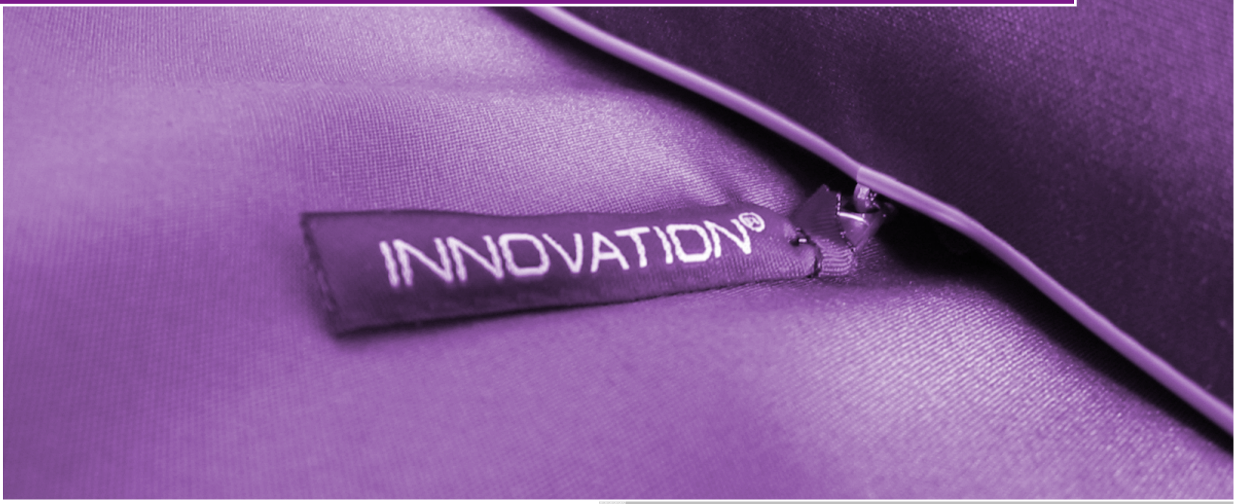
ACHIEVE More

Cluster Mapping



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ACHIEVE MORE

Judith Terstriep

Institute for Work and Technology

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Abstract

This document provides an overview of the research design, methodology and data resources for the cluster mapping which functions as the basis for the subsequent activities in work package 6 «Access to Clusters». Our definition of clusters and its underlying approach is introduced and major terms defined.

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1 Introduction

Leading political, academic and business actors, but also actors in intermediary institutions, in many European regions have joined forces to introduce and develop and to stimulate the growth of economic clusters. During recent years structural policies and regional promotion schemes have been directed towards cluster-oriented regional development. It is assumed that internal dynamics, cooperation, competition, flows of knowledge and ideas within a cluster and between the cluster and the outside environment foster an environment of increased innovation and competitiveness.

Delimited characteristics of clusters are geographic area (i.e. a region) and industrial sector resp. value chain. And although the nature of interaction between companies is more important than the geographic boundaries, it is difficult for companies from the «outside» to benefit from these location-specific advantages. Against this background work package 6 «Access to Clusters» aims at facilitating access for KIS ventures to related clusters by developing and validating practical mechanisms. For both, firms and venture capitalist being embedded in respectively linked to innovative environments like cluster is beneficiary: It allows firms and investors to cope with the increasing interdisciplinary nature at the core of today's technical change, to reduce the risks of investing in novelty, and to link innovation to demand.

In order to utilise such practice it is necessary to find those clusters that might be of interest for KIS ventures; be it because of their innovative organizational methods, marketing abilities or just flows of information. Thus, the first task is to map innovative software clusters across Europe.

In the framework of ACHIEVE More the focus is on the software sector because software innovation is associated with a high economic impact. This is, because software is not only a highly innovative and economical important sector in its own right, but also an important element of innovation in other sectors.

The purpose of this paper is to provide a framework for the cluster mapping. It is organised as follows. The next section provides some basic definitions of relevant terms. In chapter 3 the research approach and methodology are introduced. Moreover, data availability and limitations are discussed.

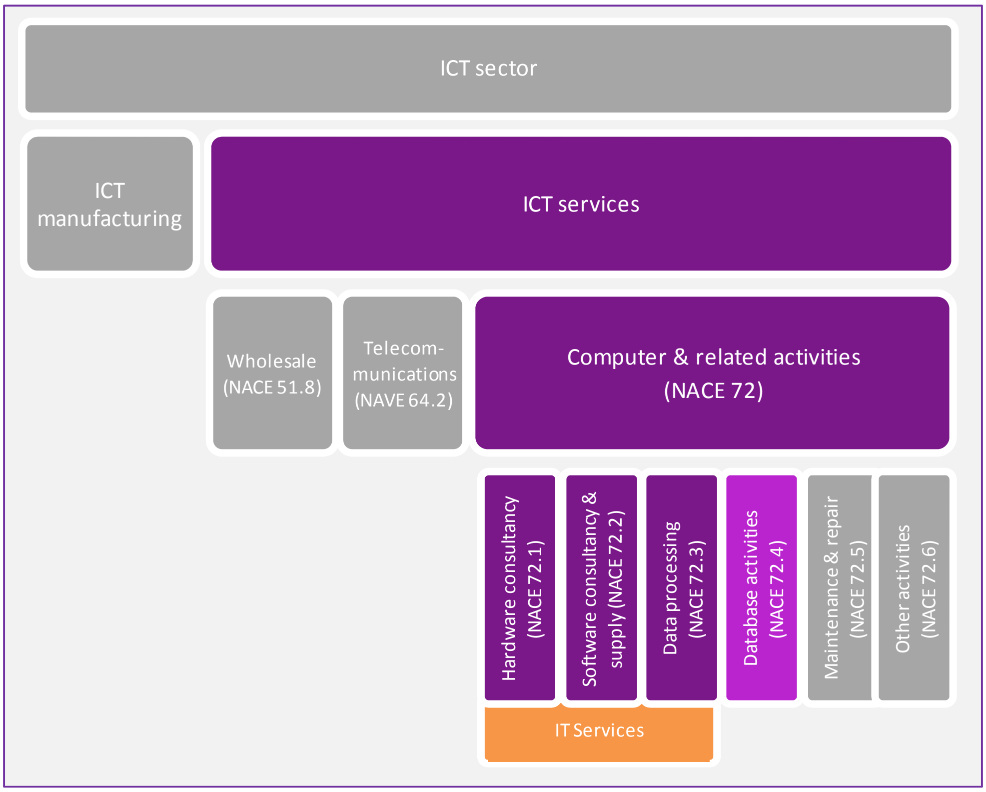
2 Definitions

As the cluster mapping functions as basis for work package 6 a joint understanding of software as sub-sector of the ICT industry, clusters and innovation is crucial.

