Taftie
The European Network of Innovation Agencies

Future Competence Centre Programmes

Report of the TAFTIE Task Force on Competence Centre Programmes CompAct

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Executive Summary

Competence Centres (CC) can be defined as structured, long-term research and innovation (R&I) collaborations in strategically important areas between academia and industry/public sector. They focus on strategic research agendas, support strong interactions between science and industry and provide truly collaborative research with a medium to long-term perspective.

Competence Centre Programmes (CCPs) are usually major initiatives within their national innovation systems. Several TAFTIE members launched this specific type of programme to support CCs with public funding. Some programmes as well as centres exist already for almost two decades.

However, new trends and challenges are influencing these programmes: globalisation requires new international approaches and national innovation system actors are confronted with several challenges and demands such as new ways of innovating, more flexibility, more risky and radical research and balancing between market orientation and scientific excellence.

Against the background of such a changing global R&I landscape, the Task Force focused on the enhancement of the next generation of CC programmes, also including important aspects of internationalisation.

The Task Force offered TAFTIE members an overview of the potential scope and use of CCPs and covered a joint and better future development of these programmes as well as the sharing of experience and good practice to be considered for future implementation.

Characterisation of Competence Centre Programmes (CCPs)

By comparing logic models of all CCPs in the Task Force in terms of their expected medium-term outcomes and long-term impacts most important similarities and differences among the programmes were identified.

The analysis showed that virtually all CCPs seek to strengthen the **economic competitiveness** of their country by increasing the innovation performance of its national industry. Only a limited number of CCPs emphasize a particular focus on SMEs and employment. Additionally, some CCPs explicitly mention a renewal of industrial branches, indicating that the programmes in these countries have a strong transformative agenda concerning existing industries. Also, a number of CCPs aim at increasing the attractiveness of the national innovation system for international actors and respective foreign investments.

The overriding operational objectives of most programmes are to **strengthen the cooperation culture between science and industry** and thereby increase innovation and foster economic growth. Sectoral co-ordination and co-operation is part of many of the programmes key objectives, whereas internationalisation of R&I and increased international visibility are only to be found in some of the programmes.

Some CCPs emphasize in particular the long-term orientation of private R&D, whereas others set a stronger focus on commercialisation of public R&D results, knowledge transfer and creation of new business ventures/spin-offs resulting from public R&D activities.

Core activities of CCPs at the centre level are the development and operation of research programmes in strategic and multi-firm projects.

- CCs perform distinguishable activities separate from the operation of the R&D programme and focus on:
- Exploitation of research results by means of IPR and spin-offs
- Training of PhDs and master students
- Dissemination of research results via publications, conferences etc.
- Stimulation of networking and knowledge transfer
- Acquisition of third-party funding (incl. EU sources)
- Provision of research infrastructures
- Provision of market intelligence

Further significant differences relate to the types of activities funded and target groups.

Analysis of CCPs

The first generation of CCPs have been established at the mid of the 1990s in Europe, hence in some countries already the second or third generation of CCPs exists. The introduction of CCPs usually had been based on specific needs and the coherence with the national policy mix but also on previous (international) experience. Several countries established different programme strands in order to meet diverse needs and networks of multi-actor science industry collaboration.

On this basis commonalities and differences among CCPs can be observed.

TAFTIE members represented in the Task Force showed significantly different policy mixes and funding instruments. This observation applies to national differences concerning focus and balance of national support mechanisms and funding instruments along the innovation chain, infrastructure measures, project funding or institutional funding but also the balance between thematically open versus thematically focused funding. Furthermore the size of the home country of each CCP needs to be considered.

1. Size and duration of CCs

The average size of CCs is significantly different amongst the CCPs observed. CCPs support the medium- and long-term coordination of collaborative research and innovation activities among a limited and defined number of partners. It seems that larger CCs are typically organized as independent entities.

Larger CCs are often located in countries with smaller HEI and RTO structures. Furthermore it is interesting to see that CCPs supporting large units have been introduced since 2005. CCPs more recently launched support smaller units. Often the largest centres are predominately industry led.

Usually CCPs support time-limited research organisations. However, Competence Centres can be differentiated by their intended duration and continuity. While in some countries CCs have successfully evolved through more than one programme generation, other CCPs followed a more rigorous interpretation of duration.

In some cases the duration is not pre-defined; however, it depends on evaluation results (open-ended). In other programmes a duration of 10 years or more is foreseen.

It can be expected that larger units need more time for constitution and establishment processes. With this in mind a plausible correlation between duration and size can be observed.

2. Policy level

Most of the CCPs are managed at the level of the national government. However, depending on each country's structure, in some cases the regional level is involved.

With few exceptions the policy principals of CCPs are national ministries or authorities. Reflecting the objectives concerning science-industry collaboration and mobilizing or paving the way for industrial innovations the majority of CCPs are run by ministries for economic development or industrial policy. Often the ministries of science and research policy and economic and industrial affairs are involved.

3. Strategic orientation: industry and academia

The CC approach has a dedicated bridging function in the innovation chain. The collaboration between academia and business has always been much more complex than bringing the right partners together and motivating the commercialisation of research results.

Discussions at the European level frequently use the concept of Technological Readiness Levels (TRL) in order to illustrate the positions of institutions and programmes. The CCPs represented in the Task Force cover a wide range of TRLs (from 3 up to 7). Overall, however, the positioning of CCPs is not only defined by the maturity level of the technologies developed but also by the need for medium to long-term strategically coordinated R&D collaboration between academia and business at different level of the innovation chain.

A range of different interests and motivations (academic, economic but also institutional) have to be considered which can also change over time. The forms of interaction are going beyond the collaboration in well-defined projects.

The specific position and focus of CCPs depends on the institutional setting of national innovation systems and the underlying policy mix and environment. The challenge of balancing interests and incentives between academic and industrial partners might be much more relevant and present in the context of medium or long term research agendas of CCs than in the context of short term collaborative projects.

The analysis shows a weak correlation between the average funding rate and a leading role of the academic side. While funding rates are defined by EU state aid rules they are also a function of national funding frameworks.

4. Selection process and evaluation

The selection mechanism of all CCPs observed was call-based (in most cases a two-step approach). In all cases external experts have been included, in some cases in a panel or commission, in some cases as individual peer evaluators.

