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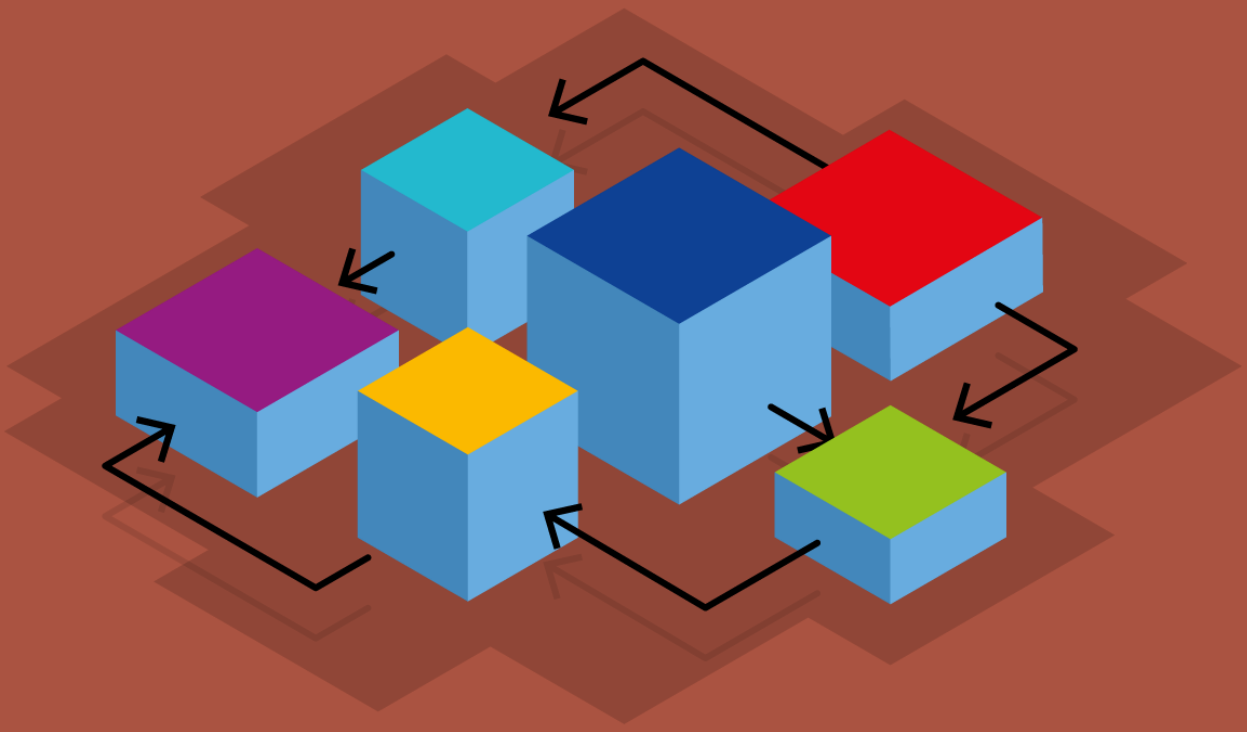

European Cluster Observatory

DISCUSSION PAPER

Clusters and Workforce Development

Prepared by VDI/VDI-IT

November 2016

Internal Market, Industry, Entrepreneurship and SMEs

European Cluster Observatory in Brief

The European Cluster Observatory is a single access point for statistical information, analysis and mapping of clusters and cluster policy in Europe. It is primarily aimed at European, national, regional and local policy-makers and cluster managers and representatives of SME intermediaries. It is an initiative run by the 'Clusters, Social Economy and Entrepreneurship' unit of the European Commission's Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs and aims to promote the development of more world-class clusters in Europe, notably with a view to promoting competitiveness and entrepreneurship in emerging industries and facilitating SMEs' access to clusters and internationalisation activities through clusters.

The ultimate objective is to help Member States and regions to design smart specialisation and cluster strategies that will help companies to develop new, globally competitive advantages in emerging industries through clusters, and in this way to strengthen the role of cluster policies in boosting Europe's industry as part of the Europe 2020 Strategy.

In order to support evidence-based policy-making and partnering, the European Cluster Observatory provides an EU-wide comparative cluster mapping with sectoral and cross-sectoral statistical analysis of the geographical concentration of economic activities and performance. The European Cluster Observatory provides the following services:

- **biannual 'European Cluster Panorama' (cluster mapping)** providing an update of and extension to the statistical mapping of clusters in Europe, including for ten related sectors (i.e. cross-sectoral) and a correlation analysis with key competitiveness indicators;
- **'European Cluster Trends' report** analysing cross-sectoral clustering trends, cluster internationalisation and global mega trends in industrial transformation; identifying common interaction spaces; and providing a forecast for industrial and cluster opportunities;
- **'Regional Ecosystem Scoreboard'** setting out strengths and weaknesses of regional and national ecosystems for clusters, and identifying cluster-specific framework conditions for three cross-sectoral collaboration areas;
- **'European Stress Test for Cluster Policy',** including a self-assessment tool accompanied by policy guidance for developing cluster policies in support of emerging industries;
- **showcase of modern cluster policy practice, provided in the form of advisory support services to six selected model demonstrator regions**. The services offered include expert analysis, regional survey and benchmarking reports, peer review meetings and policy briefings in support of emerging industries. The policy advice also builds on the policy lessons from related initiatives in the area of emerging industries;
- **the European Cluster Conferences** 2014 and 2016, which bring together **Europe's cluster policy-makers and stakeholders** for a high-level cluster policy dialogue and policy learning, and facilitate exchange of information through, e.g. webpages, newsletters and videos.

More information about the European Cluster Observatory is available at the EU cluster portal at: http://ec.europa.eu/growth/smes/cluster/observatory/.

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1. Introduction

The present discussion paper, serves to initiate a debate on the current and future role of clusters and cluster organisations in connection with skills development with a special focus on emerging industries.

In recent years, "the cluster and skills" topic gained increasing importance among policy makers in Europe, notably in the context of the New skills Agenda, the Blueprint for sectoral cooperation on skills, Sector Skills Alliance under ERASMUS+, the Digital Skills and Jobs Coalition etc [1]. As this paper will show, numerous cluster organisations have initiated actions related to education and training. The rationale for this trend is the emergence of new industries and increasing technological convergence which leads to continuously change of workforce skills by industry. The ongoing discussions point out that much more clarity is needed on how current training efforts are embedded in cluster development and by whom these measures can be implemented best. Also, more insights on what kind of role cluster organisations can or should play to assure that workforce skills match the ongoing needs of industry, markets, and society are required.

Along those lines, this discussion paper explores the role that clusters, cluster initiatives and cluster organisations can play in the context of workforce development within emerging industries. The key questions addressed in this discussion paper are as follows: What are the main challenges in providing the necessary skills to grow the talent pool? How can we better define skills needs, anticipate changes and foster multi-stakeholder partnerships? How can best practices be nurtured and scaled up? What roles can or should cluster organisations play in this context**?** How do these roles change and evolve over the various stages of workforce development and the evolving status of the emerging industry clusters?

In order to address these questions, the discussion paper starts from the premise that workforce development for existing and emerging industries requires input and guidance from many sources beyond cluster organisations. When identifying the role of the cluster organisation as an entity in the process, it is necessary to look at the entire system of actors and stakeholders in the various facets of workforce development. Depending on the sector of interest, these include government agencies, trade unions and vocational education training centres, educational institutions, public interest associations, consumer groups and private sector firms that may or may not be part of any cluster organisation as such. At any given stage of the workforce development process, different combinations of these actors and stakeholders can represent "drivers". The cluster organisations are only one of the actors in this regard.

This paper is structured into five major sections. Following this Introduction, the second section discusses the role of clusters and cluster organisations in the context of skills development. The third section focuses on the role that cluster organisations can play in terms of workforce development. The chapter draws on quantitative and qualitative data provided by the European Secretariat for Cluster Analysis. The discussion serves to better understand what kinds of services are provided by cluster organisations in this respect. The fourth section presents selected cases, namely Hamburg Aviation Cluster (Germany), Alpine Wellbeing (Italy) and Massachusetts Life Science Cluster (U.S.), that illustrate certain good practices and looks into lessons learned in the field of clusters and workforce development in emerging industries. Three very different clusters are put in focus to highlight aspects of different stages of the workforce development process as well as different combinations of actors and stakeholders that represent "drivers" in said process. The fifth section draws conclusions on upcoming challenges in terms of workforce development for knowledge-based clusters and emerging industries.