2.1 ICT & Software Sector

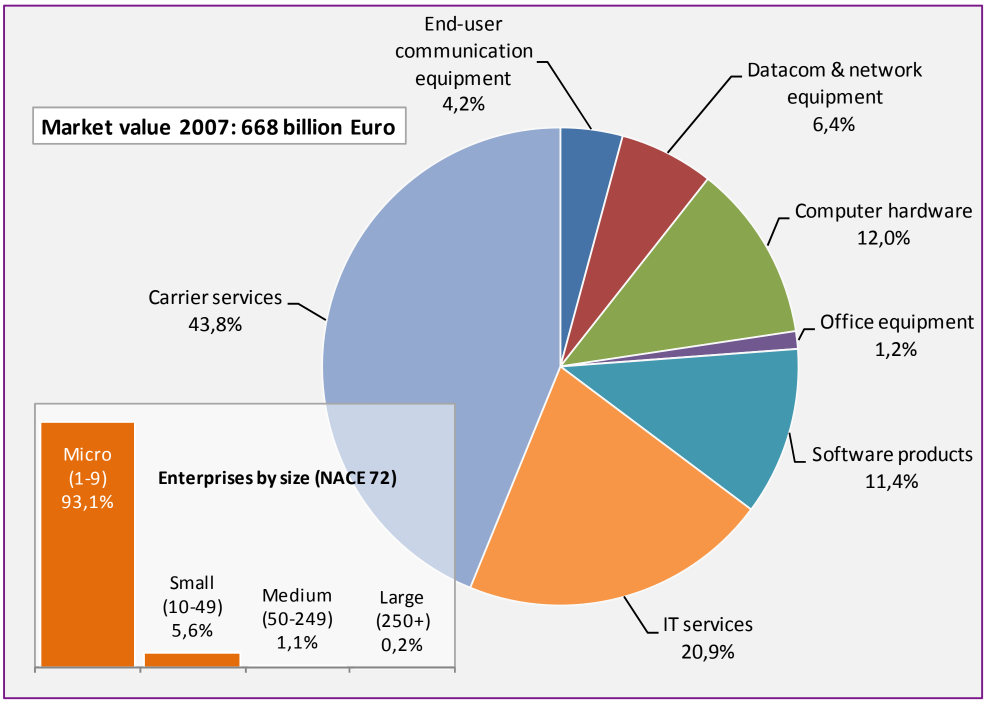
Key characteristic of ICT is its pervasiveness; it is an enabling technology which is to be found anywhere in the economy across all sectors. Accordingly, ICT research takes place in many disciplines. Furthermore, one needs to distinguish between companies producing ICT products and services and those using it. The OECD defined *"[...] the ICT sector as a combination of manufacturing and services industries that capture, transmit and display data and information electronically [...]"* (OECD 2004).

Figure 1: The ICT sector and sub-sectors



In statistical terms (see Figure 1) the sector is divided into ICT manufacturing (NACE 30, 31.3, 32, 33.2, 33.3) and ICT services (NACE 51.8, 64.2, 71.33 and 72). And, the IT service sector includes hardware consultancy (NAVE 72.1), software consultancy and supply (NACE 72.2) as well as data processing (NACE 72.3). The core activities which make up the IT service sector are planning, building and running IT systems (eBusiness W@cht 2005a). For data availability reasons, we will have to limit the sector to the narrow definition of NACE 72.

Figure 2: EU ICT Market Structure 2007



Source: EITO 2007 (excluding Malta and Cyprus)

As far as the size structure of the IT services sector is concerned, a few large players on the one hand coexist with a large number of small and medium-sized enterprises on the other. Most enterprises in the ICT sector are small, out of 682,000 enterprises 99.6% are SMEs and most of these have less than 10 employees (Wintjes/Dunnewijk 2008). The share of micro firms is close to 89%. This high percentage is explained by the computer services industry (NACE 72) which hosts two-thirds of all ICT firms and where the share of micro firms (1-9 employees) is 93% (Figure 2).

Why focus on the software sector and related clusters? In the past decade, the software sector has been one of the fastest growing knowledge-intensive industries

(Tsang 2005). Virtually every business in the European Union - in all sectors - depends on the software and IT services industries to facilitate the development, marketing, and support of its products and services.

Software and IT services (SITS) represent about one third of the entire ICT market and are its most dynamic component (European Commission 2008). The EU-25 SITS market was worth 167.3 billion EUR in 2005. The market is split into approximately 29% Software and 71% IT Services (Capgemini 2006). The main growth drivers for this segment are storage, security and business management software (EITO autumn 2007 edition). According to a forecast by a leading market analyst, software and IT services are expected to continue growing strongly for the next three years, with the EU (Software 7.8%, IT Services 7.2%) and US markets experiencing similar trends. In times of the Internet service and service-oriented software, e.g. «Software as a Service» and «Service Oriented Architecture», are seen as main driver for future growth. Enterprise software for content, collaboration and communication based on the Internet, which can be used for both intra and inter-organisational communication, is expected to see a worldwide growth rate of 13.9% in 2006-2011 (European Commission 2008).

The significance of innovation in the software sector results from two facts: Firstly, software is a highly innovative and economically-important sector in its own right. In 2006 the R&D intensity (R&D/sales) of EU companies was 13.8 in the software sector compared to 3.1 in IT Services (European Commission 2007). And secondly, software is often an important element of innovation in other sectors. Following Isaksen (2006), one might distinguish between three roles of software companies as «innovation agents»; they act as

- facilitators of innovation by supporting their customers in the innovation process as specialist consultants;
- carriers of innovation by propelling the diffusion of innovations such as new software solutions within the economy; and
- sources of innovation by initiating and developing innovation in client firms.

“Thus, the expected economic impact of software innovation is likely to be much greater than what is observed by solely examining capital investment in the sector (OECD 2007).” For example, three out of every four enterprises engaged in innovation activities purchased machinery, equipment and *software* during the observation period 2002 to 2004 (CIS 72/2007).

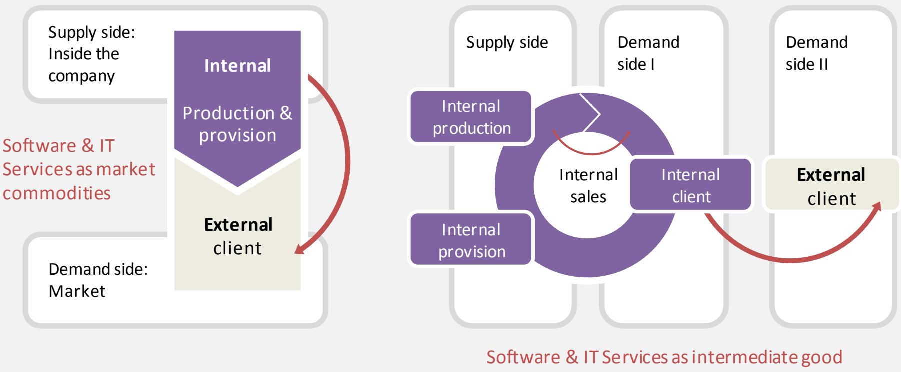
Similar to the IT service sector a key feature of the software sector is its dual structure and fragmented nature. The industry consists of a few major players on the one hand and a large number of small, niche market companies on the other hand. This specific structure of the sector, i.e. the dominance of entrepreneurs and small firms, implies that inter-organisational networks and clusters are highly important. Indeed, it is widely acknowledged that knowledge linkages, alliances and partnerships are crucial characteristics of the software industry (Jordan/Segelod 2006).

Excursion: Software & ICT Services

Software is an intangible good which is marketed as product. One can distinguish between *proprietary software* available under a payable software licence agreement which restricts usage, copying or modification of the software and *Open Source Software* available under GNU licence that generally includes the rights on usage, modification and redistribution.

IT Services comprise processes, technology and human capital input to enable a business process. They cover all stages, from planning to building and running a system. In general IT Services are a related good for software products. Today many software companies generate more revenue from related services like maintenance, customisation, integration of software and systems than from licensing fees.

