not able to confirm that a structural and institutional participation of firms in cluster steering activities positively influences cluster performance. We suppose that the firms’ participation in decision-making processes on a structural level could increase coordination efforts made by the cluster management disproportionally. Therewith, cluster managers could regard this factor as not being a determinant of cluster performance as its cost-benefit ratio is unfavorable.

Referring to the results on cluster functioning characteristics, we can state that the clarity of goals and tasks is an important determinant of cluster performance. Clear goals and clear tasks enable the cluster management to formulate and implement a consistent strategy and, thus, to sustainably enhance cluster performance. With regard to the variety of tasks, it is important for the cluster management to manage its time efficiently in order to prevent overload. In this context, defining explicit priorities (if possible in coordination with the main stakeholders) helps the cluster management in organizing and structuring the tasks and in making beneficial decisions. Besides, we can point to an interesting result concerning conflict management. Contrary to the assumption that the cluster management could feel restricted in its work by the diverse and conflicting demands of the various stakeholders (e.g., firms and public institutions), our analyses show that a proper management of these conflicts of interests even has a positive impact on cluster performance. A prerequisite of this seems to be that the cluster management is capable to explicitly address and discuss task and goal conflicts and consider them in its planning and decision-making activities. This result seems to be in line with Ren, Gray and Kim (2009, p. 820) who claim that whether the “interorganizational arrangement (…) has effective mechanisms for resolving conflicts (…) may be a more important predictor of performance than the level of conflict itself.”

We also can assume that, as managing and balancing interests is an inherent part of the cluster management’s job, cluster managers are used to handling role conflicts and thus do not perceive
that they lower their individual or overall cluster performance (see also Provan & Kenis, 2008). Comparable to the finding that the cluster management has to consider the respective cluster context in its activities, our results show that a clear focus of the management on the members’ needs positively affects cluster performance. Cluster managers therefore should develop a cluster- and member-specific, or “customized”, approach to lead the cluster and should base their strategic and operational decisions on members’ needs. Nevertheless, the generation of commitment and the incentive system are no significant determinants of cluster performance. It seems that the commitment of the cluster members is rather secured by the specific investments that the members have to make in order to participate in the cluster than by a steady and intense communication of the cluster vision by the cluster manager. Firms and institutions that invest specifically to join a cluster and to benefit from it seem to act result-oriented even without additional motivational attempts of the cluster management to generate commitment. Concerning the incentive system, cluster managers appear to be motivated rather intrinsically. This validates results from a former study (Jungwirth & Mueller, 2010), where we found out that cluster managers even accept substantial losses in income when taking over this job, as they are primarily attracted by the freedom and the scope of action that they enjoy in this position. Purely extrinsic incentives, as incentive payment, for example, do not determine the personal performance and effort of the cluster managers and therefore do not influence cluster performance in general.

**Conclusions and Implications**

At the beginning of this paper, we elaborated potential determinants of cluster performance from cluster-related literature. Next to this theoretical elaboration, we validated the identified determinants in a statistical factor analysis and then estimated the impact of each variable from cluster context, structure and functioning on cluster performance. Our results show that, in fact, we can explain cluster performance, which is measured as the level of goal attainment, by different variables counted among these three domains. Contextual conditions like security in political and financial terms and trust between the cluster members are drivers of cluster performance, just as structural characteristics like the existence of formal rules and procedures and the sustainable structural embedding of a cluster management. In addition, we see that cluster functioning characteristics, the elements which directly are related to a cluster manager’s strategic and operational work, also affect cluster performance. Clear goals and tasks, the way how the cluster manager manages time and priorities but also conflicts and a customized management approach have a positive influence on the performance of the cluster. Beyond that, we can register some surprising findings as, for example, the results that the incentive scheme of a cluster manager does not have a positive impact or that regional proximity has a negative impact on performance.