[1] *For the list of the most recent actions, see http://europa.eu/rapid/press-release_IP-16-2039_en.htm and http://ec.europa.eu/social/main.jsp?catId=1223*

For the purpose of this paper, *clusters* are understood as regional ecosystems of related industries represented through a group of firms, related economic actors and institutions that are located near each other and have reached a sufficient scale to develop specialised expertise. *Cluster initiatives* are organised efforts to support the competitiveness of a cluster and thus consist of practical actions related to the capacity of these clusters to self-organise and increasingly to pro-actively shape the future of the cluster.[2]

They usually follow a bottom-up approach, are implemented through a competitive process, and are often managed by specialised intermediaries, such as cluster organisations. *Cluster organisations* are the legal entities that support the strengthening of collaboration, networking and learning in clusters. They act as innovation support providers by providing or channelling specialised and customised business support services to stimulate innovation activities, especially in SMEs. They are usually the actors that facilitate strategic partnering across clusters.[3] *Emerging industries* can be understood as either new industrial sectors or existing industrial sectors that are evolving or merging into new industries.[4]

They are defined as "the establishment of an entirely new industrial value chain, or the radical reconfiguration of an existing one, driven by a disruptive idea (or convergence of ideas), leading to turning these ideas / opportunities into new products / services with higher added value".[5]

2. Clusters and Workforce Development

According to Michael Porter[6], clusters can be defined as "geographic concentrations of interconnected companies and institutions in a particular field. Clusters encompass an array of linked industries and other entities important to competition. Many clusters include governmental and other institutions – such as universities, standards-setting agencies, think tanks, vocational training providers, and trade associations – that provide specialised training, education, information, research, and technical support." Within such clusters, **stakeholder partnerships** represent a key factor in many regards, especially when it comes to skills development. The importance of partnerships of key stakeholders, such as industry, education at all levels, and government for successful skills development is broadly supported in the literature.[7] This is especially true for advantages of increasing stakeholder participation specifically in clusters. This is also highlighted by Michael Porter, Next to geographical and regional aspects and the positioning in regard to specific value chains, training and education institutions clearly play an important role for the competitiveness of businesses.

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2 European Commission, 2016: Smart Guide to Cluster Policy. How to make better use of clusters for promoting regional industrial modernisation, supporting the growth of SMEs and encouraging smart specialisation.See http://ec.europa.eu/growth/smes/cluster/observatory/cluster-policy_en

[3] European Commission, 2016: Smart Guide to Cluster Policy. How to make better use of clusters for promoting regional industrial modernisation, supporting the growth of SMEs and encouraging smart specialisation.See http://ec.europa.eu/growth/smes/cluster/observatory/cluster-policy_en, p. 2

[4] See the European Cluster Panorama 2016 that analyses and identifies ten emerging industries, available at http://ec.europa.eu/DocsRoom/documents/20381

[5] This definition (based on Heffernan & Phaal, 2009) was presented by the European Forum for Clusters in Emerging Industries (2013) in their "Policy Roadmap - Actions for new linkages needed: A policy roadmap for stimulating emerging industries", which was set up to support the initial extension work of the European Cluster Observatory on emerging industries. The policy roadmap is available at www.clusterobservatory.eu/index.html#!view=aboutobservatory;url=/about-observatory/emerging-industries/.

[6] Porter (2009): Clusters and Economic Policy: Aligning Public Policy with the New Economics of Competition.

[7] Elkins et al. (2014): Industry Cluster Pathways: A Focused Approach to Regional Workforce Development.

In recent discussions about clusters[8], important areas of cooperation have been highlighted. These are R&D efforts, marketing and education and skills development. One reason is that not only labour intensive industries require workers with particular skills, but especially in knowledge intensive industries, firms are increasingly faced by a *shortage of skilled workers*. Due to the demographic change, this situation is expected to be even worse in the near future. Furthermore, a very central issue of the actors in a cluster is to improve the **innovation capacities**. The human capital and workforce development are therefore at the heart of the innovation capabilities of a cluster.[9]

Additionally, the roles of the relevant actors in the system of education and workforce development are changing and clusters play an important role in the new economies of competition.

"Clusters reveal the mutual dependence and collective responsibility of all these entities for creating the conditions for productive competition. This task will require fresh thinking on the part of leaders and the willingness to abandon the traditional categories that drive our thinking about who does what in the economy. The lines between public and private investment blur.

Companies, no less than governments and universities, have a stake in education and vice versa. Universities have a stake in the competitiveness of local businesses too. By revealing the process by which wealth is actually created in an economy, clusters open new public-private avenues for constructive action".[10]

To sum up, regional clusters and networks can be seen as a flourishing environment for innovation processes, increasingly concerning education and workforce development issues. At an international level, a tendency to a closer cooperation between the fields of research, innovation, economic and education policy can be observed. In the field of education policy this has led to new or developed institutions and supplies, in order to address regional development needs and changing labour market requirements. Therefore, regional innovation systems and clusters can be described as favourable "biotopes" for collaborative developments in the education sector. [11]

The direct and indirect role of clusters in skills development must be seen within the context of the "effective demand" for certain job skills and knowledge base versus the perceived or projected need. Actual market forces are required to sustain the process of employment generation and related adaptation of the corresponding workforce. This **demand-driven approach** stands in contrast to today's supply-driven training system, organised and governed heavily by training providers.

In a cluster-based skills development model, workers will also be equipped to seek employment in multiple firms in many parts of the cluster, in contrast to training programmes that subsidize training in individual firms. This same rationale for a cluster approach applies to most types of economic development programmes.[12] Because of time lags in market demand and trained workforce availability, a fundamental issue that is of concern to knowledge industries is the ability to attract and to "import" **qualified knowledge workers** from elsewhere or different industries to address local demand in a timely and cost-effective manner.

For policy makers, clusters provide a point of contact to the main target group of workforce development programmes. Hence, it can be observed that workforce development programmes were organised around cluster groups of companies and educational institutions over the past few years. By focusing policy tools on clusters, policy makers can better address their interventions to where they impact the competitiveness of several companies simultaneously. Rather than improving competitive-

[8] *Fornahl et al. (2017): The Life Cycle of Clusters - A Policy Perspective, Edited by Dirk Fornahl and Robert Hassink, ISBN: 978 1 78471 927 2, Edward Elgar Publishing Ltd.*

[9] *Globisch et al. (2012): „Bildung für Innovationen - Innovationen in der Bildung. Die Rolle durchlässiger Bildungsangebote in Clusterstrukturen".*

[10] *Ibid.*

[11] *Ibid.*

[12] *Porter (2009): Clusters and Economic Policy: Aligning Public Policy with the New Economics of Competition.*

ness company by company, a cluster-based use of economic policy instruments reaches entire groups of companies and thereby reduces the risk of an inappropriate intervening in competitive markets. In addition, it can bring additional benefits from the spill-overs in the clusters that were triggered through the policies.[13]

In recent years, there has been a growing "anti-globalisation" climate in certain industrialised countries, some of whom blame the loss of jobs on the shift of manufacturing activities to low-skill, low-wage countries. This concern will continue to have an impact on public policy approaches to workforce development in all sectors. Traditional workforce training institutions such as universities and technical schools have needed to remain flexible in terms of course offerings and academic extension programmes in specialty fields of relevance to emerging industries. To the extent that cluster organisations respond to market forces, their role will also continue to be affected.