Software and IT Services are produced as intermediate goods or market commodities:



In case of Software and IT Services as market commodities, companies sell their products directly on the market to external clients. In case of captive production, Software or IT Services are produced and consumed within the same company. Here, Software is sold as an intermediate good, which means as an integrated part of other products. Examples are systems software which are sold with applications software or bundled with hardware.

(Source: Capgemini 2006)

Although ICT is relevant for all other sectors of the economy, the relevance of software is different from sector to sector to application. Table depicts in which functional and sectoral areas software plays a crucial role.

Table 1: Relevance of Software in 10 Sectors

	Application					
Sector	Software adoption	Software for innovation	ERP/SCM	Sourcing & procurement	Marketing & Sales	Overall significance
Food and beverage	●	●	●●○	●●	●	●○
Textile	●	●○	●●	●	●	●
Publishing	●●●	●●●●	●	●●	●●●	●●○
Pharmaceutical	●●●	●●	●●●●	●●●	●●	●●●
Machinery	●●	●●	●●●	●●	●○	●●
Automotive	●●●	●●	●●●●	●●●	●○	●●●
Aerospace	●●●	●●	●●●	●●●●	●	●●●
Construction	●	●	●	●	●	●
Tourism	●●	●●	●	●●	●●●○	●●○
IT Services	●●●●	●●●●	●●●	●●●○	●●●○	●●●●

● = Low relevance/diffusion ●● = Average relevance/diffusion ●●● =Above average relevance/diffusion

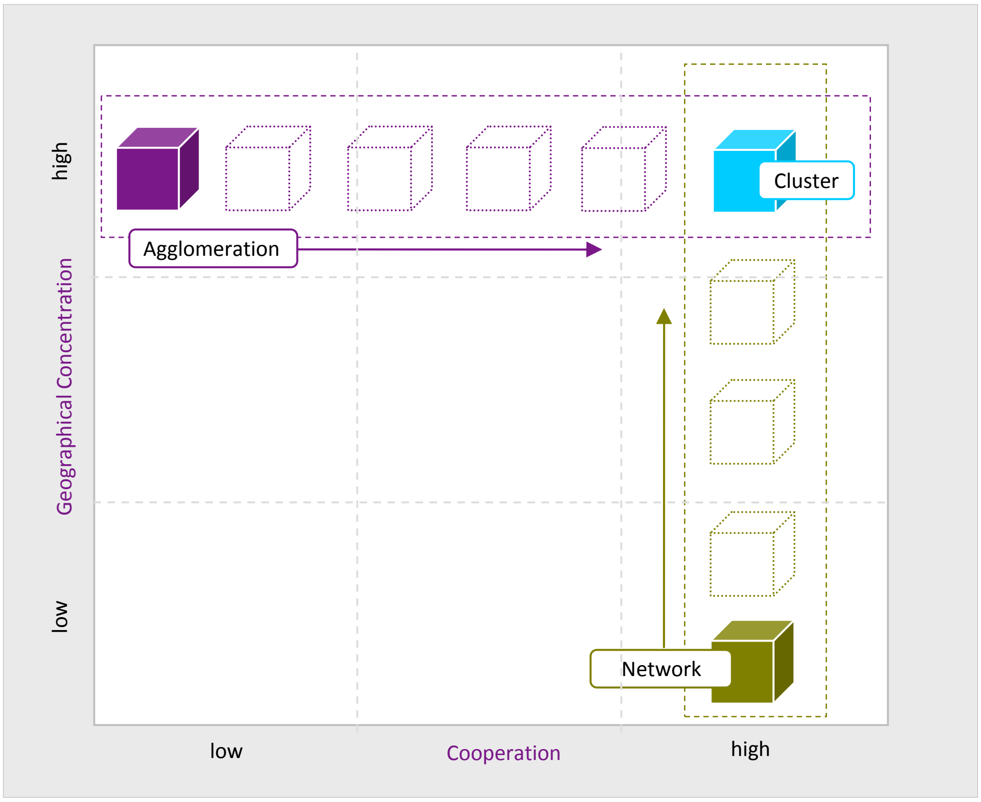
●●● =High relevance/diffusion ○ = Applies only for some sub-sectors

2.2 Agglomerations, Networks & Clusters

For the purpose of ACHIEVE MORE it is important to distinguish between agglomerations, clusters and networks. As is shown in figure 1 the three concepts can be described by the two dimensions «GEOGRAPHICAL CONCENTRATION» (also referred to as spatial concentration) and «COOPERATION». They are different yet linked concepts.

The concept of one or more industries concentrating their location in geographic space is often referred to as «PURE AGGLOMERATION». Key characteristic of industrial agglomerations is their spatial concentration (Gordon/MacCann 2000). As to say, determining criterion is the geographic dimension. Cooperation might take place – as is shown with the dotted cubes (Figure 3) – but is not obligatory. The same applies to any other form of linkage between the agglomerated firms. Benefits of agglomeration arise for example from the accumulation of human capital, productivity enhancements (i.e. economics of scale), reduction of transaction costs and spillover effects. These benefits are known as external «AGGLOMERATION ECONOMIES».

Figure 3: Agglomerations, Networks & Clusters



By contrast, in case of «NETWORKS» the focus is on cooperation irrespective of geographic concentration. They can generally be defined as alliances of organisations and people that work together towards a common goal, characterised by identifiable and stable relations. There is nothing inherently spatial about networks, although it might have spatial applications – as is illustrated in figure 1 with the dotted green cubes. This is, because networks are a form of durable social capital created and maintained through a combination of social history and ongoing collective action (Gordon/MacCann 2000). «CLUSTERS» combine both dimensions geographic concentration and cooperation and are characterised by spatial proximity, linkages and socially embedded interactions (blue cube). Like agglomerations clusters are associated with *"[...] economic benefits which potentially derived by co-locating firms* *from vertical linkages in the value chain and horizontal relationships, and the interaction with education, R&D and other organizations nearby."* (Fromhold-Eisebith/Eisebith 2004: 2).

Table 2: Cluster Dimensions

Dimension	Types
Geographical scope	_ Localised – tight grouping in small geographic area _ Dispersed – spread across large region or city
Density	_ Dense – heavy concentration/large number of firms in cluster _ Sparse – small number of firms, low economic weight
Breadth	_ Broad – variety of products in different but related industries _ Narrow – focused on one or a small number of products or industries
Depth	_ Deep – region includes range of supply chain activities _ Shallow – firms rely on external inputs
Activity base	_ Activity-rich – firms are involved in a wide range of value-adding activities _ Activity-poor – firms are only involved in a limited range of activities
Growth potential	_ Industry context – sunrise industry, "noonday", sunset _ Competitive or non-competitive within each industry
Innovation capacity	_ High innovation – the cluster is able to use its structure to generate innovation _ Low innovation – the nature of the cluster inhibits innovation
Industrial organisation	_ Core & ring: few large firms – many small firms _ Ring no core – small firms only
Co-ordinating mechanism	_ Formal structures (i.e. cluster management) _ Informal structures
Development stage	_ Working – critical mass of firms, knowledge and resources with dense interaction _ Latent – critical mass of firms but interaction and information flows not sufficient _ Potential – some elements present but a need to be deepened and broadened _ «Wishful thinking» - chosen for government support but lack critical mass or favourable conditions for organic development

Source: Adapted from Enright (1998)

As was outlined in the final report of the expert group «Clusters and Networks» (EU 2003) *"Clusters are a nebulous concept"*. Due to its popularity the concept is used for a variety of different business structures: national, regional as well as cross-border clusters, clusters of competence, industrial or production systems and innovation systems. It is also used for different purposes: to increase the competitiveness of SMEs, support collective research, rationalise a whole industry, implement environment management system. As Rosenfeld (1997) noted *"[…] there are as many definitions [of clusters] as there are types of organisations using the term"*. Even though a multitude of definitions exists, most share the idea of proximity, networking and specialisation.

