ICT Clusters

Potential of the Southern Hesse / Rhine-Main-Neckar region to develop an information and communication technology cluster

Condensed version

Ralf Elbert
Fabian Müller
João Daniel Persch

TECHNISCHE
UNIVERSITÄT
DARMSTADT

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1 Motivation for and objective of the ICT cluster study

Clusters are agglomerations of companies in related industries, educational and research institutions, and political institutions whose interaction generates a particular type of dynamic economic growth leading to a measurable competitive edge for the region. German economic policy specifically promotes clusters at both the state and federal levels.

Information and communication technology (ICT) is the epitome of a key industry in Germany. It includes all technologies related to electronically recording, transmitting, and displaying data. In particular in the ICT industry, the development of a cluster leads to enormous geographical advantages, as demonstrated by the Santa Clara Valley in California (widely known as Silicon Valley); Oulu, Finland; and Bangalore, India.

This study examines the cluster potential of the Southern Hesse / Rhine-Main-Neckar region. Many companies, along with promoters of clusters, are asking themselves which conditions and means are needed for the existing agglomeration of software companies and users to become an internationally successful ICT cluster. What potential is in this agglomeration and which measures can promote its enduring growth to take a place among the world's top ICT clusters?

What is the potential of the Southern Hesse / Rhine-Main-Neckar region to develop an internationally recognized information and communication technology cluster?

Scholars from various disciplines have investigated the Silicon Valley phenomenon and explored individual aspects of cluster development in numerous studies and analyses. Practical recommendations for action could be derived from them only in some areas, because they do not show the big picture in terms of individual requirements and effects of cluster development. This study on ICT clusters aims to close this research gap. The knowledge gained will be used to analyze the potential of the Southern Hesse / Rhine-Main-Neckar region to develop an internationally recognized ICT cluster.

Via case studies of four ICT clusters in the USA, India, Finland, and Germany, core elements of cluster development will be identified as requirements for the development of ICT clusters, and development effects that significantly influence the lasting growth of an ICT cluster will be presented.

- **Which core elements of cluster development are required to develop an ICT cluster?**
- **What influence do these core elements have on the development of an ICT cluster?**
- **Which development effect shape the long-term growth of an ICT cluster?**

This study takes into consideration the various development phases as presented in cluster literature. Translating the results of the case studies to the Southern Hesse / Rhine-Main-Neckar region means that conclusions can be drawn about the conditions under which a successful and internationally recognizable ICT cluster can develop in this region.

2 Cluster potential of the Southern Hesse / Rhine-Main-Neckar region

Comparing the Southern Hesse / Rhine-Main-Neckar region with the analyzed clusters within the scope of the case studies and applying the ICT cluster development model shows clearly that the Southern Hesse / Rhine-Main-Neckar region must already be designated an ICT cluster.

Within the scope of this study, the term ICT is deliberately applied broadly so that ICT clusters with various focal points could be included in the analysis. ICT includes hardware consulting, data-processing and tabulation services, software consulting, provision of services for time-sharing systems, software development, database development and provision, data capture services, and other IT services, as well as hardware development and manufacture. The cluster index shows that, in particular in the field of software, the Southern Hesse / Rhine-Main-Neckar region—along with regions like the Munich metropolitan area and the Stuttgart metropolitan area—is among the most important competence centers in Germany. The highest concentration of software-industry companies in Germany is found in the Rhine-Neckar area, followed by Munich and the city of Darmstadt.

This cluster is in the development phase: All the necessary requirements for developing an ICT cluster have been fulfilled (core elements of cluster development) and numerous development effects are becoming apparent. Nevertheless, the cluster has not yet achieved the conditions for entering the growth phase according to the cluster development model. The growth of the cluster depends on the interplay of various development effects identified during modeling.

- **The Southern Hesse / Rhine-Main-Neckar region is an ICT cluster.**
- **This cluster is in the development phase.**

In Section 2.1, the results of the case studies conducted are shown in a condensed form. In Section 2.2, the identified relationships are translated to the Southern Hesse / Rhine-Main-Neckar region so that recommendations for action can be derived for ways to systematically support cluster development.

2.1. Case study results: Core elements and development effects of ICT clusters

This analysis of the ICT clusters in Silicon Valley, USA; Oulu, Finland; Bangalore, India; and Dresden, Germany identifies requirements for and development effects of cluster development. In addition, the cluster lifecycle—with its three development phases of formation, development, and growth—is taken into account after the effects appear in the case studies. The formation phase is marked by the settling of individual companies, institutions, and research institutions within a region. Some of these actors later develop into the cluster's leading companies; however, minimal interaction can be observed among the companies during the formation phase. During the development phase, new connections evolve between a cluster's actors. The cultivation of formal and informal networks results in the initial feedback effects, and, increasingly, the cluster starts growing organically. During the growth phase, the cluster reaches critical mass: The cluster itself becomes the advantage offered by a particular location: Meta-industries, such as investors or logistics service providers, move in and the momentum of start-ups and offshoots reaches its peak level.