Organisations. There is good evidence that cluster organisations do play a role in skills development. Any review of the role of cluster organisations in skills development must distinguish among:

(a) offering of training programmes (the role of cluster organisations is to offer qualification and training schemes jointly developed with the cluster actors)

(b) pursuit of advocacy efforts (the role of cluster organisations is to promote the need of skills development towards industry, academia and policy) ,

(c) monitoring of activities (the role of cluster organisations is to monitor and evaluate the progress and impact made in the field of skills development as a results of the common efforts undertaking within the cluster), and

(d) "clearing house" functions (the role of cluster organisation is to moderate processes between industry, academia and policy with regard to skills development)

In this regard, the overall framework of skills development involves considerations of reaching quantitative and qualitative "critical mass" of workforce needed to sustain a given emerging industry.

It is also relevant to recognise the practice of some cluster organisations in forming "interest groups" or topic-based committees among their members. Such committees are often formed in areas such as regulatory affairs, finance, human resources and others. While such committee activities are not necessarily directed at skills building, the individual participants benefit from sharing knowledge, experiences and network contacts in the respective areas of interest. In the case of emerging industries, the role of the cluster organisations in skills development will depend on the mix between ongoing R&D activities and the level of readiness for manufacturing and marketing activities. Providing information on the level and detail of the current and projected needs on the part of a particular industry is a function the cluster organisations can carry out in close cooperation with related cluster actors.

Given that the long-term viability and attractiveness of a region or cluster will depend on the wider ecosystem in which it operates, the strategies for optimising skills development must incorporate considerations of the vertical and horizontal linkages of the relevant value chains. Any skills development efforts on the part of cluster organisations or other entities must thus allow for enabling suppliers and providers of professional services that may be considered "lateral" elements of the value chain.

[13] *Ketels, Memedovic, (2008): From clusters to cluster-based economic development.*

3. Status of Cluster Organisations Involved in Skills Development in Europe

This chapter analyses the service portfolio of cluster organisations related to skills development. The analysis is based on statistical data on service portfolio provided by the European Secretariat for Cluster Analysis (ESCA)[14].

Many cluster organisations across Europe offer services to their cluster members that aim for the facilitation of skills development. Out of the 473 cluster organisations that have been benchmarked by ESCA in the period January 1st, 2012 to February 15th, 2016, 401 (around 85 %) offer at least a limited number of services to facilitate skills development.

The most popular activities of cluster organisations are[15]:

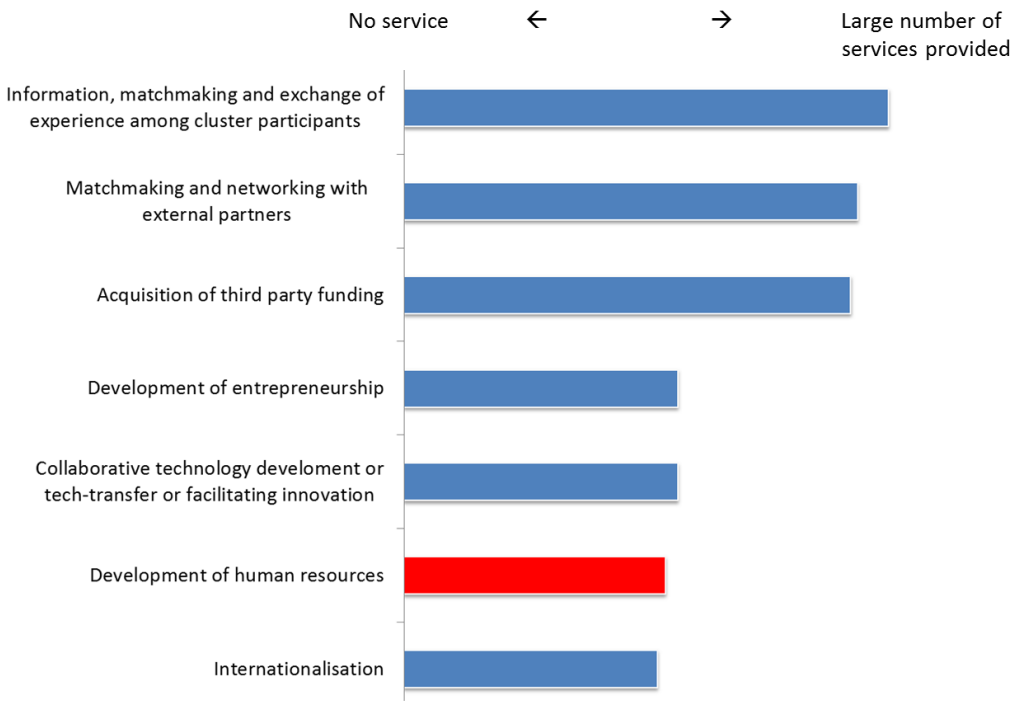
- Advocacy, promotion and lobbying
- Monitoring and intelligence gathering
- Sector analysis and projection of skills needs
- Design or implementation of direct training activities
- Collaboration with education institutions
- Matchmaking, placement and clearing functions
- Contribution to upgrading vocational training systems
- Contribution to upgrading curricula at universities

Although quite a high proportion of cluster organisations offer services in the field of skills development, the development of human resources is not among the priority areas (see Figure 1). In general, much more attention is given to networking, matchmaking, cooperation and acquisition of third party funding than to skills development.

[14] *Lämmer-Gamp, T. 2015: Clusterentwicklung durch Smart Specialisation und systemische Vernetzung von Politiken und Programmen. In: Institut für Innovation und Technik Berlin, 2015: Neue Formen der Kooperation in regionalen Innovationssystemen, Jahresbericht Vol. 7, S. 21, available at: http://www.iit-berlin.de/de/publikationen/jahresbericht-iit-vol-7.*

[15] *According to the survey the European Secretariat for Cluster Analysis, conducted in summer 2016 (based on 470 cluster organisations investigated).*

Figure 1: Service profiles of cluster organisations that offer activities to promote skills development



(0 = no services in this area → 4 = very large spectrum of different services and large number of services delivered). Source: Benchmarking data provided by the European Secretariat for Cluster Analysis (n = 401 cluster organisations, median value)

In terms of kinds of activities, the main areas in which cluster organisations are active include the design and implementation of specific training courses for workers within enterprises (42 %), followed by the recruitment of labour force and specialists for enterprises (27 %). Only 18 % focus on supporting the establishment of vocational training courses or study courses at universities and 13 % on other activities. It is interesting to note that skills development-related activities are more frequently included on the agendas of cluster initiatives driven by industry rather than by academia (s. Figure 2). Those clusters strongly driven by industrial actors offer a comparable high number of services relating to training, qualification of skills and recruiting of labour force. This fact provides evidence that industry is the key driver to measures related to skills development in clusters.

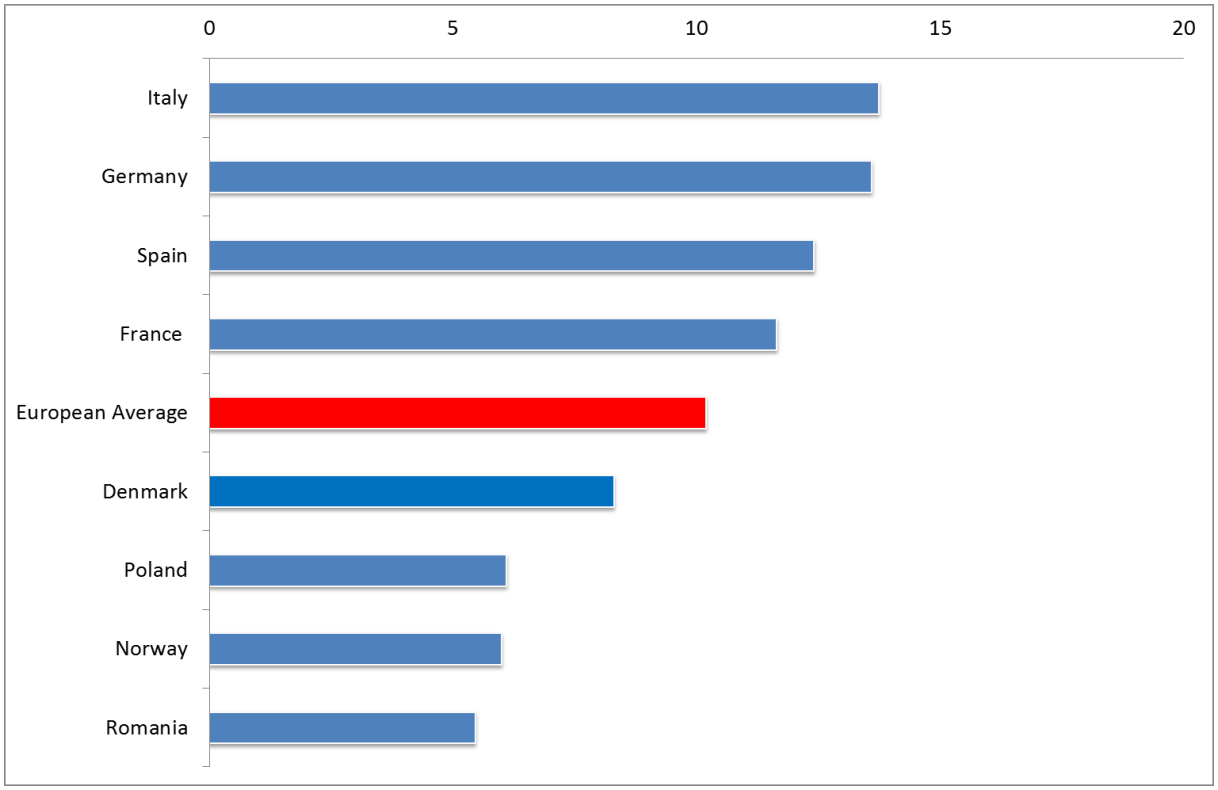
Figure 2: Industry involvement in agenda setting vs. type of skills development activities offered by cluster organisations