The most widely used is probably Porter's definition (1998: 197):

> *"Clusters are geographically concentrated groups of interconnected companies, specialised suppliers, service providers, firms in related industries, and associated institutions (for example, universities, standards agencies, and trade associations) in particular fields that compete but also co-operate."*

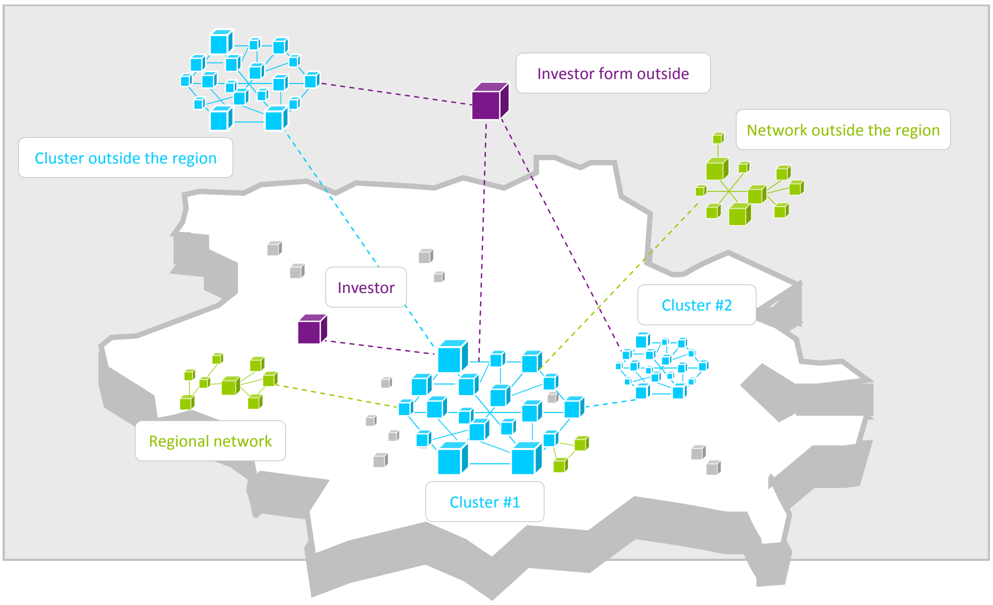
We understand «CLUSTERS» as geographic agglomerations of interconnected companies and associated institutions linked by commonalities. These commonalities as well as an increased frequency and impact of interactions are ensured through the proximity (geographic and cultural) of firms and institutions. Firms in a cluster produce similar or related goods or services and are supported by a range of dedicated institutions located in spatial proximity, such as business associations or training and technical assistance providers. The primary goal of companies in a cluster is not cost-effectiveness and efficiency, but innovation and growth.

In general clusters are organically grown and self-organised Clusters can be formally organised by a cluster management organisation that provides different services for the residing companies in the cluster, such as cluster promotion, internationalisation, networking, trend monitoring etc.

Clustering can likewise encourage a more efficient division of labour among firms and offer the possibility of scale economies for individual companies. Moreover, clusters can facilitate flows of ideas and information that underlie innovation. Such information and/or knowledge flows occur formally and informally, through contacts with suppliers and customers, and through social interactions. That is, clusters can constitute important knowledge spillovers for businesses and affect – as is well documented – companies' innovation capabilities (e.g. Baptista & Swan 1998, Bell 2005, Deeds et. al 1997, Feldman & Florida 1994, Porter & Stern 2001). In addition physical proximity furthers the creation of formal and informal linkages and networks among firms, higher education, research institutions, financial establishments, etc. However, benefits from clustering arise not automatically, but depend on the cluster members and their interactions.

Clustering is similar to networking in the sense that ideally both are learning systems which help to socialise innovation-related knowledge and reduce uncertainty in the environment in which innovative companies operate (Quandt/Pacheco 2000). Rather than being mutually exclusive cluster-based personal contacts and wider network linkages complement each other; a fact which backs the ACHIEVE MORE project rational. As is illustrated below, the cluster members might be part of networks within and/or beyond the cluster, venture capitalists might be linked to various clusters.

Figure 4: Linkages between Firms, Clusters, Networks and Investors



2.3 Cluster & Innovation

In theory as well as in practice innovation is no longer seen as linear process from R&D to market, but as «INNOVATION SYSTEM» and more recently «OPEN INNOVATION». In innovation systems innovation is characterised as complex set of interactions of firms, universities and research centres, markets and society. Moreover, innovation dynamics are not just supplier-driven, but customer-driven. In contrast open innovation takes into account that in a world of widely distributed knowledge, companies cannot afford to rely entirely on their own research, but should instead interact with other agents and communities to exchange ideas. Open innovation often supports the high value relationships between SMEs – doing the innovation – and larger organisations who are often the producers of technology. During recent years growing attention has been devoted to the concept and large companies have become aware of the increasingly importance of open innovation. The advantages of open innovation for large multinationals are apparent, especially as it concerns speeding up innovation. Through formal or informal commercial links, such as contractual access to innovative ideas, or even strategic insights such as foresight which can be fed by SMEs that are able to envisage a future beyond the horizons of larger players, emerging innovation capability in small companies can be assessed. Nevertheless, a crucial precondition is that existing competition must outweigh gains from cooperation.

Accordingly, innovation seldom occurs in a nutshell. Just the contrary, it has widely been acknowledge that innovation shows a high degree of geographical agglomeration (e.g. Cooke/Morgan 1994). In this sense the cluster approach is part of a set of innovation system approaches (Enquist 1997, Malerba 2000).

When discussing innovation one needs to distinguish between technological (product and process innovation) and non-technological innovation (organisational and marketing innovation). With regard to clusters process and organisational innovation are of particular interest. A «PROCESS INNOVATION» can be defined as implementation of a new or significantly improved production or delivery method, including significant changes in techniques, equipment and/or software. In contrast an «ORGANISATIONAL INNOVATION» is the implementation of a new organisational method in the firm's (here: cluster) business practices, workplace organisation or external relations. In addition, «MARKETING INNOVATIONS» are of interest; especially with respect to global competition of regions.