Within the Task Force one group of CCPs incorporates a bottom-up approach and is thematically open. While another group shows pre-defined thematic corridors coordinated with national priorities and needs. This means that in some cases application was restricted to certain actors/sectors, which were invited to participate.

In all CCPs evaluation and monitoring procedures are foreseen. They follow national procedures and put different weight to peer reviews/panel assessments and Key Performance Indicators.

Governance Models of CCPs

The organisational setting and governance of CCs have significant influence on collaborative arrangements, strategic focus and investment. Thus, a set of basic governance models for CCs was derived from the analysis as well as from the previous experience of the group. Following

models were used as analytical categories for summarising the key findings: “Management” Model; “Strong Entity” Model and “Host” Model

Model A: The “management” model

In model A an administrative unit receives the funding and organises the individual research projects which usually result from additional calls outside or inside the centre. These centres tend to be selected top-down (e.g. by sector structures), they tend to be more industry-driven and show some similarities to cluster activities.

The following main features of model A were identified: Top down decision e.g. by using a sector structure; research is organised through an intermediary, the administrative unit; the centres are virtual and make use of an existing infrastructure; they cover no or lesser levels of educational aspects; IPR follows the projects (on a case-by-case decision).

Policy goals more strongly related to this model: SME involvement, joint programming and international competitiveness of the companies involved.

Model B: The “strong entity” model

In model B the “full” centre – including research projects – receives the funding. The centre has its own employees and is usually based on a strong legal entity (e.g. ltd. company). The funding decision usually results from an open call. These centres are selected bottom-up.

The following main features of model B were identified: Bottom-up decision by open calls; Strong legal entity (Ltd.); the centres show less flexibility due to their legal structure; they invest in own infrastructure (or share with others); they cover more educational aspects than model A; they have a long-term perspective and a rather narrow focus (e.g. because of branding reasons); these centres are more difficult to exit/close down.

Policy goals more strongly related to this model: to strengthening of cooperation between science and industry, to increase the innovative capacity of enterprises, to sustain employment and turnover.

Model C: The “host” model

In model C a University or RTO usually acts as host. These centres tend to be more science-driven. They neither have a strong legal entity nor have own employees. The funding decision usually results from an open call. These centres are selected bottom-up.

The following main features of model C were identified: Bottom-up decision by open calls; consortium structure, no legal entity; easier to tap into other research funds (e.g. H2020); educational aspects are important; they have a long-term perspective; the academic culture/agenda makes it less flexible; these centres are easier to exit.

Policy goals more strongly related to this model: to strengthen the cooperation between science and industry, scientific reputation, economic impact – turnover/employment and increase private investments in R&D.

Monitoring and Key Performance Indicators (KPI) for Competence Centre Programmes

Due to the responsibilities associated with the provision of public funding, the programme management of CCPs has a duty to ensure high quality performance and best value for money. Creating adequate monitoring systems is an important task in this regard. The provision of

monitoring data and Key Performance Indicators (KPI) serves the purpose of scientific and financial control. Monitoring data also informs evaluations on key achievements of the programme.

When designing monitoring systems of research and innovation programmes, key user needs should be taken into account. In the case of CCPs, four types of stakeholders with different needs concerning performance information can be differentiated: programme owners, programme management, centre management and evaluators.

In designing monitoring systems for CCPs, the TAFTIE working group recommends that the logic models of CCPs should serve as a starting point for devising indicators that inform the different stakeholders about the different functions of the programmes and centres.

KPI need to be measurable in 'real time' in order to know whether the CCPs or the CCs therein are on track. The creation of performance monitoring tools should primarily be seen as a learning tool for advancing the effectiveness of implementation of CCs.

Core questions to be considered for devising KPI are:

- Timeliness: is the monitoring system delivering results when they are needed?
- Comparability: can the information of individual centres be compared across centres, with similar programmes, other funding mechanisms.
- Feasibility: what burden does a monitoring system pose on its constituents?

A first baseline for establishing monitoring systems for CCPs was provided by the TAFTIE Task Force on Benchmarking Impact, Effectiveness and Efficiency. The list of indicators suggested by this task force has a strong focus on effects on industry and places somewhat less emphasis on the variety of objectives and activities which competence centre pursue.

The TAFTIE Task Force on Competence Centres therefore suggests mapping KPI relating to the main impact dimensions of the programmes. Apart from increased competitiveness, these domains may include the dimensions international reputation, human capital, scientific reputation, societal effects, and professional culture of research.

The selection of KPI for each individual CCP is not trivial and no one-size-fits-all solutions may be applied. It depends upon the actual relevance of each domain and also the type of CCP.

Analysis of the structure and purpose of Compentence Centre Programmes

Based on the consolidated mapping of CCPs a more qualitative analysis was performed. Three overlapping groups of CCPs were identified: One group of programmes/centres was pointing at the larger programmes and centres. Another group was referring to medium-sized centres, more on the industry driven side. A third group included the "smaller" initiatives being partly more science driven.

The analysis was structured around six themes relevant for CCPs:

1. Governance and incentive structure
2. Adaptability to new RDI, market and social trends
3. Broadness of activities (e.g. for 'open innovation', technology transfer etc.)
4. Openness to new actors, potential to extend networks
5. Internationalisation
6. Exit-strategy' for gradual withdrawal of national public funding

Several good practices but also challenges were identified within the programmes, which served as ad-hoc examples and immediate learnings.

Internationalisation of Competence Centre Programmes

Due to globalisation the internationalisation is becoming an important issue for CCPs. The main drivers to engage cross-border collaborations come from

a) The centres' stakeholders facing various international challenges,
b) The developments within science and technology that require critical mass and excellence
c) and from the European, national and regional policy making bodies that see the potential for opening up to international partnerships.

Internationalisation of CCs and programmes may also encourage efficiencies in public funding by leveraging synergies between national and European funding instruments. Furthermore internationalisation is seen as a means of quality assurance. The acquisition of funds from international funding sources such as Horizon 2020 provides independent, external feedback to the quality of research of CCs and demonstrates competitiveness in the international arena.

However, there are also obstacles to internationalisation. The ability to internationalise depends strongly upon the maturity of CCs and existing network partners. Young centres and programmes first need to build-up their national networks and gain reputation before being able to internationalise. The identification of the right foreign partners and building of trust with these partners takes time and depends largely upon personal networks. Also in legal terms, arranging national public funding for foreign partners to work within CCs is still a key challenge in several countries.