Industry involvement in agenda setting	Overall average	Training und qualification of workforces	Recruitment of specialists and executive managers for the participants	Contribution to establish vocational training courses as well as study courses at universities
Industry is very strong driver	3,0	3,9	3,5	1,7
Industry is strong driver	2,9	3,7	3,9	1,1
Industry contributes to agenda setting to a certain extent	2,2	3,2	1,9	1,5
Industry only occationally contributes to agenda setting	1,7	2,3	1,4	1,5
Industry is not involved in agenda setting	1,6	2,2	1,4	1,3

(0 = no services in this area → 4 = very high number of services delivered). Source: Benchmarking data provided by the European Secretariat for Cluster Analysis (n = 401 cluster organisations, median value)

Furthermore, there is a difference between the ways in which cluster organisations from different countries are addressing the topic of skills development. A comparable high number of activities in the field of skills development are above average in particular in cluster organisations from Italy, Germany, France and Spain. As there are different influencing factors for this pattern, further investigations are needed.

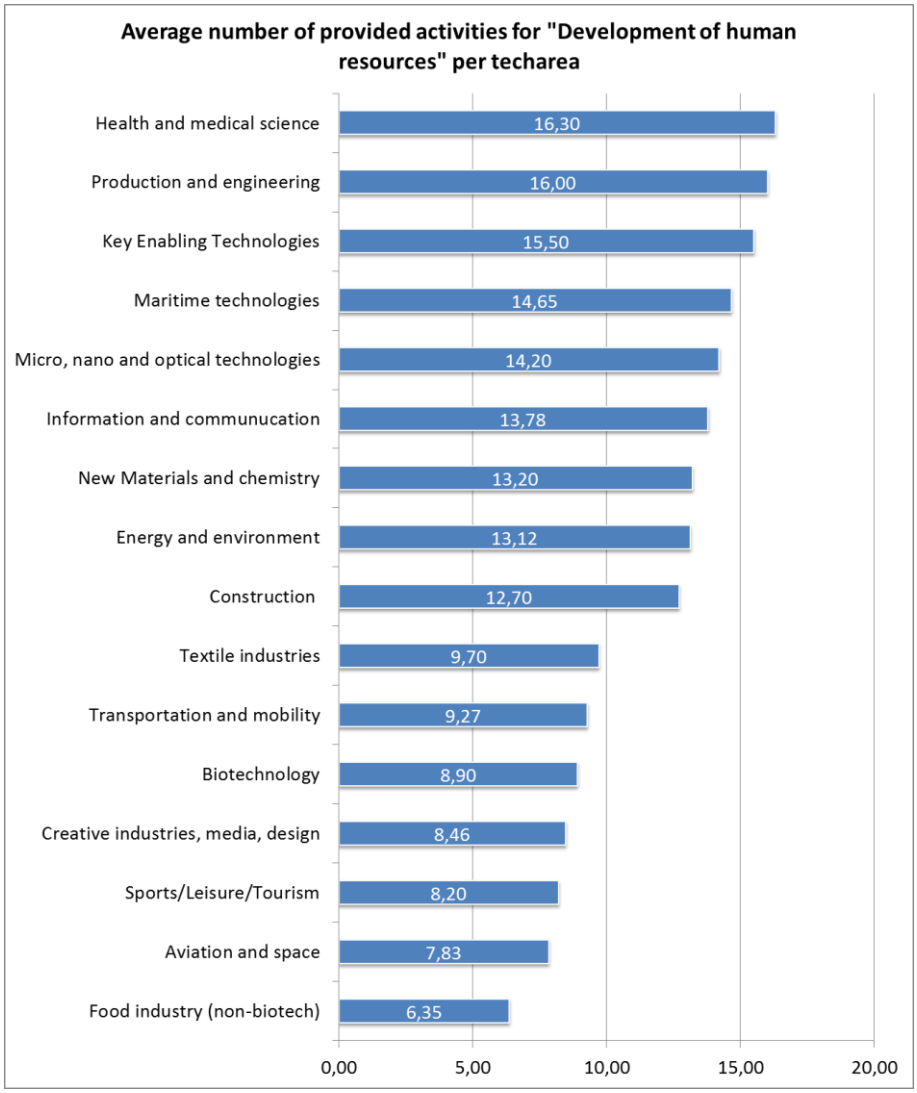
Figure 3: Number of services implemented by cluster organisations in the field of skills development per country (per year)



Source: ESCA database, min. 15 data sets per country available.

Differences in technology sectors also account for variations in the intensity of services around skills development. Cluster organisations are comparably active in areas such as Life Science, New Materials, Manufacturing or Key Enabling Technologies (s. Figure 4). These areas offer more activities for the development of skills than most other sectors. Industrial change is more prevalent in these industries leading to a continuous demand of skills development.

Figure 4: Number of services implemented by cluster organisations in the field of skills development per industry (per year)



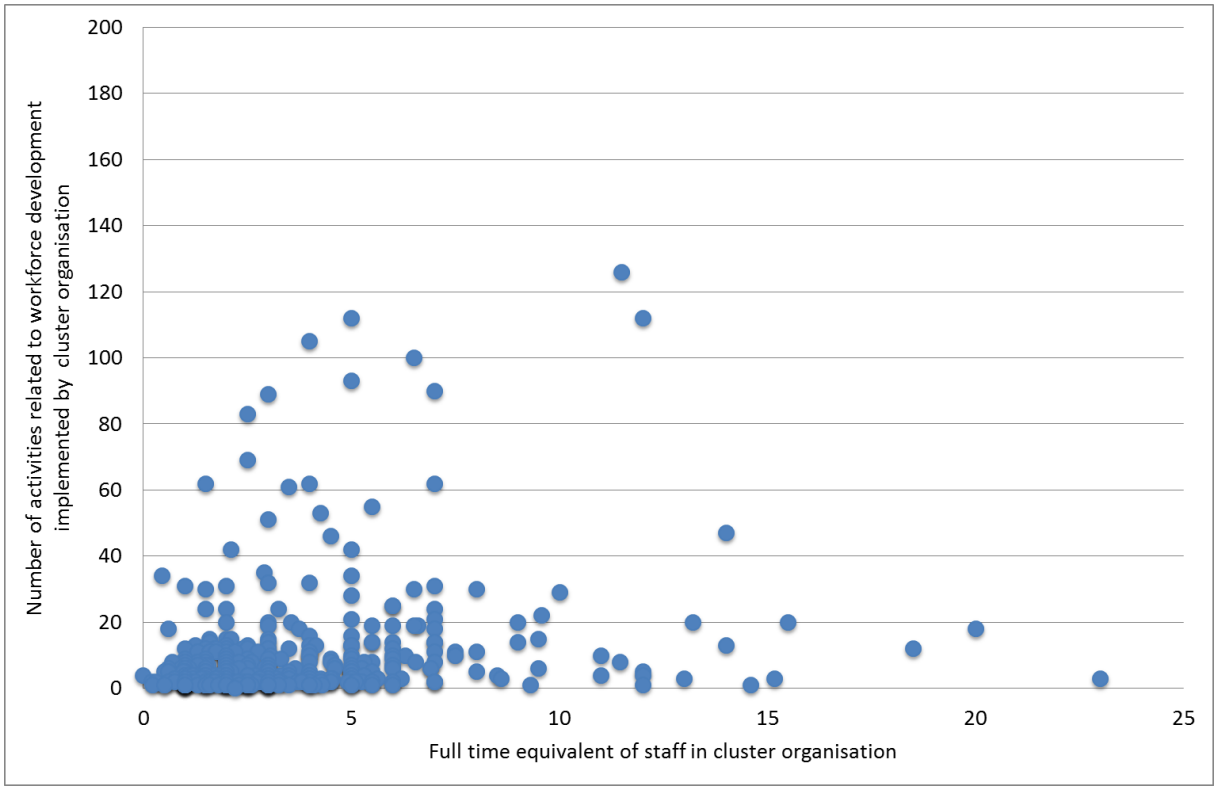
Source: Benchmarking data provided by the European Secretariat for Cluster Analysis (n = 401 cluster organisations, median value)