We contribute to cluster research and practice in various ways. Our results modify general assumptions in cluster research concerning key determinants of cluster performance. Based on conceptual and case studies, we develop an innovative model to estimate the impact of latent variables from the fields of cluster context, structure and functioning on cluster performance. This approach can be considered as explorative, as we can hardly make use of frequently tested constructs. Therefore, this study has to be seen as a first step in the explanation of cluster performance. Certainly, there is some potential to continue working on this model, e.g. in terms of construct specification. In subsequent research, one should also focus on interdependencies between the identified variables by estimating moderating and mediating effects. Besides, as we can hypothesize that differences in the determinants of cluster performance comparing bottom-up and top-down clusters could be identified, this could be answered by doing a multi-group analysis. Thanks
to our dataset that is, to our knowledge, unique in terms of the sample and the collected data, we are confident that we can advance research on these topics.

Apart from researchers, cluster managers might appreciate our results as they can use them to discuss critical aspects with their stakeholders, to adapt or optimize the cluster’s governance regime and, if necessary, to reformulate their strategy. Furthermore, firms and policymakers can use other cluster initiatives as reference points to conceptualize new clusters. However, policymakers learn from our study that it is not effective to “copy” a successful cluster initiative as the specific context seems to be important. It also is crucial for the sustainable performance of a cluster that the stakeholders, including public authorities, formulate clear goals and clear tasks. Thereby, the cluster concept has to be consistent with the goals (e.g., consistency of the nature of tasks and the nature of financing). For example, if public authorities expect the cluster to fulfill for the most part public duties, they consequently have to provide a large share of public financing, as private firms are not willing to pay for public goods. Only unambiguous goals and clear tasks allow the cluster manager to elaborate and implement a consistent cluster strategy. Another important implication of the study is that cluster initiators should consider that the performance of a cluster merely is influenced by the cluster management and the motivation and capacities of the cluster manager. Therefore, a long-term and sustainable establishment of the cluster management in the cluster structures is indispensable to guarantee long-term planning and decision perspectives of the cluster managers. An intense and open-minded communication between the public actors and the high-skilled cluster managers is likely to reduce the probability of cluster failure and to help to allocate public funds more efficiently.

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REFERENCES


APPENDIX

Figure 1: Results of structural model estimation: Path estimates and t-values (in brackets).

Note: *** Significant at the p<.01 level. ** Significant at the p<.05 level. * Significant at the p<.1 level. ns: not significant.

Table 1: Measurement items for the constructs in the model.