Internationalisation is a programme goal only in a limited number of CCPs; however it is deployed by many agencies at a centre level by formulating specific requirements and criteria. The set of requirements includes the formulation of objectives and targets for internationalisation at centre level, the setting-up of international advisory boards in governance structures, and the creation of indicator systems aiming at the identification of international visibility, awareness and reputation.

Some centres have explicit internationalisation strategies in place and are frequently evaluated by international peers. In order to enable exchange on an international level, centres allow internships, guest stays etc. Also the organisation of international conferences is part of some of the centres activities as well as their engagement in standardization bodies.

Most TAFTIE agencies offer some services and initiatives for supporting CCs in their internationalisation strategies. The main services include legal and partner search support for participation in European Framework Programmes. In some countries, international research partners can be supported in the research projects under certain conditions.

Horizon 2020 and EUREKA are suitable arenas for CCs to internationalise their research activities. CCs with a strong legal entity can apply themselves for funding in H2020. Hosted centres cannot participate directly in H2020, it is however very common that their partners participate, or lead, H2020 projects. CCs are thus functioning as a catalyst for a project idea and a node for participating partners.

Overall, internationalisation activities require a clear strategy, resources and sufficient time. Clear objectives on programme level and adequate incentives and support structures may support successful internationalisation.

Options for future CCPs

The TAFTIE Task Force identified a set of trends and challenges in R&I policy, which are not necessarily compatible with current objectives, focus and structures of the CCPs. These are:

- New ways of innovating and creation of new business models
- The need for more flexibility and entrepreneurial spirit
- The promotion of more risky and radical research
- The emergence of global value chains/networks and possibilities to strengthen international activities
- Tension in balancing increasing need for market orientation and scientific excellence
- Addressing grand societal challenges
- Use of large infrastructures
- Need to increase SME involvement
- Strengthening training & gender aspects

These trends and challenges were discussed in relation to the 3 identified governance models: the “Management Model”, the “Strong Entity Model” and the “Host Model”.

All models seem appropriate to ensure commitment among partners and implement medium to long-term strategic research agendas, but each model has different strengths and weaknesses:

- The **Management Model** is characterised by a direct bargaining process between CCPs members from scientific and industry communities. The overall adaptability of this model to new trends and challenges is considered to be high, but the capacity to engage in a broad number of activities including for example structured educational training programmes is limited. Distinct advantages of the Management Model are its openness to new actors and flexible and straightforward exit strategies.
- The **Strong Entity Model** is seen to be frequently dominated by industry and characterized by rather limited adaptability to new trends and openness to new partners. On the other hand this type of governance model is expected to create truly long term partnerships among different actors and it facilitates the creation of physical research infrastructures that are jointly used by partners. This allows implementation of a wide range and depth of activities with high commitment of individual partners, including intensive skills development and pursuit of internationalisation strategies.
- The **Host Model** is seen to be frequently dominated by scientific partners. Due to its distinct personnel structure and research focus this model is characterized by limited adaptability to new societal challenges but a rather high openness towards new company actors. As Host Model CCPs are embedded in existing research structures such as universities they are further characterized by rather flexible exit strategies, whereas room for international collaboration is seen to be somewhat limited to scientific partners and dependent on existing relationships.

The appropriate **size** of the CCPs as well as of the CCs is dependent on the overall purpose of the programme and the framework conditions of the National Innovation System. CCPs with a clear focus towards global competition and excellence need to be larger and last longer than CCPs with a distinct regional focus or a focus on SMEs in low and medium-tech industries. In order to avoid crowding out and duplication of efforts, a good balance between CCs, university

and non-university research systems and their capacities (such as research infrastructures) is needed.

The majority of CCPs are understood to be of limited **duration,** aimed at compensating medium-term gaps in strategic science-industry collaboration. The overall duration and exit strategies are seen to be closely related to the governance model (e.g. strong entity vs. management model), the size of the centres and the selected focus. Strong entity models require clearly prescribed phasing out strategies as, most likely, physical infrastructure has been built and researchers with permanent work contracts have been employed.

Policy makers need to clearly decide whether CCPs should be devoted to global competitiveness or regional development as both strategies may not easily be achieved at the same time.

The **orientation towards industry or academia** needs be dependent on the distinct objectives of the CCPs. When setting these, the readiness of industry and academia for pursuing these objectives needs to be considered in terms of availability, capacity and connectedness.

The **funding rate** of activities for CCPs is dependent on the objectives of the programme as well as the possibility of CCPs to use other support schemes than the CCPs itself.

Overall, the Task Force sees a need to increase flexibility for funding different types of activities. Concerning the choice of topics a clear trend towards **thematically open** bottom-up defined CCPs was observed, allowing for flexibility concerning the reorientation of research activities and flexibility concerning agenda setting.

1) New innovation models

At present, CCPs do not have the specific objective of promoting Open and User Innovation approaches. First steps to nurture new modes of innovation and “opening up” would be to explicitly require cross-sector collaboration and demand the development of respective actions in strategic research and innovation agendas.

Opening up also requires rethinking of the role of research and innovation activities of CCPs in terms of Intellectual Property Rights.

The 3 models do not pose a barrier for encouraging more open and user innovation approaches for CCPs, but at the centre level strategic plans should be developed in order to bring these approaches to the fore. The strong entity model and the host model may be able to develop these plans for their core partners on a longer term level. A management model might be able to include new partners in a more flexible manner and follow Open and User Innovation approaches on an individual project basis.

2) More flexibility and entrepreneurial spirit

CCs may contribute to the creation of more entrepreneurial milieus at academic institutions, in which young researchers develop ideas for new business ventures.

Increased flexibility for CCPs can be supportive, but requires a new strategic framework. Flexibility is also needed in the education system (e.g. universities), as a stronger mobility culture is needed. At the same time, a certain degree of stability in terms of strategic orientation, objectives, funding criteria and budget is needed as existing stakeholders have to be committed for the longer term.

The management model and the host model seem most suited to allow more flexibility in activities of CCPs. Management models may more easily gather a number of different academic and industry partners around low level entrepreneurship activities, which are not oriented at the

provision of typical R&D activities of CCPs. The host model approach may allow the performance of concerted actions within one institution throughout the life-time of the CCPs.

Relevant design features of CCPs for allowing more flexibility and entrepreneurial spirit are means to funding, size and strategic orientation.