Since cluster organisations are active in different fields of skills development, it is no surprise that there are significant differences among the kinds of services that are offered. Cluster organisations in the field of Health and Medical Sciences, Maritime Technologies and Production / Engineering focus much more on training courses for workers in enterprises than others.

As far as the recruitment of workforce is concerned, cluster organisations from sectors like production / engineering, energy and environment as well as transportation and mobility are very active. Contributions to vocational training schemes or study courses at universities are mainly provided by cluster organisations in the field of micro, nano and optical technologies, new materials and chemistry as well as key enabling technologies, which drive the development of emerging industries.

The ability to offer a broad spectrum of activities strongly depends on the capacity of the cluster organisation[16]. Thus, one could argue that there is a higher likelihood that cluster organisations with higher numbers of staff tend to offer more activities related to skills development compared to those with less capacity. Figure 5 suggests that this correlation is not necessarily correct. There is no evidence that cluster organisations with higher numbers of staff offer more activities in the field of skills development than those with less staff (Figure 5).

Figure 5: Capacity of cluster organisation vs intensity of activities implemented in relation to skills development.



The number of activities is the sum of all activities implemented by cluster organisations over 24 months with regard to skills development. Source: Benchmarking data provided by the European Secretariat for Cluster Analysis (n = 401 cluster organisations)

[16] *Künzel, Meier zu Köcker, Köhler, Cluster and Innovation - Cluster-Initiatives as Driver for Innovation, Stuttgart, 2016, http://www.clusterportal-bw.de/service/publikationen/fachpublikationen-der-clusteragentur-bw/.*

4. Good Practices - How Cluster Organisations Contributed to Skills Development

In the following sections, three different "good practice" examples demonstrate how cluster organisations can contribute to skills development. Each of the three very different sectors selected belongs to the broad field of Emerging Industries.[17] The Aviation Hamburg example represents an emerging industry of (Logistical Services), where the convergence of technologies is the key driver of industrial change, resulting in ongoing demand for the skilled skills participants to continuously update their technological skills. The South Tyrolian case represents an Experience Industry example, which is an important Emerging Industry, where service innovations are the key drivers. The case demonstrates that skills development is not only a challenge in high-tech areas. The Massachusetts case reveals that cross-sectoral innovations in the Medical Technology sector give rise to entirely new demands for skills skills.

4.1. Aviation Cluster Hamburg

Home to over 39,000 aviation sector workers, Hamburg is one of the leading locations for the civil aviation industry. In 2000, the decision was made to expand the existing Airbus site in Hamburg to be the second most important location for the development and production of the Airbus A380. In addition, Lufthansa Technik, one of the world's leading companies for overhaul, maintenance and repair of aircraft, strengthened its base in Hamburg.

Not only Airbus, but also those companies working as aviation suppliers in the area were faced with major tasks and corresponding manpower requirements. New technological frontiers became a structural challenge for the education and labour market of the Free and Hanseatic City of Hamburg. As a partial response to this challenge, the Qualification Initiative Aviation Industry was founded under the auspices of the Economic Authority. The key objective for the aviation industry in the short, medium and long term was to be able to provide enough qualified personnel so as to strengthen the innovation capacity of the companies. Consequently, the cluster organisation of the Aviation Cluster Hamburg took over the responsibility to turn the key objectives into practice.

Example 1: Academic Skills Development

As a first measure, the cluster management developed, in close cooperation with the industrial cluster partners, an extraordinarily successful concept in accordance with the skills development. Within the initial five months, 30 non-specialist engineers and scientists were selected to be trained in the core subjects of classic aircraft design. The design of the training scheme was again coordinated by the cluster management. Additionally, adaptations were made in medium-sized engineering companies. The key departments of Airbus proceeded to define the substantive cornerstones of the new skills and the participants were selected by the company. Fifteen places were occupied by Airbus and the other fifteen were filled by small and medium engineering companies. The professors of Hamburg University of Applied Sciences (HAW) volunteered to develop a modular course concept along with the content details. The costs were shared by the cluster participants and the city. As can be seen, this approach was initiated by industry, coordinated by the cluster management and implemented as Triple Helix approach.

[17] *See the European Cluster Panorama 2016 that analyses and identifies ten emerging industries, available at http://ec.europa.eu/DocsRoom/documents/20381*

Initiating the necessary level of trust between the competing companies and universities within the cluster was a breakthrough for a new form of cooperation and development. The cluster management operated as moderator to facilitate communication and trust building among the actors. The development and production of the aircraft cabin for the Airbus A380 required a good deal of cooperation among all participants because of the unprecedented complexity of the tasks involved and the need for specially trained engineers who were in short supply. Therefore, the cluster actors aligned the training content of the starting programme with special courses on aircraft cabin and cabin systems design. Due to the successful start, a total of five courses for 150 non-specialist engineers were implemented for this purpose. In this manner, Aviation Cluster Hamburg became the Centre of Excellence for aircraft cabins in Europe and it attracted a bigger share of cabin production among the Airbus consortium.

To meet the continuing high demand for engineers for aircraft cabins, a new globally unique study programme were established in 2005 with a focus on cabin and cabin systems. This outcome is a result of a close cooperation between cluster enterprise, Hamburg University, the public sector and the cluster management. Twenty five additional academic places were created and Airbus supported this measure with the endowed chair "Architecture of the Aircraft Cabin." The economic authority further supported this initiative from structural funds for equipment needed for academic training in the cluster centroid.

The study and training slots at Hamburg University are in great demand. In the field of aircraft-related studies, the number of applications to the bachelor's degree courses is three times higher than the number of places available. The dual study programme carried out in cooperation with the participating air carriers is especially attractive for applicants. In addition to the higher education programmes, students can complete a dual degree with additional practice assignments in the factories during the holidays and during additional internship opportunities. Thus, they are optimally prepared for their careers.

Example 2: Professional Masters Programmes

The top cluster project “Simultaneous Engineering Education (SEED)” is under the project management of Airbus. This project develops concepts and strategies that represent innovative new training formats for academic training in a sustainable manner. SEED is funded by the BMBF top cluster project which is carried out in cooperation with the HAW Hamburg and Hamburg University of Technology (TUHH).

One of the project results is the systematic development of the Masters-level qualification via university-industry collaboration. The basic idea of the part-time technician training (namely the higher qualification with simultaneous continuation of employment in the company) has been further developed with the university partners HAW and TUHH for occupational academic training.