<table>
<thead>
<tr>
<th>Items</th>
<th>Loading/weight</th>
<th>Mean</th>
<th>S.D.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Planning security</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I am convinced that firms will ensure the survival of the cluster by their membership fees.</td>
<td>.192</td>
<td>4.12</td>
<td>2.01</td>
</tr>
<tr>
<td>I am convinced that public funding authorities keep their financing promises.</td>
<td>.484</td>
<td>5.45</td>
<td>1.60</td>
</tr>
<tr>
<td>I expect that initiating clusters will rank among the most important instruments of regional policy in the next years.</td>
<td>.709</td>
<td>5.51</td>
<td>1.34</td>
</tr>
<tr>
<td><strong>Trust</strong> (Composite Reliability = .92, AVE = .74)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooperation between firms in the cluster region is fair.</td>
<td>.762</td>
<td>5.50</td>
<td>1.07</td>
</tr>
<tr>
<td>Firms in the cluster region are in general reliable.</td>
<td>.886</td>
<td>5.43</td>
<td>1.04</td>
</tr>
<tr>
<td>Firms in the cluster region are in general honest.</td>
<td>.916</td>
<td>5.43</td>
<td>1.03</td>
</tr>
<tr>
<td>Firms in the cluster region are in general trustworthy.</td>
<td>.874</td>
<td>5.61</td>
<td>.97</td>
</tr>
<tr>
<td><strong>Proximity</strong> (Composite Reliability = .91, AVE = .83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Regional proximity to the members facilitates my work as a cluster manager.</td>
<td>.963</td>
<td>5.76</td>
<td>1.46</td>
</tr>
<tr>
<td>Regional proximity facilitates cooperation between cluster members.</td>
<td>.855</td>
<td>5.86</td>
<td>1.30</td>
</tr>
<tr>
<td><strong>Cooperation history</strong> (Composite Reliability = .73, AVE = .49)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The members continue many of their cooperations in the cluster which already have existed before.</td>
<td>.637</td>
<td>5.34</td>
<td>1.59</td>
</tr>
<tr>
<td>In our region, the value chains traditionally are closely interconnected.</td>
<td>.886</td>
<td>4.47</td>
<td>1.50</td>
</tr>
<tr>
<td>In our region, the level of specialization traditionally is high.</td>
<td>.532</td>
<td>5.06</td>
<td>1.43</td>
</tr>
<tr>
<td><strong>Formalization</strong> (Composite Reliability = .80, AVE = .57)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rules and procedures occupy a central place in the cluster structures.</td>
<td>.608</td>
<td>4.55</td>
<td>1.62</td>
</tr>
<tr>
<td>There are clear rules for how to accomplish my job.</td>
<td>.74</td>
<td>4.24</td>
<td>1.70</td>
</tr>
<tr>
<td>The cluster management checks all involved actors for rule violations.</td>
<td>.892</td>
<td>5.47</td>
<td>1.41</td>
</tr>
<tr>
<td><strong>Sustainability</strong> (Composite Reliability = .81, AVE = .59)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>As cluster manager, I see myself in this position for at least the next five years.</td>
<td>.801</td>
<td>4.33</td>
<td>2.05</td>
</tr>
<tr>
<td>As cluster manager, I think that the cluster will generate more advantages in ten years than it does now.</td>
<td>.824</td>
<td>5.75</td>
<td>1.53</td>
</tr>
<tr>
<td>The funding of the positions in the cluster management is secured for the long term.</td>
<td>.672</td>
<td>3.63</td>
<td>2.03</td>
</tr>
<tr>
<td><strong>Participation</strong> (Composite Reliability = .75, AVE = .52)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>There are some firms involved in the cluster governance.</td>
<td>.62</td>
<td>4.55</td>
<td>2.30</td>
</tr>
<tr>
<td>The rules of the cluster have been compiled by the members themselves.</td>
<td>.547</td>
<td>4.64</td>
<td>1.74</td>
</tr>
<tr>
<td>The goals of the cluster have been fixed by the members themselves.</td>
<td>.933</td>
<td>5.04</td>
<td>1.55</td>
</tr>
</tbody>
</table>
Clarity (Composite Reliability = .91, AVE = .55)
- I know what my responsibilities and competences are for being a cluster manager. .76 6.03 1.23
- I know exactly what is expected of me as a cluster manager. .82 5.85 1.23
- It is clear to me what has to be done in order to take care of my business in a good way. .76 6.08 1.12
- The cluster has clearly defined goals. .74 6.10 1.00
- The goals of the cluster are clear to all involved actors (members, cluster management, financiers). .67 5.49 1.23
- All involved actors explicitly agree on the goals of the cluster. .68 5.12 1.32
- It is easy to explain the goals of the cluster to outsiders. .67 5.43 1.47
- The priorities of the single goals are clearly communicated to the cluster management. .78 5.23 1.50

Time management (Composite Reliability = .89, AVE = .72)
- I have enough time to finish all my tasks. .77 3.42 1.71
- My time management helps me to pursue my goals efficiently. .88 4.36 1.63
- I am satisfied with the way I allot my time. .89 4.72 1.53

Conflict management (Composite Reliability = .82, AVE = .54)
- I sometimes have to bend a rule or policy in order to carry out a certain assignment. .41 4.46 1.90
- I often do things that are accepted by one stakeholder (i.e. firms) but not by others (i.e. public actors). .79 3.23 1.83
- I often get inconsistent requests from two or more of the stakeholders (e.g., firms, public actors). .81 3.32 1.93
- I receive assignments without adequate resources and materials to execute them. .83 3.95 2.00