3) More risky and radical research

Research and innovation risk (market failure therein) is a main justification for public schemes supporting innovation activities. There is clear need for radical and breakthrough innovation providing a basis for future competitiveness in Europe. However, existing funding schemes do not necessarily provide proper incentives for “out of the box” thinking, high risk undertakings and breakthrough innovations. For CCPs trade-offs exist between entrepreneurial thinking and allowing major impact innovations.

TAFTIE members may increase their flexibility and can allow for variations in terms of funding rates which may provide incentives for allowing for more risky research. There is also a clear need to allow for flexibility in terms of funding, duration, scope, content and the involvement of new partners (e.g. end users). Certain programmes already have flexibility in certain areas and would like to keep these (e.g. roadmaps, budgetary freedom for boards, open space in the research agenda etc.).

Allowing for more risky research requires quick access to new technologies and precompetitive research. “Host models” which usually are located at higher education institutions and “strong entity models” may provide easier access to new sources of knowledge. Academic driven larger programmes, with longer programme duration and higher funding rates seem more apt to follow more risky research approaches.

4) Global value chains

The emergence of global value chains/networks were considered as one of the major challenges for the future development of CCPs. While there is at present mainly cooperation within EU-funded projects, there is a perceived need to provide more incentives and measures to allow CCPs to operate at an international level, in order to further increase the quality of research performed within centres.

A general advice from the TAFTIE Task Force is to free/set aside money in the centres for international collaboration, in order to help centres to develop their own strategic approach.

Competence Centres may also play an active role in developing international standards. In many industries, standards need to be widely adopted for the research to become industry relevant and therefore internationalisation is a key pre-requisite.

The development of shared infrastructures may also provide interesting potential concerning internationalisation.

At a centre level, cooperation between centres, in particular within EU-projects, but also concerning exchange of staff could facilitate a greater integration of centres. In this regard, also participation in Knowledge and Innovation Communities of the EIT could be considered.

Larger programmes, with a longer duration, operated either in the management model type or the strong entity model seem more appropriate for developing successful internationalisation strategies.

Concluding remarks

In the course of the Task Force a series of intermediate results were already used by the several TAFTIE members in the ongoing process of enhancing their individual CCPs. In this respect the ad-hoc discussions within the group were particularly useful in order to get additional feedback as well as insight. Thus, the successful enhancement of future Competence Centre Programmes is also a result of sharing experiences and good practices. In this respect we would like to thank all participating TAFTIE members for their active and open participation.

1 Introduction

Since the late 1990's research and innovation support programmes have undergone systematic change. Support programmes began to go beyond the provision of funding for research and innovation (R&I) via institutional funding or single, rather narrowly defined research and innovation projects and instead, increasingly more innovation system oriented approaches were deployed.

The main objectives of these new support measures were to facilitate closer interaction between the various stakeholders in the innovation system, by creating network structures for knowledge creation and diffusion and by incorporating multiple support measures. The support schemes acknowledged the increasing relevance of collaboratively created knowledge and put a focus on enabling structural change for the better functioning of local, regional, national or sectoral innovation systems.

Competence Centre Programmes (CCPs) are major initiatives within their innovation systems in this regard. Many European Union member countries have launched this specific type of programme and some Competence Centres have been in existence for over two decades. Throughout several programming periods and calls for proposals for the initiation of new Competence Centres, these programmes have evolved. While it is of no doubt that CCPs have contributed to the enhancement of science-industry co-operation in Europe, new trends and challenges are influencing these programmes: globalisation requires new international approaches and national innovation system actors are confronted with new challenges and demands:

- Business enterprises face stronger, global competition as well as new business opportunities through increased openness of markets, global value chains of production, new business models and new means of innovation.
- Governments also increasingly seek to contribute to solving grand societal challenges by means of new mission oriented R&I policies that prepare for transition towards a sustainable economy. Simultaneously, there is higher demand for accountability and more needs to be achieved with reduced funding levels. In particular, R&I support instruments need to pave the way for new measures which spur economic growth.
- Universities now have higher institutional autonomy but also face higher degrees of accountability, such as the use of performance contracts in order to justify spending of block grants for research and to guarantee that their strategic orientation meets societal and political targets. Demands for third party funding are increasing and the third mission of universities, i.e. to foster collaboration with business enterprises, is nowadays a key performance criteria for many, which has been subsequently augmented by other forms of direct engagement with society (e.g. participation in the public debate, communication of research results to a broader public, contribution to societal questions etc.) (Elias et al. 2011)[1].

Against the background of this changing global R&I landscape, national innovation agencies running CCPs see a need to further enhance these programmes. The TAFTIE-Academy Workshop on "The future of Competence Research Centre (CRC) models" which took place in May 2014 provided insights into future outlines of types of CCPs, intended to strengthen new generations of CRC programmes and achieve a better understanding of challenges and policy

1 http://www.joanneum.at/uploads/tx_publicationlibrary/CIA4OPM_OMC_NET_2011_POL.01-10.AF.012-01.pdf

implications. The ideas and solutions discussed in this workshop led to the foundation of a new Task Force on Competence Centres Programmes comprising the following research funding agencies: Austrian Research Promotion Agency – FFG (AT), Flanders Innovation and Entrepreneurship – VLAIO (BE), Technology Agency of the Czech Republic- TACR (CZ), PtJ- Projektträger Jülich (DE), Enterprise Estonia (EE), TEKES (FI), Enterprise Ireland (IE), Innovate Luxembourg (LU), RVO (NL), Research Council of Norway (NOR), and VINNOVA (SWE).

The Task Force proposal was brought to the TAFTIE Board, which approved the plan at the November 2014 meeting.

The scope of the Task Force covered a joint and better future development of these programmes, the sharing of experience and good practice and the authorization of joint analysis on economic and societal impacts of CCPs. Therefore, the Task Force focused mainly on "the enhancement of the next generation of CRC programmes", also including important aspects of "internationalisation". On the basis of a comparative analysis of CCPs context and practices, the work of the Task Force offers political decision makers and funding agencies an overview of the potential scope and use of competence centre models and good practice to be considered for future implementation.