Requirements for the development of an ICT cluster

The case studies show that the formation phases of the ICT clusters analyzed demonstrate numerous parallels. The characteristics of cluster formation observed in equal measure in all case studies are designated the core elements of cluster development in this study. The analysis of the Silicon Valley, Oulu, Bangalore, and Dresden reference clusters shows that four such core elements (CE1–CE4) exist.

A cluster will not develop without the core elements (CE) of cluster development, and they play an important role in the formation phase of a cluster, in particular.

CE1: Start-ups and companies moving into the area

Corporate decisions precede every ICT cluster: Start-ups are a core element of ICT cluster development. Start-ups are a primary requirement for the formation of an ICT cluster, as is the settlement of highly innovative companies from ICT industries in the area during the cluster's formation phase. These companies develop into leading companies and form the cluster's backbone in the later development phase.

CE2: The success of established companies

Successful leading companies reinvest in the cluster by supporting research and education and by promoting and attending to start-up companies. In addition, leading companies span networks between employees of various companies that survive for years, positively influencing constant knowledge transfer and trust between the companies. The success of established leading companies is a core element of ICT cluster development.

CE3: Knowledge transfer through technical universities and colleges

It has been shown that technical universities and colleges played a key role in the formation phase of all ICT clusters. Their crucial influence on the foundation of the initial leading companies and guaranteed further education of highly qualified employees are requirements for cluster development. Technical universities are a core element of ICT cluster development.

CE4: Availability of a highly qualified workforce

With the growth of established companies, qualified employees are increasingly "consumed" by the market. If enough qualified employees are no longer available, leading companies tend to outsource their added value to other regions. Qualified employees represent a bottleneck within ICT cluster development. They are constantly required for the continuous flow of start-ups needed for innovation, as well as for the further growth of the region's established companies. The availability of qualified employees is a core element within ICT cluster development.

Development effects of cluster development

The case studies show that the growth of existing ICT clusters (clusters that have concluded the formation phase) is shaped in the long term by the development of self-reinforcing effects. These mutually influential effects are illustrated within the scope of this study in a system dynamics model to analyze individual cause-and-effect relationships and their embedding within the overall system. The cause-and-effect relationships relevant for cluster development are called "development effects" in this study.

Development effects (DE) of cluster development are cause-and-effect connections that influence the growth of an existing cluster significantly.

DE1: Development effects during the development phase

- *Formation of regional networks:* Positive influence on job hopping, knowledge transfer, and division of labor
- *High degree of division of labor:* Positive influence on start-ups and knowledge transfer
- *Job-hopping intensity:* Positive influence on workforce availability, the formation of regional networks, and knowledge transfer

DE2: Development effects during the growth phase

- *Venture capital*: Positive influence on regional networks, supply of seed money, and supply of active support for start-ups
- *Expert immigration*: Increased supply of qualified employees, formation of national networks, and development of new markets
- *Cultural factors*: "Entrepreneurial culture" influences modularization of the product structure (division of labor)
- *Human resource service providers:* Headhunters promote job hopping and the formation of national networks
- *Regulatory framework:* Software patents to protect innovation

2.2. Southern Hesse / Rhine-Main-Neckar ICT cluster: Evaluation of cluster potential

Core elements of cluster development

The requirements for and basic conditions of an ICT cluster in the Southern Hesse / Rhine-Main-Neckar region were analyzed on the basis of the identified core elements (CE 1 - CE 4) and development effects (DE 1 - DE 2). This comparison shows that the requirements for cluster development are in place and individual development effects have already become apparent: The region can already be described as an ICT cluster.

In the Darmstadt administrative district, an exceptionally high proportion of added value is generated by ICT industries. In 2006, 90 percent of the Hessian ICT industry was located in the Darmstadt administrative district, with €30 billion in revenues generated by about 8,000 companies with more than 70,000 employees. At about 7,500 km^2, the administrative district covers an area nearly twice as large as Silicon Valley. Nevertheless, the network covered by the Darmstadt Rhine-Main-Neckar Chamber of Industry and Commerce encompasses an area of only about 3,000 km^2 (Darmstadt environs). Here alone, 4,500 companies employ a workforce of more than 25,000. The city of Frankfurt am Main is home to more than 1,000 software companies and more than 90 telecommunications service providers within an area of only 250 km^2. It also plays host to one of the world's largest Internet nodes. In neighboring Wiesbaden, about 500 companies from the named industries are registered within a space of 200 km^2.