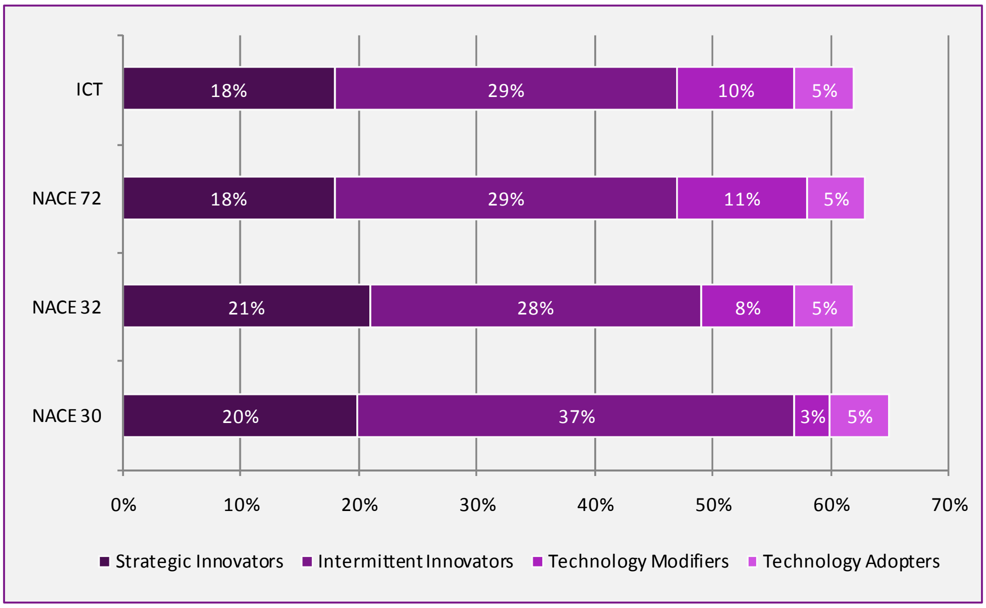
Arundel and Hollanders (2005) developed an innovator classification system using Community Innovation Survey (CIS) data based on two main criteria: First, the level of novelty of the company's innovations and second, the creative effort that a company expends on in-house innovative activities. They distinguish between four resp. five types of innovators if one takes into account the non-innovators:

- STRATEGIC INNOVATORS: Companies active in national or international markets which have introduced a product or process innovation that they developed at least partly in-house and which is new to their market. R&D is performed on a continuous basis. These firms will be the source of many innovative products and processes that are adopted by other firms throughout their domestic economy and internationally.

- INTERMITTENT INNOVATORS: Companies in this category also develop innovations at least in part in-house and have introduced new-to-market innovations. But, they are unlikely to develop innovations that diffuse to other companies.
- TECHNOLOGY MODIFIERS: Companies which develop innovation at least partly in-house but do not perform R&D. If they are active on national and international markets they have not introduced a new-to-market innovation (otherwise they would be classified as intermittent innovators). If they are active in local or regional markets, they may have introduced a new-to-market innovation and have slightly modified it for this market.
- TECHNOLOGY ADOPTERS: Companies which have innovated, but depend on adopting innovations developed by other companies. They innovate through diffusion.

The sectoral analysis of innovations modes shows that in the ICT sector 18% of companies are strategic innovators, 29% are intermittent innovators, 10% are technology modifiers and 5% are technology adopters (Hollanders 2008). But the sector is by no means homogenous, as is shown in the following figure.

Figure 5: Innovation Modes ICT Sector (% share of all companies)



Source: Hollanders (2008)

As NACE 72 makes up almost two-thirds of the ICT sector, it is not surprising that the distribution pattern is the same as that of ICT. According to the analysis high-skilled labour forces are crucial in NACE 72, almost half of all employees have a higher education degree and almost two-thirds of all firms – and 3 out of 4 strategic innovators – innovate by training their personnel. The share of innovators using formal methods of Intellectual Property protection is about equal in the different ICT industries, but NACE 72 innovators rely more on trademarks and copyrights. Moreover, strategic methods of property protection are used relatively more by NACE 72 innovators, with more than half of them using lead-time advantage on competitors (Hollanders 2008).

Table 3: EU companies R&D investment by sector

Sector	Change 2005-2006 (%)	CAGR 3 years (%)	R&D intensity 2006 (%)
Fixed-line telecoms	21.6	12.8	1.6
Telecom equipment	5.6	-0.2	11.4
Software	15.5	11.2	15.1
IT services	3.2	-7.6	5.8

Source: The 2007 EU Industrial R&D Investment Scoreboard (JRC – European Commission)

But innovation is not always related to a new or substantially changed technological goods, services or processes. Examples of non-technological innovation are the creation and management of intellectual and social capital by companies. Innovations lead to spillovers by transferring knowledge through information contained in the product itself, and through the diffusion of information among staff and the mobility of human resources between firms, sectors and regions.

As has been outlined, clusters contribute to facilitating innovation processes. Today innovation is not just a sole preserve of universities or research centres; it is mainly result of a series of business initiatives and experimentation. Ideally, in a cluster enterprises voluntarily or involuntarily learn from each other and copy each other.

Furthermore, it is assumed that clusters are built on linkages and relationships that integrate the isolated capabilities of institutions, firms and individuals into a collective, territorial asset. Thus, the establishment of mechanism to coordinate efficiently these relationships is essential to create a supportive environment for interchange, cross-fertilisation, risk-sharing and collective learning.

A cluster that improves the «INNOVATIVE CAPABILITY» or «DYNAMIC EFFICIENCY» by reducing uncertainty through information sharing and screening, and by establishing a durable relational basis for building competences can be categorised as «INNOVATIVE CLUSTER». In this context one needs to recognise that it is not only the innovation and related processes which differ between clusters, but also the way innovation is taking shape (Hertog et al. 2001).

Factors that determine clusters specificity and innovation style are (1) the historic background and country specificities, (2) the type of knowledge, (3) the stage of cluster development, and (4) the networking practices (ibid.).

Concerning these specificities we will not go into further detail here. But one needs to bear in mind that as every cluster is unique as is cluster-related innovation and innovation processes.

3 Research Approach & Methodology

As mentioned the aim of work package 6 is to involve innovative clusters in the ACHIEVE More partnership. The cluster mapping exercise is the first step to identify the clusters of interest. Before going into detail on the methodology some preliminary remarks on cluster analysis are made to better understand the planned procedure.

3.1 Cluster Studies & Mapping Approaches

In general cluster studies are useful analytic instruments in better understanding how individual economies are structured, their specialisations and the role clusters play in the wider economy (Hertog et al. 2001, EU 2007).

The field of cluster analysis has emerged as hybrid discipline which comprises economic, geographic and management studies. So far no standardised cluster analysis approach is established, and only a limited number of common procedures exist. Whereas some of them are based on qualitative information, others rely on economic modelling and are based on statistical methods. Nevertheless, cluster analyses can *"[…] provide valuable insights into the factors influencing regional growth"* and *"[…] can be useful for mapping industry landscapes to reveal what already exists."* (Mazzarol et al. 2005: 3ff.). Most cluster studies are either oriented towards the micro-level or the meso-level. While meso-level measures like location quotients provide a more detailed picture of the regional industry by sector, micro-level analyses are designed to pinpoint the supply-chain relationships and strategic networks in single sectors (ibid.).

Qualitative (micro-level) analysis typically employs methodologies that are labour-intensive and time-consuming, such as face-to-face interviews or focus groups comprised in case studies. By comparison, meso-level analysis (quantitative analysis) is more likely to make use of secondary source statistical data (e.g. employment data). However, both techniques have their limitations. Whereas micro-level studies suffer from external validity as the findings are neither representative for all regions nor for all industries in a specific region; meso-level studies are limited by problems with data availability and comparability. To overcome these limitations and to fully understand the dynamics of cluster behaviour, ideally, both methodologies should be combined.

Furthermore, cluster mapping efforts can be differentiated by the approach used to allocate individual industries to specific cluster categories. In the past, this was mainly done on case-by-case basis. The «CLUSTER MAPPING» approach taken by the European Cluster Observatory relates to two aspects of the research method: *"First, cluster mapping is based on the mapping of the industrial classification code into clusters. And second, cluster mapping data allow the mapping of clusters across geographies, indicating which clusters are present where."* (Ketels/Sölvell 2006: 20).