The work programme of the Task Force comprised a number of interrelated work packages and Tasks:

- Work Package 1 included the management activities of the Task Force.
- Work Package 2 elaborated a working definition of Competence Centre Programmes and examined the actual details of each programme of the Task Force members. The work comprised an analysis of the theoretical background (literature research etc.) and a comparative logic chart analysis of the mission, objectives, inputs, processes, results and desired outcomes of the programmes in order to provide a brief insight into the logic underpinning existing programmes.
- In Work Package 3 the Task Force analysed the main design features and key characteristics (target groups, budget etc.) of the competence centre models. The analysis of these design elements and characteristics identified distinct programme clusters and various types of competence centre programme models.
- In Work Package 4 the Task Force analysed design options for future programme development of CCPs based on the different types of existing Competence Centres models. The Task Force examined the desirability of different competence centre models compared to alternatives and identified possible measures for future programme development. This also included an examination of potential Key Performance Indicators relative to key aspects of new missions/visions of/for CCPs. As a final result the Task Force sets out recommendations for development of the next generation of CCPs, wherein advantages and drawbacks of different programme models are taken into account.

An overview on the work plan of the TAFTIE Task Force CompAct is provided in Figure 1.

Figure 1: Work plan of the TAFTIE Task Force CompAct

Work package Milestone (M)	Title	Description
WP 1 M1: Project finalised	Project Management	• Start project • Coordinate project • Finalise project
WP 2 M2: Work packages and responsibilities defined	Preparatory work for Workshop I (WS I) Kick-off meeting	• Study **theoretical background** (literature research etc.): Definition of Competence Centres • Identify **recent developments** influencing CCs: Examine actual situation for each CC programme, carry out an analysis of the environment, create "Logic Charts" for each programme (input for WS I) to allow quick understanding of the logic behind
WP 3 M3: Models defined	Work on CC models and analysis	• **Identify main features** for CC models: Identify essential design elements for the different models, examine, what makes the CC approach attractive compared to alternatives; policy implications, possibilities on EU level (KICs, EIT, …) • Carry out **analysis of possible models**: Define the criteria for the analysis (templates, typologies etc.), analyse and compare the different models, check hypothesis
WP 4 M4: Prepare final report and presentation to the TAFTIE Board (TB)	Work on design options for future programme development	• **Identify possible measures** for future programme development: Identify possible measures for the future programmes, examine KPIs in relation to crucial facts; find the new mission/vision of/for CCs; analyse the contribution of CCs to overall goals of the innovation system • **Develop the next generation** of CCs: Allow different models (taking into account the diverse approaches), identify and explain, which elements do we need; reformulate the logic charts, final check with working hypothesis • Develop **recommendations** for future programmes

Source: TAFTIE Task Force for Competence Centres Programmes

The Task Force on Competence Centre Programmes carried out its work through a series of workshops:

- In February 2015 at the Kick-Off Meeting of the Task Force in Vienna, the findings of the TAFTIE-Academy Workshop were used as a starting point for structuring the work of the Task Force. The group collected initial data on each programme including the key parameters, as well as a "logic chart" explaining the mission and objectives of each programme and its (expected) output, outcome and impact. Future trends and forces were updated and complemented by a stakeholder analysis.
  The main similarities and differences between programmes led to initial ideas on how to analyse different types of programmes (models). It was proposed to carry out a mapping exercise, in order to cluster the programmes against different parameters (science vs. industry driven, funding volume, duration…). Discussions on the governance of CCPs introduced a new topic on Key Performance Indicators. Initial thoughts on how to increase internationalisation (and why) were collected, also dealing with hurdles and measures how to improve the situation.
- At the Mid-Term-Meeting, which took place in June 2015 in Stockholm, clusters resulting from the mapping exercise were introduced and discussed in the group. Each cluster was analysed against six themes (governance, adaptability, broadness, openness, international collaboration and exit-strategy). As a working hypothesis initial ideas on models were introduced and related to their main features and policy goals.

The team agreed to continue its work with three types/models and a new set of KPIs was introduced and discussed.

- The Final Workshop took place in Oslo in October 2015 reviewed the analysis of different types/models of CCPs and brought forward the work on design options for future programme development, trends and forces.
- A last Task Force meeting took place in January 2016 in Brussels in order to discuss the final report of the Task Force.

This report summarises the main findings of the work of the TAFTIE Task Force CompAct.

2 Characteristics of Competence Centre Programmes: Commonalities and differences

This section provides an analysis of the key characteristics of CCPs and analyses of the commonalities and differences among existing programmes. Starting with the provision of working definitions of CCPs, we provide comparative analyses on the following key aspects of Competence Centres 1) key objectives, expected outcomes and impacts, 2) activities of CCPs, 3) structural composition of CCPs, and 4) governance models of CCPs. As a result, different governance concepts of competence centre models and clusters of Competence Centre types are summarised.

2.1 The Definition of Competence Centre Programmes

CCPs are, in the widest sense, Multi Actor – Multi Measure Programmes (MAP), with a focus on strengthening of science-industry cooperation. MAP can be characterised as complex support programmes in the area of RTI policy, which are geared to different actors in the innovation system, employing a variety of measures (cf. No formal definition of 'Competence Centres' exists so far. According to the COMPERA ERA-NET it is a broad concept that covers a large variety of initiatives. The core objective of MAP in the sense of CCPs is to demonstrate a positive impact on the interaction between key actors within an innovation system: science & industry. Definitions for CCPs have been provided by several authors/studies:

- Arnold et al. (2004) define CCPs as long term oriented research alliances between public research performing organisations and industry, performing both fairly fundamental but also more applied problem-oriented research.
- According to the COMPERA ERA-NET (2008) Competence Centres are a broad concept that covers a large variety of initiatives. The following, non-restrictive, definition on "competence research centre (CRC)" was used: "CRCs are structured, long-term R&I collaborations in strategically important areas between academia, industry and the public sector. They aim to bridge the gap between technological and economic innovation by combining academic excellence with industrial and/or public needs. The activities within CRCs can be multiple: pooling of knowledge, concentration of infrastructure, creation of new knowledge by performing different types of research (pre-competitive and competitive research), training and dissemination of knowledge to target groups of stakeholders in a tailor-made way. In general, they have a large degree of autonomy in determining their own strategies and activities that enable them to anticipate topical developments within their desired working environment."
- In the CREST Report on "Industry-led Competence Centres" the following definition was agreed by the working group: Competence Centres are formal organizations, which have a long term but typically finite duration. They are engaged in collaborative research, typically focused on medium/long term issues. The research is conducted on areas of direct industrial relevance. The areas of research are focused on gaining competence in areas of technology or innovation which are relevant to the industry stakeholders.