To the south, the Darmstadt administrative district borders the Karlsruhe administrative district in the state of Baden-Wurttemberg, which contains the Rhine-Neckar metropolitan area (Mannheim, Ludwigshafen, and Heidelberg). This region houses the headquarters of Germany's largest software company, SAP AG, which has about 15,000 employees at that site and revenue of more than €10 billion, making it one of the world's largest software companies. Because SAP AG alone employs more than one-third of all ICT employees in the Karlsruhe administrative district and the concentration of other ICT companies is significantly higher in the Mannheim, Heidelberg, and Ludwigshafen metropolitan region than the average ICT density in the Karlsruhe administrative district, this conurbation is included in assessing the cluster's borders.

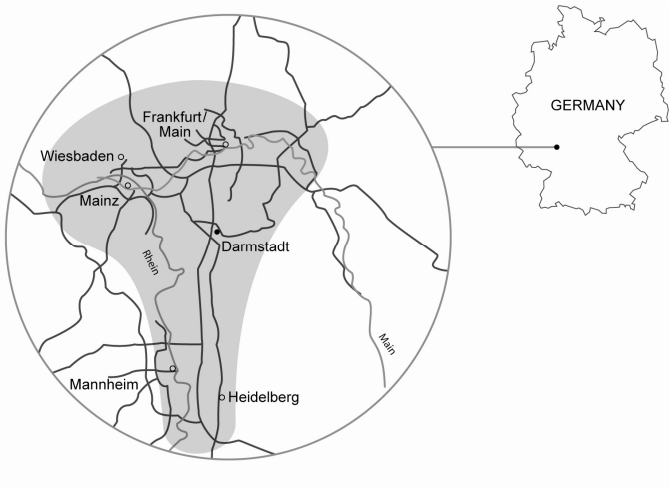


Figure 1: Area of the Southern Hesse / Rhine-Main-Neckar ICT cluster

The geographic area of the cluster is shown in Figure 1. The borders were drawn using an analytical procedure. As indicated frequently in cluster research, cluster borders generally cannot be defined exactly, because the density of interaction between companies is difficult to measure.

The cluster therefore extends over an area of about 5,000 km², reaching a maximum of about 100 km in length from north to south (Frankfurt am Main to Wiesloch). From north to south, the Southern Hesse / Rhine-Main-Neckar region is about as long as Silicon Valley, which extends from San Francisco to Palo Alto. Although this area—with 90,000 people employed in ICT industries—is much less ICT focused than the American reference cluster (500,000 employees), it is on par with Bangalore, India (80,000 employees), and significantly exceeds Oulu, Finland (18,000 employees). The number of companies in the Darmstadt administrative district alone (7,800) surpasses that of Silicon Valley (approx. 7,000). Along with many small and medium-sized enterprises, numerous internationally known market leaders are located in the cluster. Examples include the headquarters of Internet service provider T-Online in Darmstadt as well as the world's largest logistics group, Deutsche Post, which operates a trust center for digital signatures in Darmstadt. The world's largest Internet node, DE-CIX, is located in Frankfurt am Main. The field of corporate software is represented by SAP AG in Wiesloch and Software AG in Darmstadt—two of the cluster's most important software companies.

The development of an ICT cluster requires not only a certain number of resident companies and significant established leading companies, but also technical universities and colleges that educate engineers and computer scientists, transfer research results into business practice, and support start-ups and spinoffs. The cluster features six universities and colleges—the Darmstadt University of Technology, Johann Wolfgang Goethe University of Frankfurt am Main, the University of Mannheim, and technical colleges in Darmstadt, Frankfurt, and Wiesbaden—which are to be seen as a knowledge base and source of knowledge in the field of the engineering sciences and computer science. In addition, there are the Fraunhofer Institute for Computer Graphics Research IGD, Fraunhofer Institute for Secure Information Technology SIT, and Fraunhofer's Integrated Publication and Information Systems Institute IPSI (which is closing, but whose projects will all be continuing at other Fraunhofer institutes). Outside the cluster, but within spitting distance, is Karlsruhe Research University to the south.

The availability of highly qualified employees in the Southern Hesse / Rhine-Main-Neckar region benefits from the high density of higher education institutions, as found in no other ICT cluster. This contributes in particular to a comparatively high availability of graduates and experts. Nevertheless, the availability of professionally experienced job-seekers is between 6% (Darmstadt, Heidelberg, and Ludwigshafen) and 8% (Frankfurt, Mainz, and Mannheim) in light of low unemployment, and—in direct comparison to the case studies—relatively low job hopping is a critical factor for growth.