Commitment (Composite Reliability = .81, AVE = .52)
- Articulating a cluster vision ranks among my most important tasks. .57 4.84 1.56
- I often speak with the individual cluster members to communicate the goals of the cluster. .77 4.41 1.47
- I contribute new ways of looking at things in the discussions with the cluster members. .74 5.04 1.29
- By my own behavior, I set an example of "networking". .76 5.71 1.23

Customizing (Composite Reliability = .86, AVE = .75)
- To adequately perform as cluster manager, one has to acquire cluster-specific knowledge. .77 5.86 1.37
- I manage the cluster according to its specific characteristics. .94 6.11 1.02

Incentive system
- In my current position, assured future prospects are important to me. .36 4.56 1.76
- Large decision-making freedom is important to me. .26 5.94 1.10
- In my current position, I enjoy large decision-making freedom. .65 5.62 1.29
- Success-related bonuses let me think in an entrepreneurial way and thus are of the cluster’s benefit. .20 4.15 2.27

Performance (Composite Reliability = .86, AVE = .61)
- Overall the members are satisfied with the cluster. .79 5.72 .84
- The cluster meets the objectives of the public funding authorities. .67 6.13 1.15
- The cluster meets the objectives of the members. .84 5.86 .88
- The cluster meets the objectives that I have set as cluster manager. .80 5.54 1.05

Note: Participants evaluated each item using a 7-point Likert scale (anchors: strongly disagree (1) and strongly agree (7)).

Table 2: Discriminant validity analysis.

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
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</thead>
<tbody>
<tr>
<td>1.</td>
<td>.742</td>
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<td></td>
<td></td>
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<tr>
<td>2.</td>
<td>.018</td>
<td>.829</td>
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<tr>
<td>3.</td>
<td>.046</td>
<td>.047</td>
<td>.491</td>
<td></td>
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<tr>
<td>4.</td>
<td>.026</td>
<td>.006</td>
<td>.009</td>
<td>.570</td>
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<tr>
<td>5.</td>
<td>.048</td>
<td>.048</td>
<td>.012</td>
<td>.115</td>
<td>.591</td>
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<tr>
<td>6.</td>
<td>.032</td>
<td>.000</td>
<td>.007</td>
<td>.041</td>
<td>.027</td>
<td>.518</td>
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<tr>
<td>7.</td>
<td>.078</td>
<td>.014</td>
<td>.015</td>
<td>.307</td>
<td>.180</td>
<td>.103</td>
<td>.350</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>8.</td>
<td>.024</td>
<td>.010</td>
<td>.026</td>
<td>.169</td>
<td>.191</td>
<td>.042</td>
<td>.232</td>
<td>.724</td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>9.</td>
<td>.056</td>
<td>.002</td>
<td>.018</td>
<td>.055</td>
<td>.018</td>
<td>.092</td>
<td>.242</td>
<td>.162</td>
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</tr>
<tr>
<td>10.</td>
<td>.046</td>
<td>.047</td>
<td>.001</td>
<td>.089</td>
<td>.094</td>
<td>.004</td>
<td>.110</td>
<td>.041</td>
<td>.001</td>
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<tr>
<td>11.</td>
<td>.044</td>
<td>.031</td>
<td>.001</td>
<td>.022</td>
<td>.035</td>
<td>.000</td>
<td>.043</td>
<td>.002</td>
<td>.000</td>
<td>.097</td>
<td>.749</td>
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<tr>
<td>12.</td>
<td>.137</td>
<td>.021</td>
<td>.037</td>
<td>.167</td>
<td>.205</td>
<td>.017</td>
<td>.294</td>
<td>.156</td>
<td>.042</td>
<td>.096</td>
<td>.060</td>
<td>.614</td>
</tr>
</tbody>
</table>

Note: Values on the diagonal show the AVE; values below the diagonal are squared construct correlations.