The definitions provided above show that common features of CCPs are its focus on strategic research agendas, strong interactions between science and industry in the sense of providing truly collaborative research, and a long-term strategic focus, i.e. Competence Centres are expected to build core competences in the area of technology focus of its industrial partners and thereby develop strong linkages between researchers and industry. In spite of these common

characteristics, CCPs show considerable variations as regards rules for implementation and operationalization. These relate in particular to (CREST 2008):

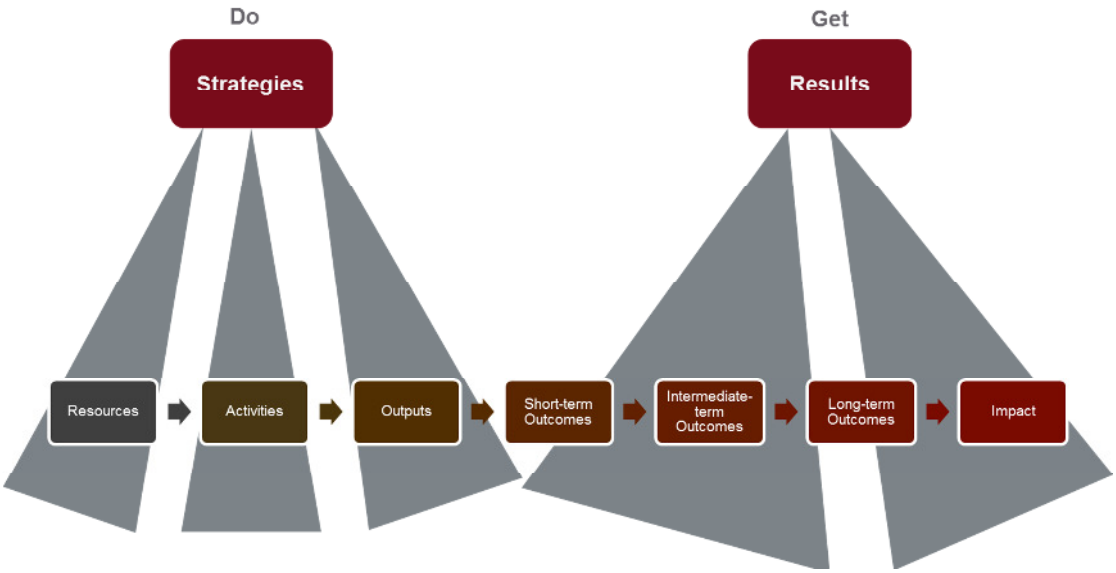
- the location (programmes exist with physical centres and programmes also operate in a virtual mode, i.e. competence networks),
- the characterisation of networks with prerequisites to include regional, national and international partners,
- the funding structures, i.e. variations in requirements concerning the degree of contract research, public core funding and the possibility to participate in national and international programmes,
- the governance of networks with strong variations in representation of actors of higher education institutions, industry and policy stakeholders,
- the selection procedures of centres, i.e. some programmes have created Competence Centres in a top-down manner whereas other programmes made use of competitive calls for tender including national and/or international expert panels (bottom-up)

In the TAFTIE Workshop in May 2014 it was agreed to start with a broader understanding of Competence Centres (the term “compentence research structures” was mentioned), in order to allow for new ideas.

2.2 Comparative summaries on expected impacts and outcomes

At the kick-off meeting in Vienna the concept of logic models was introduced in order to provide a basis for comparative analysis of the CCPs of the TAFTIE working group (Figure 2). Logic models represent how an intervention (such as a programme, project or policy) is understood to contribute to its impacts. By comparing the “logic charts” of all CCPs represented in the task force, the most important similarities and differences among the programmes were identified.

Figure 2: Using Logic Models for Programme Planning



Source: TAFTIE Task Force on Competence Centre Programmes

2.2.1 Comparative summaries of expected impacts and outcomes

Relating to expected long term impacts and medium-term outcomes, the analysis shows that virtually all CCPs seek to strengthen the **economic competitiveness** of their country by increasing the innovation performance of national industry.

Figure 3: Desired impacts of Competence Centre Programmes

	FFG	VLAIO	TA-CR	PtJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN*	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FIN	IE	LU	NL	NO	SE	UK
Increased economic competitiveness	X	X	X	X	X	X	X	X	X	X	X	X
Specific impact on competitiveness of SMEs		X										
Renewal of industrial branches						X						X
Specific impact on selected sectors or challenges								X	X			X
Increased attractiveness of NIS for international actors	X							X			X	X
Increased attractiveness of research location	X			X						X	X	X

* RCN: Norwegian FME programme is concentrated on energy research. The other Norwegian programme (SFI) is thematically open
Source: TAFTIE - Task Force on Competence Centre Programmes, Logic Charts

Concerning this competitiveness impact, only a limited number of programmes emphasize a particular focus on small and medium sized companies (e.g. Belgium/Flanders) and employment (e.g. Ireland). Additionally, some programmes also explicitly mention a renewal of industrial branches (e.g. Finland, UK), indicating that the CCPs in these countries have a strong transformative agenda concerning existing industries. Also, a number of programmes emphasize that the competence centre programme aims at increasing the attractiveness of the national innovation system for international actors and respective foreign investments (Finland, Sweden, Austria, UK and Ireland).

However, while a general focus on economic competitiveness can be found in all CCPs, only about half of the CCPs of the working group also mention a desired impact on research location (local/geographic) and the academic sector in particular. Furthermore, long term impacts are not mentioned in the domain of qualification and training.

While the first observation can be seen as an indication that programmes show, to varying degrees, a stronger rooting in industry vs. academia, the latter might be due to the reasoning that training and education are seen as a means to an end and desired outcomes of centre operations, rather than an ultimate impact (see below). Furthermore, when considering activities of CCPs, only a limited number of programmes like the Norwegian initiatives show distinct, structured activities in the area of education.

The desired outcomes of the CCPs also can be structured into certain domains (Figure 4). Three domains, 1) development of new products processes and services, 2) an increased innovation capacity of participating networks, and 3) strengthened technology transfer are present in all CCPs studied.