In evaluating characteristics of the Southern Hesse / Rhine-Main-Neckar region, it becomes clear that there already is a Southern Hesse / Rhine-Main-Neckar ICT cluster. All the requirements for the formation of a cluster have been met, and the cluster has already moved out of the formation phase and into the development phase, because the initial development effects (including the formation of regional ICT networks) can be observed. These results are summarized in Figure 2.

Core elements	Silicon Valley	Bengaluru	Oulu	Dresden	Südhessen/ Rhein Main Neckar
Start-ups and companies moving into the area	●	●	●	●	●
The success of established companies	●	●	●	●	●
Availability of a highly qualified workforce	●	●	●	●	●
Knowledge transfer through technical universities and colleges	●	●	●	●	●

● Fulfillment of requirements for cluster development proved.
◆ Fulfillment of requirements for cluster development not proved.
○ Requirements are not fulfilled.

Figure 2: Core elements of ICT cluster development (a comparison)

Development effects of cluster development

As shown in the case studies, the growth of the cluster is fostered by the development of self-energizing effects. These mutually influential effects are illustrated within the scope of this study in a system dynamics model to analyze individual cause-and-effect relationships and their embedding within the overall system. The cause-and-effect relationships relevant to cluster development are called "development effects." While evaluating macroeconomic figures relating to the Southern Hesse / Rhine-Main-Neckar ICT cluster provides clear information about the cluster's level of development, assessing the development effects is difficult. Because this study is based on text analyses, it is to be seen as a basis for discussion. For a continuing assessment of the development effects, a larger empirical elevation must be carried out.

The results of the case studies show that the growth of ICT clusters in the development phase benefits from the formation of regional networks, an increased division of labor, and more job hopping. An initial translation of these results to the Southern Hesse / Rhine-Main-Neckar region shows that multifaceted regional network activities have developed in the field of ICT. Worth mentioning are the "Rhine-Main-Neckar Corporate Software Cluster" of the Chamber of Industry and Commerce and the Darmstadt University of Technology, the state of Hesse's "Arbeitskreis Forum Hessen IT" working group, and the Hesse Center for Satellite Navigation (CESAH). The European Space Operations Center (ESOC) is a coordination center for European space exploration, and INI-GraphicsNet is an international network of continuing education institutions, and research and development in the technologies, systems, and applications of computer graphics. There are also a multitude of international research cooperations with numerous chairs of the local colleges and universities.

There was no evidence of the development of a modular product structure and increased job hopping—in comparison with other countries. These results are summarized in Figure 3.

Development effects in the development phase	Silicon Valley	Bengaluru	Oulu	Dresden	Südhessen / Rhein Main Neckar
Formation of regional networks	●	●	●	●	●
Development of a modular product structure	●	●	●	◆	◆
Institutionalization of job-hopping	●	●	◆	◆	◆

● Fulfillment of requirements for cluster development proved.
◆ Fulfillment of requirements for cluster development not proved.
○ Requirements are not fulfilled.

Figure 3: Development effects during the development phase (a comparison)

The development effects of the growth phase must be included in any assessment of the cluster's long-term development. During the growth phase, the development of an ICT cluster is positively influenced by the availability of venture capital, a highly qualified workforce moving in, the development of an entrepreneurial culture, and by the growth of service industries, in particular in the area of human resources development and legal services. The case studies showed that venture capital plays an important role in ICT clusters, especially in early-phase financing. Although Germany's banking capital, Frankfurt am Main, lies within the cluster, the supply of venture capital is low in comparison to other clusters throughout the world. There are, however, some examples of venture capital financing in the Southern Hesse / Rhine-Main-Neckar ICT cluster—such as in the case of iPharro, an offshoot of Fraunhofer IGD made possible by venture capital financing in the amount of €4 million. A study by BITKOM (the German Association for Information Technology, Telecommunications and new Media) proves that venture capital financing plays a much lesser role in Germany than it does in the rest of Europe. For comparison: In 1998—before the IT boom of 2000—more than €2 billion of venture capital was awarded in Silicon Valley.