As various cluster mapping approaches show cluster models applied in European regions are quite heterogeneous. This is result of *"[…] different development paths as a consequence of different cultures, historical circumstances, size of the economy, ways of business behaviour and governance, way of networking and management relationships, cluster policies and instruments to foster clusters' competitiveness."* (EU 2003: 20).

In addition, inspection of the cluster profiles in Europe's regions reveals the heterogeneity of economic activities, in terms of size, connectedness, R&D intensity, share of innovative products/services and so on (Hertog et al. 2001). These facts need to be taken into account when trying to identify «INNOVATIVE CLUSTERS».

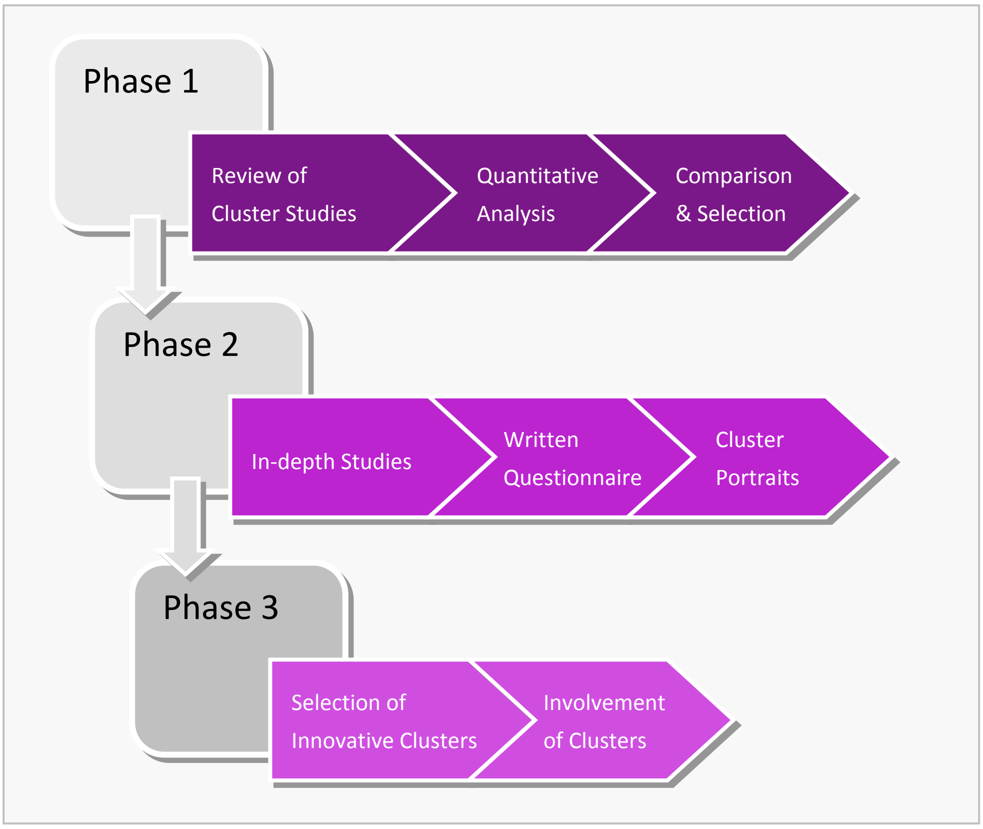
3.2 Cluster Mapping Methodology

The envisaged cluster mapping methodology in our project comprises three phases that involve both meso-level analysis using employment and industry concentrations based on NACE codes, and micro-level analysis using interviews. Guiding questions are how innovative software clusters are distributed across Europe and how they are configured.

As is shown in figure 1, the FIRST PHASE of the cluster mapping addresses the meso-level through secondary statistical data analysis and desk research. Due to the lack of a standardised cluster analysis approach the applied methodologies vary depending on the purpose of the single studies. When using such findings as secondary source one needs to take into account that comparability is limited.

Against this background it seems to be a reasonable approach, to cross-check the results of third party cluster surveys with own quantitative analysis. The aim is to identify spatial ICT agglomerations and to contrast our findings with existing cluster studies, such as European Cluster Observatory, TCI cluster lists and cluster surveys provided by Europe INNOVA projects. It is worth noting that one can not draw from the existence of regional sectoral agglomerations the existence of clusters. Nevertheless, the results might provide information on regions which are relevant from sectoral perspective and are not shown in the available cluster studies or are not identified as strong clusters in the European Cluster Observatory. Based on the results of this analysis a first selection of potential clusters will take place.

Figure 6: Cluster Mapping Roadmap



After the initial phase based on statistical analysis and desk research, resulting in the identification of software clusters, an in-depth analysis will be carried-out in PHASE TWO aiming at identifying the innovative clusters. As is generally known, the relation between clusters and innovation is complex. Forasmuch, a suitable procedure for getting a first idea of where the innovative clusters might be located, is to compare the cluster regions with the best performing innovation regions in Europe, as measured by the European Regional Innovation Scorebord (RIS) and the analysis available on European R&D and technological specialisation (erawatch).

Although statistical cluster mapping is an important tool for identifying clusters, it is not sufficient. Qualitative information is also necessary to validate the statistical findings and to provide complement information that cannot be captured from statistical data. Thus, the next step will be a qualitative analysis. The necessary information will mainly be collected through questioning at cluster management level (as far as a formal cluster management is established) and screening of cluster-related secondary material (i.e. strategic documents, roadmaps, cluster monitoring reports etc.). We expect to gain valuable insight in the clusters' basic characteristics, their functioning and performance. The results will be visualised in a cluster map highlighting the clusters location and clusters portraits will be compiled (see Appendix 1 for a draft version of such «Cluster Template»).

In the final THIRD PHASE the project consortium has to select those clusters which are of interest for the ACHIEVE More partnership and get into consultations and negotiations to involve them in our project.

In order to speed-up the process of brining clusters into membership of the E&I exchange, existing information on innovative ICT clusters from previous projects and our long-standing experience in cluster analysis will be collected and forward to the leader of work package 4.

3.3 Data Availability & Indicators

An important aspect is the data availability which must always be taken into consideration when choosing a mapping method. Thus, we examine the availability of data and explain different measures to be used for the quantitative analysis.

3.3.1 Data Limitations

Hitherto, many comparative cluster studies suffer from poor quality of data in terms of availability and comparability. That is, because a majority of data is only available either on aggregated regional or industry level, but not on disaggregated industry *and* regional level. Or in other words, statistically the intersection of regions and industries is inadequately covered for the following reasons:

First, the only indicator which is available in Europe across all sectors and regions is employment. Second, the 4-digit NACE, at which European industry data is available, is not granular enough to go beyond traditional sectors. Further limitations result from the fact that the regional level – NUTS 2 – at which European data is available is defined based on administrative boundaries which may not reflect economic interactions. In addition, available metrics (data, models and indicators) *"[…] are not covering the fact, that innovation is a matter of interaction, within and beyond sectoral or regional boundaries."* (Pro INNO Europe 2007: 9). Besides, using employment data – which is the only data set available in sufficient level of detail across most sectors and regions in Europe – creates a certain bias towards employment-intensive clusters. Moreover, NUTS 2 regions differ in size and which might affect the relevance of single sectors for the regional economy. For example, some NUTS 2 regions like Denmark represent nations with approximately 4.3 inhabitants while others, e.g. the German region Detmold with only 2.2 inhabitants («Regierungsbezirk Detmold») are sub-national regions with local authorities.