Since 2012, Airbus has offered part-time training in core competencies defined by top management. This is done in cooperation with local universities within the Airbus facilities in Hamburg, Stade, Buxtehude and Bremen. A concrete example of this is the close cooperation between Airbus and the HAW Hamburg Master Programme aircraft. Participants will have the opportunity to choose between different time models: either work at reduced current remuneration (Anspar model) in conjunction with a full-time study or work part-time in conjunction with part-time study. The programme includes a requirement to complete a scientifically-based study which closely follows the needs of industry. The completion of this study requires a flexible time model for working professionals. The first pilot run was launched with about ten Airbus engineers in winter of 2012/13.

The individual modules of the master's programme were designed to be offered in the form of individual specialist training at a later date. These modules are also made accessible to participants without being qualified for university entrance.

Example 3: The Hamburg Centre of Aviation Training

With the Aviation Industry Qualification Initiative, the cluster organisation has established a network within the Aviation Cluster Hamburg that includes all facets of education, training, university studies and recruitment. A milestone within the Aviation Industry Qualification Initiative was the Hamburg Centre of Aviation Training (HCAT). The HCAT is a private-public common undertaken and offers occupational and academic training programmes in key cluster technologies such as avionics and electronics, cabin and cabin systems, modern manufacturing methods and new materials brought together "under one roof".

At the beginning of the creation of HCAT, the need for additional capacity and new training content was focused on the field of training and adaptation skills, which was the result of a common need analysis among cluster actors, moderated by the cluster management In addition to the already established field of aeronautical technician, new emphasis was given to Avionics – which also became a very successful semester model. The required seminar and computer rooms were created within the first stage of HCAT.

In the second stage of the HCAT, Lufthansa Technical Training (LTT) and Airbus endowed workshop rooms for structure repair and composite manufacturing. This additional capacity was created for adaptation training, and was based on the latest technological standards. In addition, Airbus presented a 16m-long fuselage segment of an Airbus A300. This equipment is made available for training on cable installation.

A large area in HCAT is the laboratory for cabin and cabin systems. With this lab, Hamburg University receives a quality laboratory infrastructure with a focus on aircraft cabin systems. The practical laboratory training is a quality seal and an essential building block for vocational training for students of Hamburg University.

Summary for Hamburg

Innovations can be neither planned nor ordered, but rather the structures and conditions must be created to facilitate and promote innovation. This includes skills and skills development. The example has been selected as a good practice how a cluster organisation can become a key moderator in the process of continuous skills development strategy within the Aviation Cluster Hamburg. It also shows that a systematic approach is needed, which far beyond isolated training activities. As far as Hamburg Aviation Cluster is concerned industry and the public sector heavily invested in new training facilitates and training schemes. Academia understood this trend and significantly contributed accordingly. The cluster organisation was always in der driving seat by identification of the industrial needs and by moderating the process of implementation of skills development activities. In Hamburg, the skills qualification campaign was, to a certain extent, the nucleus of the "Initiative aviation industry", which was founded in 2001 by business, science and the Senate of the Free and Hanseatic City of Hamburg. The Aviation Cluster Hamburg Metropolitan Region has won recognition as one of the first five clusters in the top cluster competition (Spitzenclusterwettbewerb) of the Federal Ministry of Education and Research (BMBF).

Through the cooperation of universities, vocational schools and companies, the mental barriers associated with clusters were broken down and a level of trust was created. Thus, the way was prepared for fluid and novel educational concepts that interlink different skills levels; in particular, vocational training, academic education and in-service training. These innovative training concepts contribute significantly to efficient capacity building in the cluster.

4.2 South Tyrolian Wellbeing Cluster

Increasingly, service innovation plays a significant role in upgrading traditional economic sectors and industries into more productive, competitive and high value-added business eco-systems. Especially in the area of Experience Industries, which comprise companies whose activities supply innovative products and services to provide customers with 'experiences' that stimulate emotions and senses, move, entertain and surprise, thrill, enthuse and involve"[18], service innovations are of high importance.

Experience Industries is one of the most important areas in the South Tyrolean economy. The more than 10.000 accommodation companies provide guests with over 200.000 beds. In 2015, companies reported more than 5 million arrivals and 28 million overnight stays with an average, daily per capita spending of around EUR 120 that results in an annual tourism turnover of more than 3 billion euros results. Due to the strong increase of tourists and the changing demands from the tourist in the recent past, there was a continuous pressure on Experience Industry in South Tyrol, to offer new innovative services. Among others, this led to a critical shortage of qualified and skilled workforce in the region. The challenges were twofold: firstly, the quality of the skilled workforce and, secondly, the size of the workforce available.

The Wellbeing Cluster South Tyrol

Within the Wellbeing Cluster South Tyrol, there is a long-standing tradition of using natural resources for health-giving purposes to provide service innovations for the tourists. When analysing these trends in the region, it became obvious that tradition-based service innovations were gaining importance. At the same time, tourists yearn more and more for regionally sourced authentic products. South Tyrol companies working in the Experience Industry sector and who were cooperating within the Cluster "Health & Wellness" have been making sustainable and profitable use of these trends. New service innovations have been developed from natural local resources, while traditional Alpine practices which had largely been forgotten are being rediscovered and brought to market. The cluster contains 100 members, mainly family-managed SMEs. The focus of the cluster is to jointly create service innovations, strengthen cooperation among cluster actors, and share information and training. However, the new products and services required new skills on the part of the local workforce. Such skills were not easy to gain.

The Overall Approach and Related Actions

Previously, when the growth trend of the Experience Industry South Tyrol was predictable and mainly driven by new and innovative experience-based services, the cluster actors and the cluster organisation of the South Tyrolian Tourism and the Wellbeing cluster agreed on a common undertaking to better cope with this shortage of workforce. The cluster organisation initiated, in close cooperation with the private and public cluster actors, a strategic approach to enable businesses to access appropriately-skilled staff in requisite numbers to ensure that operations remain productive and sustainable and are able to meet rising consumer expectations. It was obvious that all cluster actors had to work together to create and promote the plethora of possible career pathways. A holistic approach was needed to succeed in the long run. Attracting, training and retaining people from a broad range of labour sources into quality workplace environments would empower the regional businesses to meet their potential and maximise the opportunities that the growing demand for new experience industry-based services provide. The lack of up-to-date and certified vocational training courses additionally hampered efforts to get young people motivated.

[18] *https://ec.europa.eu/growth/smes/cluster/observatory/cluster-mapping-services/cluster-panorama_en*

The common brainstorming of the cluster actors, moderated by the cluster management resulted in three focus areas—or pillars—to be underpinned by a series of actions that would have an positive impact. These were:

- Labour supply (that local businesses have access to appropriately-skilled people in the requisite numbers)
- Building capability (improving skills, leadership and management)
- Quality issues (measures to increase the quality of skill-based outcomes through improving the quality of delivery and assessment as well as certification)

In the beginning, *information campaigns and thematic workshops* were implemented to inform about the skills requirements and existing quality issues in order to increase the awareness of the family business to invest in training and quality improvement of the existing staff.

In a second step, a core group of family businesses developed a set of quality criteria for the most important services offered by cluster actors. The cluster organisation moderated and triggered this process and ensured that all mandatory actors be involved.

In a *third step*, a vocational training scheme was jointly developed, which also contained a personal certification approach to assure higher attractiveness for trainees to participate.

Example: Certified Traditional Medicine Practitioners

The basic principles of Traditional European Medicine are based on a series of treatment and healing methods which have been handed down and which have arisen over thousands of years in the European cultural area. However, the quality of service providers within the cluster has varied greatly. In addition, the attractiveness of jobs in this field has been limited due to a lack of recognition of any kind of related education.

In a first step, the cluster organisation, together with key actors from the cluster, implemented awareness campaigns to improve the image of Traditional Medicine and related services. This was needed since many companies were reluctant to follow the demands of clients and were reluctant to offer such services. In *a second step*, curricula and training courses were designed to develop updated and internationally certified schemes in order to assure a sufficiently qualified workforce in case of a broader implementation of the new innovative services. Due to the international recognition of the educational offerings in this field, more young people volunteered to undergo this training. In a third step, once the certified training scheme was established, all of the interested cluster actors (especially those interested in implementing these applications in their own service portfolio) were invited to participate in various kinds of seminars and training courses in the area of Traditional European Medicine. International visibility of the South Tyrol as an international Wellbeing Innovation Hub was achieved as a result of organising national and events related to this topic. *Finally,* additional measures were implemented by the cluster organisation to support interested cluster actors to further develop products and services based on Traditional European Medicine. Various cooperation measures were initiated.