While highly qualified skilled workers are actively recruited from within the country and abroad to come to Silicon Valley, Oulu, Bangalore, and Dresden, no comparable programs have been identified in the Southern Hesse / Rhine-Main-Neckar ICT cluster. In addition, there is no evidence of an increased start-up culture in comparison to the rest of Germany. Software patents–patents protecting software code—cannot be issued in Germany at present, because patent law in Germany is based on the European Patent Convention (EPC) of 1973, which forbids the patenting of "schemes, rules and methods for performing mental acts" as well as "programs for computers" (Article 52). Although suggested amendments were presented to the European Commission in 2002, they have not yet been adopted. In 2005, a great majority of the European Parliament came out against software patents. The political debate continues. The positive development effects that arose in Silicon Valley through software patents (protected innovation and knowledge transfer) cannot develop in the Southern Hesse / Rhine-Main-Neckar ICT cluster in the near future, however.

Development effects in the growth phase	Silicon Valley	Bengaluru	Oulu	Dresden	Südhessen / Rhein Main Neckar
Cultural aspects	●	●	●	●	◆
Provision of initial capital	●	●	●	●	◆
Immigration of highly qualified specialists	●	●	◆	◆	◆
General conditions for software patents	●	◆	◆	○	○

● Fulfillment of requirements for cluster development proved.
◆ Fulfillment of requirements for cluster development not proved.
○ Requirements are not fulfilled.

Figure 4: Development effects during the growth phase (a comparison)

The growth phase's listed development effects are summarized in Figure 4, making it clear that only some of them can be detected in the Southern Hesse / Rhine-Main-Neckar ICT cluster. The effects of software patents on companies' innovative activity and the knowledge transfer supported by patents are certainly not present.

2.3. Southern Hesse / Rhine-Main-Neckar ICT cluster: Recommendations for action

On the basis of the case-study results shown here and the translation of the development effects to the Southern Hesse / Rhine-Main-Neckar ICT cluster, five recommendations are being issued for medium- and long-term systematic cluster support.

1] Promotion of a start-up and entrepreneurial culture

The existence of a start-up culture plays a central role in the development and growth of ICT clusters. The development and promotion of a start-up culture is an important component in cluster development. Successful stories of start-ups and the public relations work of established companies can have a supportive effect. Universities and technical colleges must raise entrepreneurial awareness correspondingly while they are training and educating their students.

2] Formation of regional networks

Developing regional networks can help the involved companies concentrate on their competencies and their most successful steps that add value, which can, in turn, contribute to increasing the companies' global competitiveness. In the field of ICT, these processes result in a modular product structure, among other things. As a tool for knowledge transfer, regional networks are also especially suited to compensating for limited and undervalued job hopping in Germany. Gaining experience and transferring knowledge within networks promotes knowledge transfer across companies, just as job hopping does.

3] Provision of initial capital

Encouragement of the venture capital industry in the region compensated for a lack of initial capital for start-up companies. In addition to providing capital, this service industry also produces the important network effects and active support for company founders that ICT clusters need. Direct state support for start-ups generates a competition situation here and is to be avoided, because suitable effects are not generated. The analysis in Silicon Valley showed that capital gains tax, possible company types, and available capital (for instance, the pension fund) have an effect on the establishment of the venture capital industry.

4] Training and recruiting of highly qualified specialists

The continued availability of a qualified workforce is a critical core element: In particular in regions with low unemployment, like Darmstadt, over the long term, this leads to a bottleneck in ICT cluster development. The basis for future growth of the cluster's ICT companies depends on two things: high-quality education of engineers and computer scientists at German universities and colleges and the support of immigration of qualified employees from abroad. Only through a combination of these measures is it possible to combat the "workforce growth bottleneck" while stimulating the region's networking and promoting international collaboration.

5] Enforcement of software patents

Protecting intangible property still represents a difficulty for software patents in Germany and the EU. A program cannot be patented as such, resulting in unintentional knowledge transfer from the cluster and inhibiting the reinvestment of the profits gained from innovation in the cluster. The political world can improve the basic conditions of software innovation in Germany by allowing software patents.

3 Study design

The methodology of this ICT cluster study is based on case studies that were conducted with the help of text analyses. The study design encompasses five phases, which are briefly explained here.

Phase 1: Mapping of development history

In the first phase, the most important milestones in the development of the four observed clusters (Silicon Valley, Bangalore, Oulu, and Dresden) were identified. The clusters were classified according to level of development within the lifecycle: "formation phase," "development phase," or "growth phase." In addition, scientific publications from various research disciplines and the economic history of the observed clusters were analyzed. This resulted in a description of the most important milestones in cluster development over time as well as classification of the clusters within the phases of the cluster lifecycle.