Accordingly, cluster studies or mapping efforts – like the European Cluster Observatory – are based on heterogeneous data sources and indicators which makes comparison and interpretation difficult. Thus, from our perspective cross-checking the results of secondary studies by own analysis is useful. As the European Cluster Observatory provides the largest set of cluster-related data and will serve as one data source we introduce their methodology in the following.

3.3.2 The European Cluster Observatory's Methodology

In the framework of the European Cluster Observatory the *geographical* dimension is operationalised through 259 regions, predominantly NUTS 2 regions. For comparison reasons both in terms of land area and employment NUTS 1 regions are used for Belgium, Greece, Netherlands and Turkey; for Ireland due to data availability. The *sectoral* dimension is expressed by employment data on the 4-digit industry level (and in a few cases 3-digit data). Comparable data on wages, value added, or productivity at the level of regions and detailed industries is unfortunately not available.

According to the European Cluster Observatory's rational industries that are present in some regions but not in others are called «CLUSTER SECTORS». Within the cluster sector, specific groups of industries tend to locate in the same places; these are referred to as «CLUSTER CATEGORIES». The notion is operationalised through the definition of 38 cluster categories. The cluster category of interest for ACHIEVE More is «Information Technology» which comprises both, ICT manufacturing and services.

The term «REGIONAL CLUSTER» is used if the employment in a given region in a particular cluster category meets cut-off criteria in terms of share of cluster sectoral employment, share of regional employment, and specialization.

To evaluate the regional clusters' strength the so-called *3-star concept* is applied. Hence, regional clusters are assigned one «star» for each of the following criteria which reflect whether the cluster has reached a «specialised critical mass» to develop spillovers and linkages: SIZE, SPECIALISATION AND FOCUS. They bring forward the argument that the amount and quality of knowledge circulating and spilling over between firms located in a cluster is dependent upon the cluster's size, the degree to which it is specialised and the extent to which the locality (the region) is geared towards and focused upon production in the relevant industries comprising the cluster.

Consequently, the European Cluster Observatory shows the extent to which clusters have achieved this specialised critical mass by employing measures of these three factors as described below, and assigning each cluster 0, 1, 2 or 3 stars depending on how many of the below criteria are met.

3.3.3 Localisation Quotient

Clusters can be identified and mapped by looking at localisation quotients. The «LOCALISATION QUOTIENT» (LQ) is most frequently used in economic geography and location analysis. Basically, it measures the extent to which a region is more specialised in an industry compared to the geographic are in question (benchmark). It is calculated as the industry's share of total employment in a given region relative to the industry's share of total employment in the whole geographic area in question. The quotient can reveal what makes a particular region «unique» compared to e.g. national average. And thus, reflects the relative significance of a phenomenon (e.g.

employment in software sector) in a region compared with its significance in a larger region (e.g. a federal state or the country as whole).

As has been outlined in chapter 3.3.1 at European level data is only available at NUTS 2 level. In case of «ACHIEVE More» we will calculate the location quotient for 256 regions in Europe based on employment data made available at Eurostat. Data at software sector level (NACE 72.2) is not available. Nevertheless, taking into account that the location quotient is only one of a set of different measure and following our argumentation in the previous chapter, we will use the higher aggregated level of NACE 72.

Whereas a LQ equal to 1 means that a given region is not specialised in the given industry, an index of above 1 indicates a specific degree of specialisation compared to the benchmark. For example, a LQ of 1.5 means that the industry is represented by a 50% larger share of employment in the given region, than the industry's share of employment of the region in question. In general high quotients in a group of related industries in a particular region suggest that a cluster exists (Cortright 2006).

The basic argument for taking this measure into account is that *"[...] if a region is more specialised in a specific cluster category than the overall economy, this is likely to be an indicator the economic effects of the regional cluster have been strong enough to attract related economic activity from other regions to this location [...]"*. Moreover, it is assumed that spillovers and linkages in these regions will be stronger.

In the framework of the European Cluster Observatory a cluster category in a region with a specialisation quotient of 2 or more received a star.

Alternative to employment data, one can use payroll to compute location quotient. Ideally, on would prefer to use output or value-added to compute location quotients, but these data are seldom available below the national level for detailed industry categories.

As is well known, clusters rarely follow defined administrative boundaries (e.g. counties or political divisions). Forasmuch, the «G statistic index», developed by Feser et al. (2001), can be used to measure whether adjacent regions have similarly high levels of an industry concentration. This measure is suitable for identifying clusters that span administrative boundaries.

3.3.4 Concentration

The «CONCENTRATION INDEX» (CI) will be used to express whether a particular industry is concentrated in a small number of regions or dispersed widely across many regions. A widely used measure for concentration is the Gini coefficient (Krugman 1991). The locational Gini coefficient is calculated by summing the differences in shares of total employment and specific industry employment for each region in an analysis. A specific industry is considered to be concentrated if a large part of its employment is found in a small number of regions (Traistaru 2002). A Gini coefficient of zero indicates that an activity is exactly as dispersed nationally as total employment. If all employment is concentrated in a single region, the Gini coefficient approaches 0.5.

«FOCUS» is used as concentration measure in the framework of European Cluster Observatory. It shows the extent to which the regional economy is focused upon the industries comprising the cluster category. This measure relates employment in the cluster to total employment in the region. The top 10% of clusters which account for the largest proportion of their region's total employment receive a star.

Following the European Cluster Observatory it is more likely that meaningful economic effects of clusters will be present in a region if the employment reaches a sufficient absolute level. To determine the clusters relevance in Europe the measure «SIZE» which relates the employment in the regional sector to total European employment in the designated sector was used. The measure shows whether a cluster is in the top 10% of all clusters in Europe within the designated cluster category.

3.3.5 Performance Indicators

In order to answer the question on clusters' performance, one must identify what part of the wealth creation can be attributed to a specific cluster, which is a difficult task.

Since innovation data is not available at cluster level the European Cluster Observatory has chosen a pragmatic approach and based its «INNOVATION INDEX» on the Regional Innovation Scoreboard (RIS) 2006. The RIS benchmarks 208 European regions on the basis of 7 indicators (see Table 2) which are reflected in the compound RIS index. The value of the index lies within a range from 0 to 1 with the region with the highest RIS scoring 0.90 (Stockholm, Sweden). The data used is derived from the

Community Innovation Survey (CIS), which currently is available in its fourth edition (CIS-4).

As RIS is only calculated for the NUTS 2 regions as a whole, without any division by cluster categories, it can only indicate an innovative climate within a region. Thus, a 3-point scale was used within the Cluster Observatory. All regional clusters within a region were ranked according the according to the RIS. The bottom third of regions got the «low» value, the second quantile the «medium» and the top third the «high« mark.

Table 4: Regional Innovation Scoreboard Indicators

Human Resources in Science and Technology (% of population)	Labour Force Survey
Participation in life-long learning (% of 25-64 years age class)	ditto
Employment in medium-high and high-tech manufacturing (% of total workforces)	ditto
Employment in high-tech services (% of total workforces)	ditto
Public R&D expenditures (GERD – BERD) (% of GDP)	R&D Statistics
Business R&D expenditures (% of GDP)	ditto
EPO patents per million population	Patent Statistics

Source: Hollanders (2007)

To better capture the reality and consider the emergence of knowledge-based economy in our analysis we will combine different economic sources and data, technological and scientific activities. RIS data will then be used to cross-check our findings. Some ideas how this can be done, can be drawn from the following mapping approaches:

First, an approach developed in the framework the *Cluster Benchmarking Project,* a joint initiative by the Nordic Innovation Centre (Andersen/ Bjerre/ Wise Hannson 2006). They distinguish between «FRAMEWORK CONDITIONS» understood as clusters' specific contextual factors that affect its performance (like human resources, investment in R&D, venture capital), «PERFORMANCE» in terms of cluster-specific results which are the drivers of economic outcomes, and «ECONOMIC OUTCOMES» (i.e. employment, wages, productivity). Accordingly, three types of data are needed: outcome, performance and framework data.