Summary for South Tyrol

During the last few years, good progress has been made to improve skills development in all pillars. Quick success was gained in some areas that motivated even more cluster actors to support the overall approach. The cluster organisation was able to provide added value in this regard and strengthened its role as key coordinator. The increased number and skills-level of related workforce participants also led to a couple of service innovations which further strengthened the position of South Tyrol as a leading hub. Due to this great success, the cluster actors also started to follow the same three pillar approach in other service areas. The South Tyrolian example reveals that also in non-high-tech areas workforce development is a key component of cluster-based efforts to offer new innovative services.

4.3 Life Science Cluster Massachusetts

While the state of Massachusetts in the U.S. is well known for its world class life science cluster, it also has a long history of early success in traditional industrial manufacturing. There are well-known examples of textile manufacturing, machine tools production, furniture making in the western regions of the state; leather tanning and others. At the same time that many of these activities were migrating to areas of the world with lower labour costs, these industries were slowly being replaced by knowledge-based economic activities spurred by national defence investments and related innovations in electronics, computing, new materials, life sciences and others. The following paragraphs briefly highlight some of the strengths and conditions in Massachusetts that contribute to skills development for innovation in the state with specific reference to field of life sciences. Observations are made to various incentives for research, on-the-job training and other factors relevant to skills development efforts in the life sciences. Compared to the Hamburg Aviation Cluster example, there was not one cluster organisation that took the lead in initiating skills development related actions. Rather, there were several entities in Massachusetts that significantly contributed.

Massachusetts institutions received EUR 70 million in National Institutes of Health (NIH) grants in 2015 to train the next generation of innovative scientists. A total of 111 Massachusetts businesses received NIH funding totalling EUR 100 million for the research and development of technologies with potential commercial applications[19].

Growth of life sciences: The impressive growth of the life-sciences cluster in Massachusetts can be traced to the world-class standing of the research hospitals associated with the top universities and related brain pool in the state. Enabled by highly competitive federal research funds from the NIH and related agencies, the life-sciences sector in Massachusetts has thrived with continuing innovations in medical devices, robot-assisted surgery, bio-pharmaceuticals, diagnostic tools, telemedicine, digital medicine and other sub-fields.

In the overall life-sciences area, during the 2015 fiscal year, Massachusetts institutions received more than EUR 2.2 billion in competitively awarded grants from NIH[20]. From the human resource standpoint, such funding (awarded at similar levels each year on an increasing basis) reflects the consistently high quality of the principal researchers and participating research teams. As a major centre for clinical trials, the state enjoys a global reputation for leading-edge treatments and revolutionary discoveries in life sciences. In addition to the multi-tiered education and training programmes for life-science professionals and support staff, Massachusetts attracts many talented persons from outside the state and outside the country.

[19] *(www.report.nih.gov).*

[20] *www.nih.gov.*

Regional context of life sciences in Massachusetts: The global nature and dynamics of technology research and commercialisation activities associated with the life sciences are well recognised. However, it is necessary to acknowledge the types of local conditions associated with regional clusters where such activities take place. In Massachusetts, the regional development context is constantly changing and evolving in accordance with the growth stages and diversification of the knowledge-based industries. In terms of the life sciences, a good portion of the activity is concentrated in the Boston / Cambridge area in the eastern region of the state as well as in the Worcester area in the central region of the state.

Part of the challenge for policy makers has been to provide local enabling conditions for this technology-intensive effort to thrive. Another part of the challenge has been to address the evolving array of public issues arising at each stage of development.

For purposes of reviewing skills development in the life science cluster in Massachusetts, the key questions posed are: Who are the key actors and stakeholders in innovation efforts in Massachusetts? What are the principal enabling factors and related skills development policy issues? How do leadership roles rotate? How do the public and private sector dynamics shape the life science cluster and related innovation "ecosystem"?

Sector interaction: First of all, one must recognise the actors and the sectors that comprise the governmental, academic, industrial and general public in Massachusetts. Each of these sectors can be further disaggregated into distinct levels and types of entities. In the government sector, there are federal, state, municipal and regional agencies. In the case of the federal government, the federal procurement policies have greatly benefited Massachusetts over the years in areas associated with technology advancement in electronics, software and control systems. The federal government's Small Business Innovation Research Programme[21] is associated with several different federal agencies and has made an important contribution to the state.

In the biotechnology area, for example, several of the federal government agencies have a direct or indirect impact on the innovation trends relating to the sector[22].

In the academic sector, there are universities, community colleges, research institutes, teaching hospitals and technical schools. Each of these levels plays a significant yet distinctive role in human resource development and capacity building. In the industrial sector, it is relevant to consider distinctive innovation-related roles played by large, medium and small firms, service providers, commercial R&D, manufacturing and business associations. To understand the role of the general public as a sector, it is helpful to stratify the various "publics" according to the particular technology issues they focus on and their respective levels of activism.

Structural-functional adaptations: Another key consideration in observing the environment for life science workforce development in Massachusetts is that the above-named sectors have dynamic interactions that cut across organisational boundaries and evolve over time. In this regard, certain structural and functional adaptations can be observed in each sector. At Massachusetts universities, for example, some of the structural adaptations have involved the creation or expansion of technology licensing offices, patent policies, conflict of interest provisions, industrial liaison offices and others. Some of the adaptations at the state government level have included the formation of dedicated offices and programmes for innovation stimulation, special fiscal instruments, locational incentives as well as workforce development. In recent years, a particularly important workforce development measure

[21] The Small Business Innovation Research (SBIR) programme is a highly competitive programme that encourages domestic small businesses to engage in Federal Research/Research and Development (R/R&D) that has the potential for commercialisation, www.sbir.gov.

[22] like National Institutes of Health, National Science Foundation, Environmental Protection Agency, Food and Drug Administration, Department of Defence, Department of Energy Department of Agriculture, Department of Commerce, National Institute of Standards and Technology or Economic Development Administration

on the part of the public sector has been with regard to adjusting the "non-compete" provision in the state law that previously inhibited the ability of qualified professionals to accept a position with a competing company. Other adaptations that can be observed in the private sector include the creation of specialised trade associations, industry consolidation, partnerships with large industry, proliferation of professional services and more.

Inter-industry dynamics: General workforce development in Massachusetts has been driven in large part by the nature of the types of industries in the state. In addition to selected areas of life sciences such as biopharmaceuticals, diagnostics and medical devices, these have included others like aerospace, defence, semiconductors, computers, and related fields. Certain well-known anchor companies have served Massachusetts in this regard. It is recognised that the vertical integration of industries like those mentioned above has been changing over the last several decades. Because these industries deal in products with high proprietary content, high knowledge content and high information content, they require advanced skills levels, high product quality and rapid response to market trends. The larger companies have continuously increased the outsourcing of much of their production and have increasingly relied on suppliers to drive the innovation process. It is important to consider how knowledge and sources of innovation flow between key participants within the manufacturing innovation ecosystem.

Qualified human resources as a critical enabling factor for life sciences research, development and commercialisation: According to the Massachusetts Biotechnology Council, employment in the biopharmaceutical sector in Massachusetts increased by 4.2 % in the calendar year 2015[23]. From the public policy standpoint, the presence and growth of a solid and growing core of qualified human resources in the life sciences in Massachusetts is considered to be a key enabling factor for the success of the sector. The pool of highly trained men and women involved in upstream research represent a wide variety of basic and applied disciplines. Similarly, as the life science cluster has expanded and diversified, new professional disciplines are now represented in downstream activities of bioprocessing, separations, quality control / quality assurance and others.