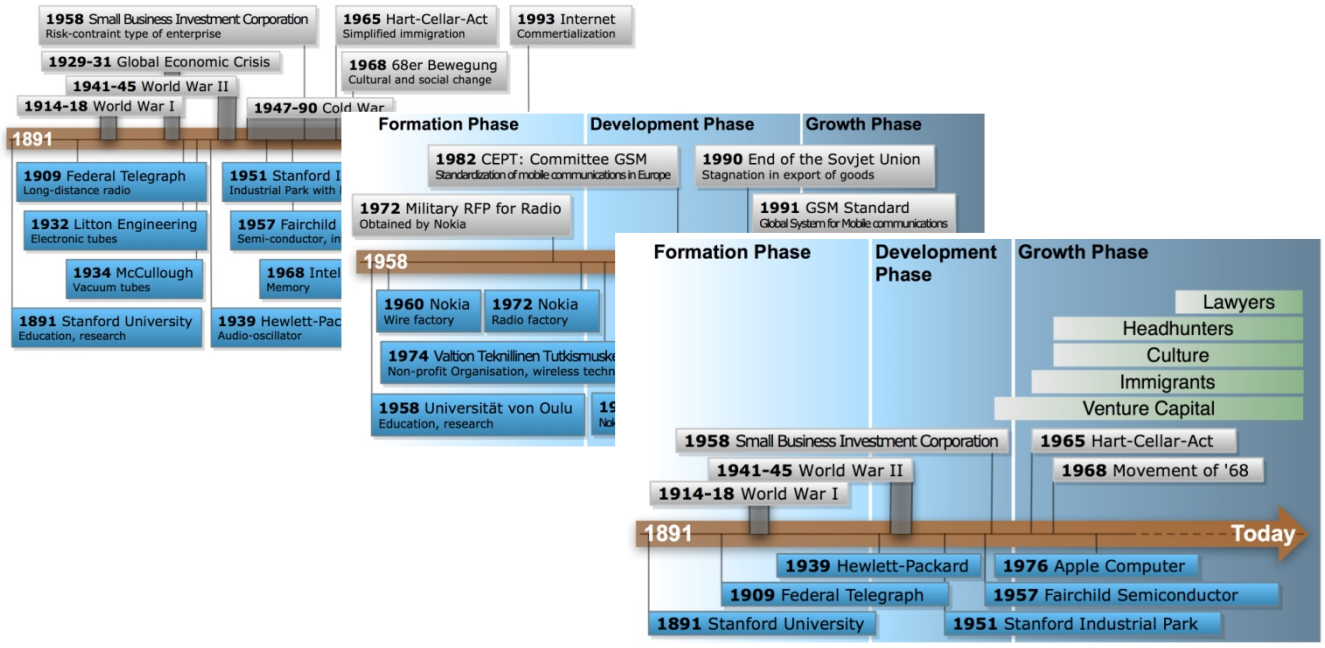


Figure 5: Development history and classification within the phases of the cluster lifecycle

Phase 2: Identification of cause-and-effect relationships

In the second phase, scientifically proven cause-and-effect relationships were identified to formulate theses about causal relationships in the development of ICT clusters. The data set used encompasses more than 100 scientific publications. Individual cause-and-effect relationships were isolated from the Silicon Valley reference cluster and systematically documented in a database.

Phase 3: Analysis oft he cause-and-effect relationships

The objective of the analysis of the cause-and-effect relationships is to tie together the documented causal connections from Phase 2 and to describe the complexity of the development of ICT clusters in their entirety. In doing so, critical connections were uncovered and closed loops were identified to show crucial starting points for external influence on the ICT cluster system.

The system dynamics method was used, and the ICT cluster was modeled as a dynamic system. The model serves to record complex chains of cause and effect in their entirety and describe them transparently. Linking milestones (temporal perspective) with cause-and-effect relationships (causal perspective) helps determine in which phase of cluster development which connections influence the

development of the cluster system. This phase resulted in conclusions and theses about core elements, their effects, and development effects of the reference cluster Silicon Valley.