Also, a considerable number of programmes emphasize the creation of sustainable innovation networks (i.e. going beyond the funding period), and qualification of human resources. Specific issues, such as a targeted improvement of educational schemes or the targeted creation of spin-offs are only to be found in a rather limited number of programmes.

Figure 4: Desired outcomes of Competence Centre Programmes

	FFG	VLAIO	TA-CR	PtJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FI	IE	LU	NL	NO	SE	UK
New products/ processes/ services	x	x	x	x		x	x	x	x	x	x	x
Increased innovation capacity	x	x		x		x	x	x	x	x	x	x
Strengthened technology transfer	x	x	x	x		x	x	x	x	x	x	x
Sustainable innovation networks	x	x		x				x	x	x	x	x
Highly qualified HR	x			x			x			x	x	x
Improved educational schemes										x	x	x
Spin-Offs						x	x	x			x	
Increased visibility of R&D in community & society										x		

Source: TAFTIE - Task Force on Competence Centre Programmes, Logic Charts

2.2.2 Comparative summaries of key operational objectives

The desired outcomes as indicated in the logic charts of the CCPs are by large mirrored by the concrete, operational objectives of the programmes (Figure 5).

The overriding operational objectives of most programmes are to strengthen the cooperation culture between science and industry and thereby increase innovation and foster economic growth.

Sectoral co-ordination and co-operation is part of many of the programmes key objectives, whereas internationalisation of R&I and increased international visibility are only to be found in some of the programmes.

Furthermore, some differences concerning the orientation of R&D activities can also be found in the objectives of the programmes. Some programmes emphasize in particular the long-term orientation of private R&D, whereas other put a stronger focus on commercialization of public R&D results, knowledge transfer and creation of new business ventures/spin-offs resulting from public R&D activities.

Figure 5: Objectives of Competence Centre Programmes

	FFG	VLAIO	TA-CR	PtJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FI	IE	LU	NL	NO	SE	UK
Strengthening cooperation culture between science and industry	x			x		x	x	x	x	x	x	x
Increase innovation and foster economic growth	x	x		x		x	x	x		x	x	x
Sectoral coordination and cooperation	x	x		x			x	x	x			
Internationalisation of R&D and international visibility	x	x		x		x	x	x	x	x	X	X
Strenthening HR and Gender	x			x			x			x	x	x
Long term orientation of private R&D activities				x				x		x		
Faster commercialisation of state funded research		x		x			x		x			
New business potentials: spin-off projects						x	x	x				

Source: TAFTIE - Task Force on Competence Centre Programmes, Logic Charts

2.2.3 Comparative summaries on activities

Core activities of CCPs at the centre level are the development and operation of research programmes in strategic and multi-firm projects. Apart from this overarching aim of CCPs, the

analysis of the logic charts of CCPs shows that competence centres perform distinguishable activities separate from the operation of the R&D programme (see Figure 6) and focus to varying extent on:

- Exploitation of research results by means of IPR and Spin-Offs
- Training of PhDs and master students
- Dissemination of research results via publications, conferences etc.
- Stimulation of networking and knowledge transfer
- Acquisition of third-party funding (incl. EU sources)
- Provision of research infrastructures
- Provision of market intelligence

Apart from clear differences in the focus of CCPs, it is worth noting that the cited internationalisation activities of the programmes relate to acquisition of third-party funding from European sources, dissemination activities and attracting international partners. This is probably due to the Key Performance Indicators used, which are easy to measure. However, the scope of the international activity is probably broader (Comment RCN).

Figure 6: Core activities of Competence Centre Programmes

	FFG	VLAIO	TA-CR	PtJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FI	IE	LU	NL	NO	SE	UK
Realisation of strategic R&D programme by multilateral projects	X	X	X	X	X	X	X	X	X	X	X	X
Training and education	X			X						X	X	X
Exploitation of R&D and Spin-Offs	X	X		X		X	X	X				X
Dissemination via publications	X	X		X		X			X	X	X	
Acquisition of third party funding	X			X		X	X	X	X	X		
Stimulation of networks and knowledge transfer		X		X				X	X	X	X	X
Provision of R&D infrastructure	X			X				X				X
Market intelligence				X				X				X

Source: TAFTIE - Task Force on Competence Centre Programmes, Logic Charts

Further significant differences concerning activities of CCPs relate to the types of activities funded and target groups, i.e. funding recipients that are entitled to apply for funding or receive funding, as shown in the figure below. Unfortunately, this type of information was only available for a limited number of programmes.

Figure 7: Funding recipients and Type of activity funded

Target groups	FFG	VLAIO[1]	TA-CR	PtJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN (FME)	RCN (SFI)	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FI	IE	LU	NL	NO	NO	SE	UK
Large companies	x	X		x	x	x		x			(x)		
SMEs	x	X		x	x	x		x			(x)		
Start-ups	x	X		x		x		x					
Research and technology organisations	x	X		x		x	x	x		x	x	x	
Unviersities	x	X		x		x	x	x		x	x	x	
International partners allowed	x	X		x	x	x	x	x		x	x	x	
Funded international partners	x	limited		x[2]	x		limited			limited	x		

[1] Taking both the funding of the central innovation platform as well as the dedicated budget for projects.
[2] Provided that German office exists and exploitation of results takes place in Germany

Type of activities funded	FFG	VLAIO	TA-CR	PTJ	EAS	TEKES	Enterprise Ireland	LXI	RVO	RCN (FME)	RCN (SFI)	VINNOVA	CATAPULT
	AT	BE	CZ	DE	EE	FIN	EI	LU	NL	NO	NO	SE	UK
Basic research	X	X		x		x				x	x	x	
Industrial development	x	X		exceptional	x	x	x	x		x	x	x	
Experimental development	x	X			x	x	x	x		limited	limited	x	
Technology transfer	x	X			x	x	limited	x		limited	limited	x	
Training	x				x			x		x	x		
Research infrastructure	x				limited		limited	x					