Second, a methodology developed by the *National Research Council (NRC)* in Canada which takes the cluster lifecycle into consideration (Davis et al. 2006). The NRC segments on the one hand between immediate and long-term outcomes from cluster development activities and on the other hand between current conditions (inputs) and current performance (output); constructs of the latter are «SIGNIFICANCE», «INTERACTION», and «DYNAMISM».

Table 5: NRC Performance Indicators

Construct	Sub-constructs	Indicators
Significance	Critical mass	Number of cluster firms Number of spin-off firms Size of cluster firms
	Responsibility	Firms structure Firm responsibilities
	Reach	Export orientation
Interaction	Identity	Internal awareness External recognition
	Linkages	Local involvement Internal linkages
Dynamism	Innovation	R&D spending Relative innovativeness New product revenue
	Growth	Number of new firms Firm growth

Source: Andersen/Bjerre/Wise Hannson 2006

A third only slightly different approach is used by Innovation Norway. They distinguish between performance and process measures. Performance indicators are critical mass, innovation activity, human, knowledge, and financial resources. As process indicators complementarity, competitive situation, dissemination of knowledge, collective learning and international contacts have been applied. The aim is not international benchmarking, but to monitor the development of single clusters over time.

Table 6: Innovation Norway Performance Indicators

Critical Mass
_ Productivity
_ % revenue from regional, national, international markets
Innovation Activity
_ Number of companies how have introduced new products or services in the last three years
_ Number of companies who have introduced an organisational change in the last three years
Human Resources
_ Share of workforces with documented specialised competencies
_ Share of workforces with higher education
Knowledge Resources
_ R&D investment (as % of revenue)
_ Costs of R&D services purchased externally
Financial Resources
_ Yearly investment from seed and risk capital funds
_ Evaluation of availability of risk capital

Source: Andersen/Bjerre/Wise Hannson 2006

As one can draw from these examples organisations working in this field employ similar approaches in terms of data and information gathering (combination of quantitative and qualitative data). However, there is no recognised standard, neither as it concerns a standard structure for delineating which factors/conditions influence or determine cluster performance, nor a standard set of data for measuring cluster performance.

Nevertheless, these examples provide in combination with the methodology applied within the European Cluster Observatory a good basis for the development of an indicator catalogue for the purpose of ACHIEVE MORE.

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Appendix 1: Cluster Portrait Template (first ideas)

The following template is to be understood as first draft version and basis for further discussion.

(1) Cluster Description

» Biographic information

» Cluster characteristics: employment, number of members, industry structure, specialisation)

(2) Location

» Geographic boundaries (e.g. within a city, metropolitan area, region, state, across state boundaries, nationwide, transnational)

» Regional economic development

(a) Status in the life-cycle: embryonic, growing, mature, declining (inside-perspective)

(b) Categorisation by outside perception: among the world's 3 most highly developed, highly developed, critical mass present, partly developed, lacking critical mass, rudimentary (emerging or unravelling)

(3) Determinants of Competitiveness

(4) Evolution Path

(5) Degree of managed interaction within the cluster. (Maybe just the presence of a paid cluster manager, or a formal programme of interaction, as in Clusterland Upper Austria. Could have several of these criteria and score 1 for each. Below a score means it is not actively managed, above means it is.)

(6) Degree of provision of innovation services (which in our case could be external s/w design and development, or other advanced services provision)

Appendix 2: Summary of 1 to 3-star ICT Clusters European Cluster Observatory

Cluster	Employees	Size	Spec.	Focus	Stars	Innovation	Exports
Berks, Bucks and Oxon (Oxford), UK	45,071	2.19%	3.68	4.10%	***	High	Weak
Oberbayern (München), DE	45,026	2.19%	2.56	2.85%	***	High	Weak
Karlsruhe, DE	36,164	1.76%	3.41	3.81%	***	High	Weak
Stockholm, SE	34,633	1.69%	3.21	3.59%	***	High	Weak
Zürich, CH	23,685	1.15%	2.8	3.12%	***	N/A	Weak
Stuttgart, DE	36,592	1.78%	2.25	2.51%	**	High	Weak
Kozep-Magyarorszag (Budapest), HU	30,735	1.50%	2.27	2.53%	**	High	Strong
Surrey, E and W Sussex (Brighton), UK	25,743	1.25%	2.04	2.28%	**	High	Weak
Hants and Isle of Wight (Southampton), UK	20,428	0.99%	2.2	2.46%	**	High	Weak
Oslo og Akershus, NO	16,256	0.79%	2.42	2.70%	**	N/A	Weak
Dresden, DE	16,185	0.79%	2.81	3.14%	**	High	Weak
Oberpfalz (Regensburg), DE	15,081	0.73%	3.83	4.28%	**	High	Weak
Kozep-Dunantul (Székesfehérvár), HU	12,535	0.61%	2.65	2.96%	**	Low	Strong
Nyugat-Dunantul (Györ), HU	10,995	0.54%	2.48	2.77%	**	Low	Strong
Malta, MT	4,858	0.24%	3.02	3.37%	**	Low	Very strong
Île de France (Paris), FR	81,204	3.95%	1.55	1.73%	*	High	Weak
Lombardia (Milan), IT	66,582	3.24%	1.46	1.63%	*	Medium	Weak

Cluster	Employees	Size	Spec.	Focus	Stars	Innovation	Exports
West-Nederland (Amsterdam), NL	49,253	2.40%	1.37	1.53%	*	N/A	Strong
Madrid, ES	46,013	2.24%	1.46	1.63%	*	High	Weak
Inner London, UK	44,950	2.19%	1.69	1.89%	*	High	Weak
Lazio (Rome), IT	40,054	1.95%	1.75	1.96%	*	High	Weak
Cataluña (Barcelona), ES	38,050	1.85%	1.06	1.19%	*	Medium	Weak
Danmark, DK	34,465	1.68%	1.18	1.31%	*	High	Weak
Ireland, IE	30,353	1.48%	1.71	1.91%	*	N/A	Very strong
Darmstadt (Frankfurt am Main), DE	29,884	1.45%	1.91	2.14%	*	High	Weak
Rhône-Alpes (Lyon), FR	28,066	1.37%	1.3	1.46%	*	High	Weak
Outer London, UK	26,020	1.27%	1.39	1.56%	*	High	Weak
Piemonte (Turin), IT	25,419	1.24%	1.3	1.46%	*	Medium	Weak
Düsseldorf, DE	20,929	1.02%	1.13	1.26%	*	Medium	Weak
Etelä-Suomi (Helsinki), FI	19,819	0.96%	1.5	1.67%	*	High	Weak
Emilia-Romagna (Bologna), IT	19,577	0.95%	0.98	1.10%	*	Medium	Weak
Köln, DE	19,559	0.95%	1.31	1.47%	*	High	Weak
Kärnten (Klagenfurt), AT	4,635	0.23%	2.13	2.38%	*	Medium	Weak

Source: European Cluster Observatory