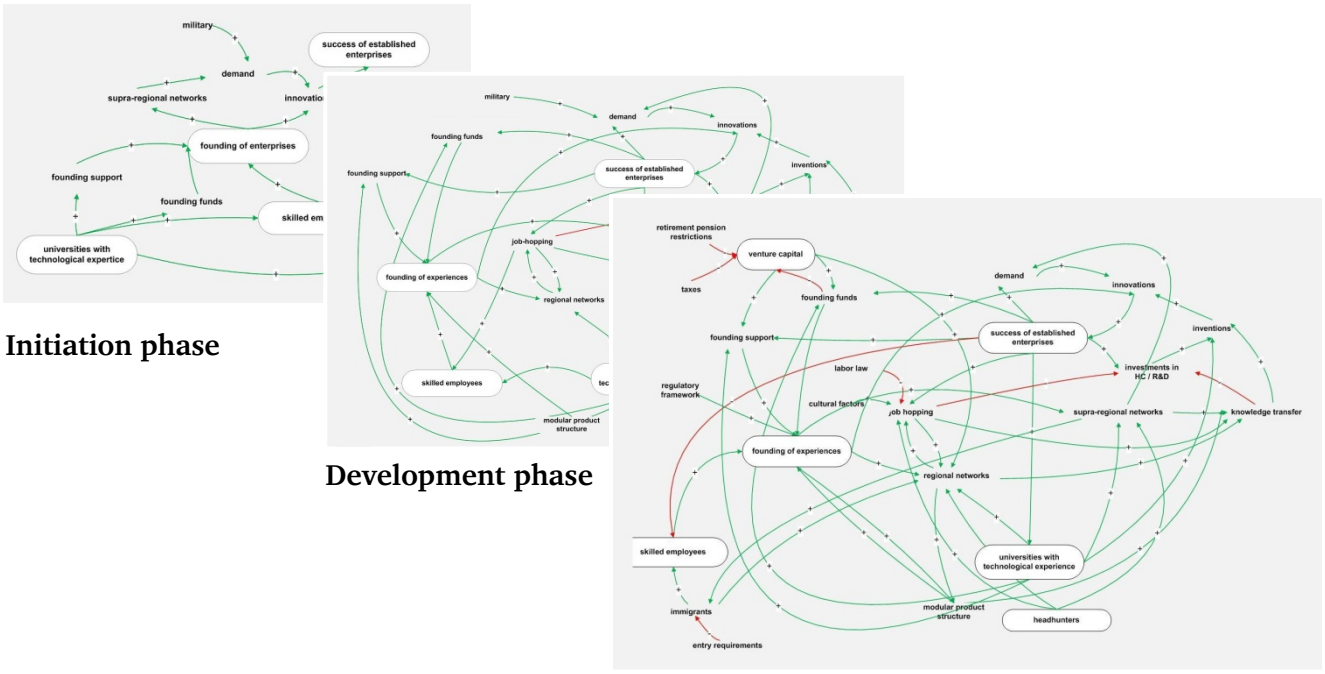


Figure 6: System dynamics modeling of cluster development

Phase 4: Falsification and discussion of the results

The purpose of falsification and discussion is to ascertain the plausibility of the results of the analysis of Silicon Valley (Step III) through comparisons with the developments of the Bangalore, Oulu, and Dresden ICT clusters (Step I). The results are then depicted via a three-step scale. The result of this step is checklists that describe the development of the core elements and development effects.

Phase 5: Translation of the results to the Southern Hesse / Rhine-Main-Neckar region

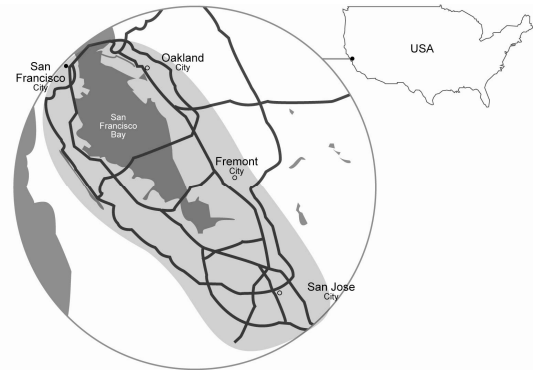
The purpose of translating results to the Southern Hesse / Rhine-Main-Neckar region is to assess whether the typical characteristics needed to develop an ICT cluster are present in the Southern Hesse / Rhine-Main-Neckar region. In addition, recommendations were made on how to support further development of the ICT cluster. In sum, the Southern Hesse / Rhine-Main-Neckar region can be assessed in terms of its potential for the development of an internationally recognized ICT cluster and recommendations are made as to how this development can be supported through systematic cluster support.

4 Short descriptions of the analyzed ICT clusters

This section includes short descriptions of the clusters investigated in the study. The text boxes give an overview of the individual clusters' economic data, while the Figures show their geographical position and area schematically. The first four clusters were investigated as part of the case-study analysis and supply the data set for developing the ICT cluster model (results are shown in Section 2. The ICT cluster model is shown in the main version of the study). The application of the model to the Southern Hesse / Rhine-Main-Neckar ICT cluster is shown in Section 1 of this condensed version of the study.