[23] *www.MassBio.org.*

Key actors and drivers involved in the process of human capital formation: Massachusetts is home to 114 colleges and universities, many of which are among the top-ranked research universities in the country as well as internationally. In addition to providing leading-edge training and education to the state's human resource base, these university institutions are engines of novel discoveries in virtually every field of science engineering and technology relevant to today's competitive global challenges. As engines of continuous innovation, selected universities and research hospitals in Massachusetts have been the source of new start-up companies, many of which have grown to be significant players in the state's innovation economy.

While one can look to the public and private universities, colleges, hospitals and clinics in Massachusetts as the primary source of human capital formation in the state, it is equally as important to note the role of the life science companies themselves. Companies involved in drug development, diagnostics, pharmaceuticals, biotechnology, medical devices and related areas provide critical professional experience at all levels and in all disciplines of relevance to the life-sciences cluster. Additionally, both large and small companies participate in industrial internship programmes that allow undergraduate and graduate students participate in corporate activities under supervision of mentors. One such internship programme is sponsored by the Massachusetts Life Science Center. The programme, called the "Internship Challenge", is a skills development programme directed at the goal of enhancing the talent pipeline for Massachusetts life science firms. This effort helps to place students and recent graduates in paid internship positions at selected companies. Under this programme, the Massachusetts Life Sciences Center will reimburse the host company for part of the salary paid to the selected interns.

Selected policies, programmes and places affecting qualified human resource development: In the area of public support for biomedical innovation, the Massachusetts Life Sciences Center (MLSC) is among the highest profile state sponsored initiatives. This Center manages a EUR1 billion Life Sciences Initiative which offers several incentives programmes[24]. Among these are the following: The Cooperative Research Grant programme is designed to support industry-university cooperation. Through a competitive process, these university grants of EUR 220,000 per year for up to three years require that the industry partner provide a matching amount. The Accelerator Loan Programmme can provide up to EUR 650,000 early-stage life science companies to help obtain investment capital[25]. Additional programmes of this agency are designed to enable internships at companies and others are designed to provide tax incentive benefits on the basis of projected job creation impact of applicant companies. Other general tax credit programmes are also available to qualified companies through the Mass Tech Collaborative and MassDevelopment. These include the Workforce Training Fund[26] which provides grants up to $100,000 to improve the skills of new or incumbent workers.

Role of cluster organisation in skills development in the Massachusetts innovation ecosystem: The concept of an innovation ecosystem in Massachusetts has been much discussed as a key factor in the success of start-up enterprises and new product introduction. Reference is continuously made to actors such as trade associations, professional services such as lawyers and accountants, investment community, press and communications media, public interest groups, patient advocacy groups and others. While this is only a partial list, the important observation here is with regard to the diversification of the groups and their respective roles within the innovation community. State-sponsored agencies such as MassDevelopment, the Massachusetts Life Sciences Center, Massachusetts Technology Collaborative and others all address different niches of associated with the innovation process at different stages of the cycle. **Cluster organisations** such as the Massachusetts Medical Device Council (MassMedic) and the Massachusetts Biotechnology Council (MassBio) have also sponsored special skills development efforts.

[24] *www.masslifesciences.com.*

[25] *ibid.*

[26] *ibid.*

In the case of MassBio, it has set up the Massachusetts Biotechnology Education Foundation (MassBioEd) which is dedicated to the engagement of teachers and students in support of the life sciences workforce. The Foundation also sponsors a Job Trends initiative which identifies workforce needs and enables preparation for careers in the life sciences. Over the years since its establishment, MassBioEd has taken initiatives to (a) provide guidance on career pathways in biotechnology; (b) monitor and report on job trends in this field; and (c) provide training programmes and workshops for corporate professional development.

Indirect effects of cluster organisation activities should also be recognised in terms of their contribution to skills development. In the cases of both MassBio and MassMedic as cluster organisations, their advocacy activities with the public agencies and with the legislative bodies result in promoting the general enabling conditions that sustain the life sciences sector and related employment opportunities. These cluster organisations also sponsor yearly conferences which highlight the current issues facing their respective industries, including qualified workforce recruitment issues. Similarly, the day-to-day activities of these organisations also contribute to the recruitment and establishment of life science companies that further expand employment opportunities and skills development incentives.

Summary for Life Science Cluster Massachussetts

The case of the Life Science Cluster Massachussetts illustrates how a sector, comprised by the governmental, academic, industrial actors and general public in Massachusetts, was able to jointly contribute to the increasing demand of skills development. Key actors and drivers were actively involved in the process of human capital formation, whereas cluster organisations played an important, but more indirect, role by advocating activities that resulted in promoting the general enabling conditions that sustain the life sciences sector and related employment opportunities

5. Conclusions

The timely development of qualified workforce for emerging industries primarily occurs on the basis of current and projected labour market demand. The skills requirements of emerging industries such as medical devices, digital industries, blue growth, mobile technologies and similar fields are evolving and adapting at the same time that the industries themselves are evolving. In this regard, skills development efforts for emerging industries present multiple facets and stages.

Government efforts to support and enable the development of the corresponding workforce at each stage of development must understand the nature and dynamics of the emerging industry of interest. However, governments often act as risk takers to invest at a much earlier stage than industry would act. Timing of capacity building efforts is a critical factor for purposes of achieving and maintaining the level of competitive standing required remain at the forefront of innovation. Equally important are the tools needed for monitoring the conditions, indicators and trends associated with assuring the availability of qualified professionals and support personnel. This paper puts forth the argument that corrective functions involving promotion and advocacy for training and education are increasingly assumed by cluster organisations in association with government agencies. The paper also points out how cluster organisations can also serve as a “clearing house” for linking the available talent pool to employment opportunities. Cluster organisations in Europe and in the US are carrying out a variety of functions in support of skills development for emerging industries. The inclusion of many of these functions can depend on the status and advancement of the overall “ecosystem” in which the cluster organisation operates. In reviewing the activities and impact of cluster organisations with regard to skills development, it is essential to keep in mind that the availability of qualified workforce can be considered to be **the** most important factor in determining the success of the industry cluster in question.

The case examples described in this discussion paper serve to illustrate the dynamics among those skills development efforts directed at research and those directed at knowledge-based product manu-

facturing. Emerging industries of relevance to Europe require a balance between the two. Furthermore, the sample analysis of cluster organisations in both Europe and the US described in this paper reflects the fact that the respective activities relating to skills development correspond to the particular stage of advancement of the industry cluster itself. At early stages, it is often the case that the most significant impact is in raising the profile of the emerging industry and in framing policy-level issues relating to job creation, competitiveness and general economic development. At later stages, the focus can shift to assuring the availability of training and education programmes.

Workforce training and education functions are carried out in both a direct and indirect manner. As illustrated by the sample models reviewed in this paper, cluster organisations work with existing educational institutions to promote **training activities in fields of interest to the particular industry sector**. In this context, cluster organisations themselves often provide certain types of training on a limited basis. Such programmes can evolve over time and are often financially supported by selected government entities. Subsequent stages of skills development interests on the part of cluster organisations will continue to involve ongoing monitoring of trends and facilitation of employment connections via on-line postings and job fairs.

Another important field where **cluster organisation provide added value is the field of recruitment**, especially in regions where is a significant shortage of skilled workforces. As cluster organisation-sponsored conferences and meetings often include opportunities for recruitment and job-oriented networking, these events will continue to be relevant to the process of skills development for emerging industries. Also, as national and international labour migration continues to evolve, it will have a growing influence on value-chain patterns and workforce configurations. This will invariably affect the role of regional cluster organisations and their approach to the skills development issues addressed in this discussion paper. Finally, it is of interest to consider the skills development needs of the evolving value-chains associated with the emerging industries and the role of the cluster organisations and corresponding public policy initiatives.

The main consideration for policy makers is how policy will use cluster organisations in the context of smart specialisations and skills development in years to come. Not much experience exists at the moment. There is a strong need to share experiences and lessons learned across Europe, not only on the policy level but also at the cluster management level. Thus, an EU expert working group focused on clusters and skills development might help to structure the process better in order to support industrial renaissance, skills development and job creation in the EU.

For further information, please consult the European Cluster Observatory Website:

http://ec.europa.eu/growth/smes/cluster/observatory/

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