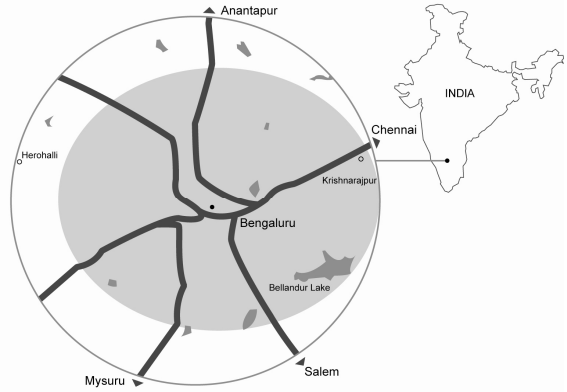
Silicon Valley ICT cluster (USA)

figure	value
Branch focus	software, hardware
area	4.000 km²
habitants	2,3 Mio
employees (ICT)	500.000
firms(ICT)	7.000
turnover/year (ICT)	180 Mrd. €
Average anual salary	43.000 € ICT: 68.000 €



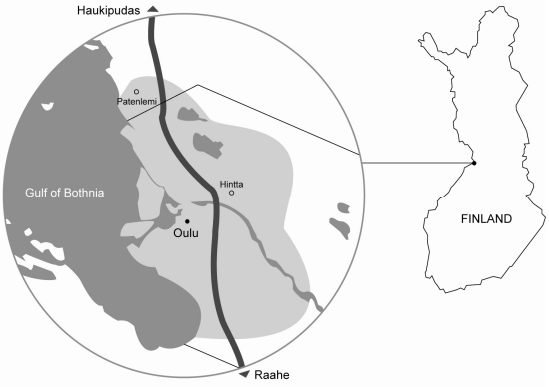
Bengaluru ICT cluster (India)

figure	value
Branch focus	software
area	500 km²
habitants	5 Mio
employees (ICT)	80.000
firms(ICT)	1.500
turnover/year (ICT)	2 Mrd. €
Average anual salary	900 € ICT: 8000 €



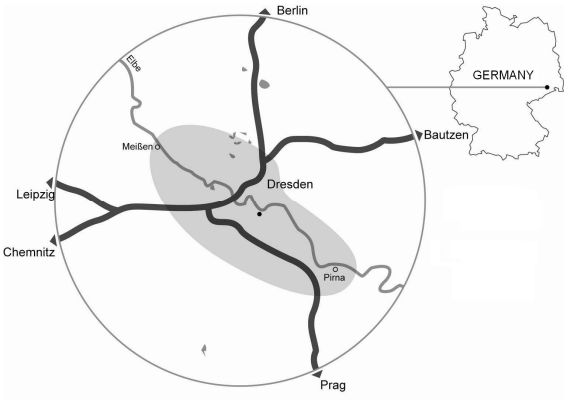
Oulu ICT cluster (Finland)

figure	value
Branch focus	telecommunication
area	400 km²
habitants	130.000
employees (ICT)	18.000
firms(ICT)	800
turnover/year (ICT)	5 Mrd. €
Average anual salary	40.000 € ICT: 52.000 €



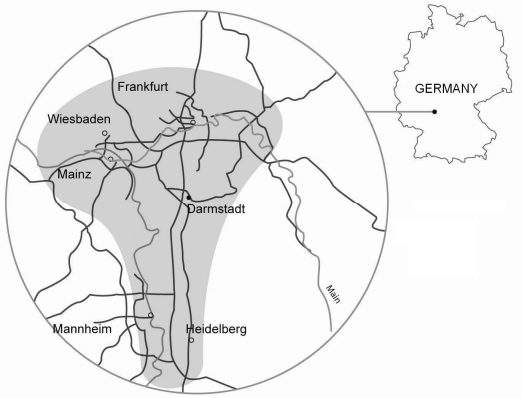
Dresden ICT cluster (Germany)

figure	value
Branch focus	semiconductors
area	330 km²
habitants	500.000
employees (ICT)	45.000
firms(ICT)	1.200
turnover/year (ICT)	6 Mrd. €
Average anual salary	22.000 € ICT: 42.000 €



Southern Hesse / Rhine-Main-Neckar ICT cluster (Germany)

figure	value
Branch focus	software
area	5.000 km²
habitants	4,8 Mio
employees (ICT)	80.000*
firms(ICT)	8.000*
turnover/year (ICT)	42 Mrd. €*
Average anual salary	30.000 € ICT: 55.000 €



* Darmstadt administrative district and SAP AG in 2008.

This condensed version of the ICT cluster study reproduces the results of the study in a condensed form. The overall results are provided in detail in the main version of the study.

Autors:
Prof. Dr. Ralf Elbert
Dipl.-Wirtsch.-Ing. Fabian Müller
Dipl.-Wirtsch.-Inf. João Daniel Persch

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