Source: TAFTIE - Task Force on Competence Centre Programmes, Logic Charts

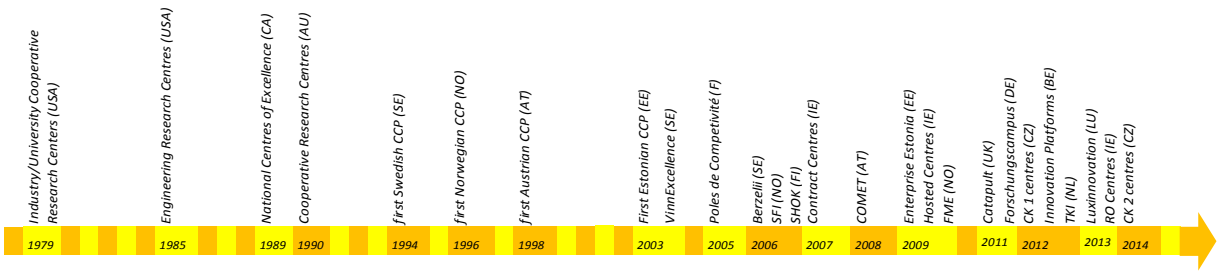
As can be seen from Figure 7, in some programmes (e.g. Austria) all types of research organisations are entitled to receive funding and also all type of activities are being funded. Other programmes either limit the type of activities funded (e.g. the German Forschungscampus) or the organisations that are entitled to receive funding (e.g. Norway, Ireland).

By limiting either funding of “basic research” activities on the one hand or “technology transfer activities” and “innovation activities” on the other hand, the differences in the strategic orientation in terms of valorization of research results vs. long-term creation of competences become apparent.

2.3 Analysis of structural composition of Competence Centre Programmes

The first generation of CCPs has been established at the mid of the 1990s in Europe, hence in some countries already the second or third generation of CCPs exists (see Figure 8).

Figure 8 Timeline of Competence Centre Programmes starts



Source: TAFTIE - Task Force on Competence Centre Programmes

Following on from this discussion of policy objectives and the logic of intervention it is interesting to see commonalities and differences concerning the involvement of different policy levels or ownership and management of CCPs in Europe.

The introduction of new CCPs usually had been based on specific needs and the coherence with the national policy mix but also on previous (international) experience.

Several countries established different programme strands in order to meet diverse needs and networks of multi-actor science industry collaboration.

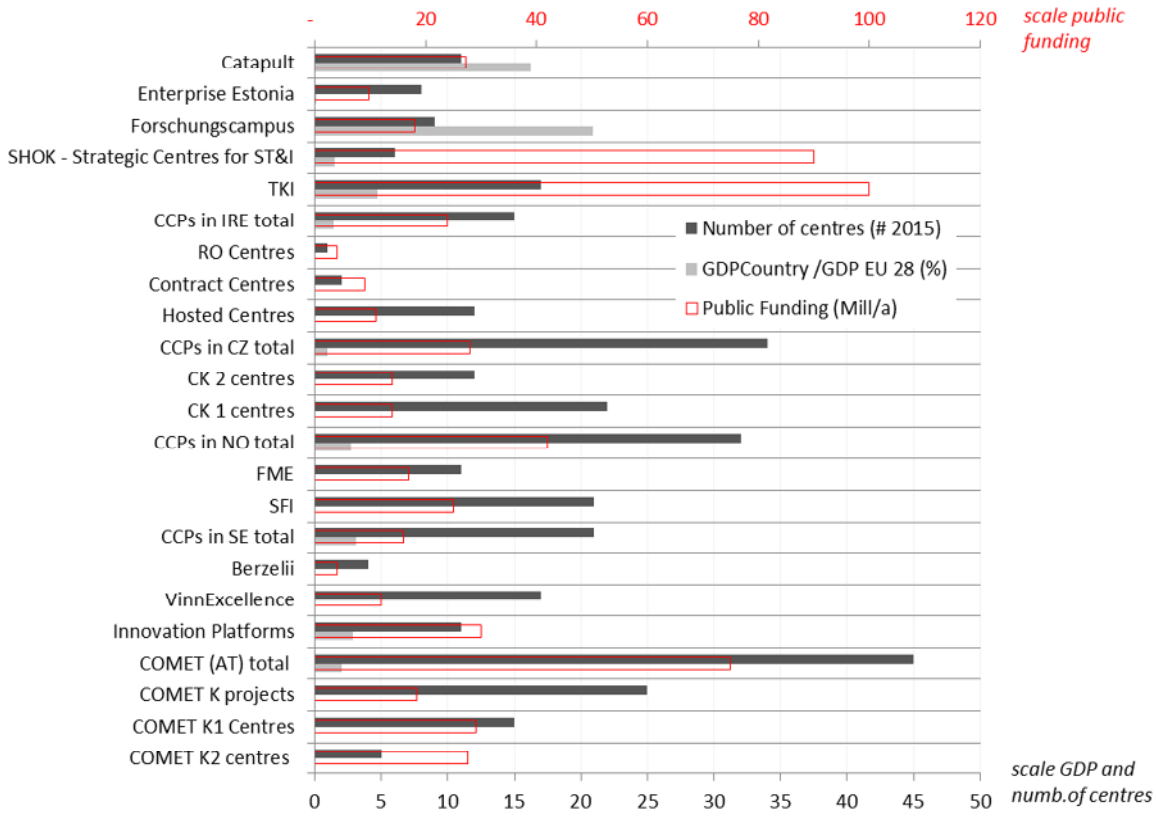
For the analysis of the structural composition of CCPs, the participants extended the sample by adding the Catapult (UK) Competence Centre Programme. On this basis commonalities and differences among CCPs in Europe can be observed. The initial parameters were: academia vs. industry led, large companies vs. SME, number of partners, regional vs. international scope. Finally the mapping was carried out with the parameters “funding volume” vs. “industry led” as well as the “duration” of the centres. The templates for this mapping exercise were completed by each partner of the Task Force. Thus the following discussion is based on details of the main structural characteristics collected by the Task Force Members.

2.3.1 Size of the Programme versus size of the Country

The countries and programmes under consideration show significantly different policy mixes and funding instruments. This observation applies to national differences concerning focus and balance of national support mechanisms and funding instruments along the innovation chain, infrastructure measures, project funding or institutional funding but also the balance between thematically open versus thematically focused funding.

Furthermore the size of the home country of the different CCPs needs to be considered. Larger countries can be expected to launch larger programmes and higher numbers of Competence Centres.

Figure 9: Comparison of total public funding per year and CCPs, the number of Competence Centres and the (relative) size of the country



Source: TAFTIE - Task Force on Competence Centre Programmes

Figure 9 provides an overview total public funding per year and competence centre programme, the number of Competence Centres and the (relative) size of the country. Considering the size of the country, the largest CCPs are the Estonian Competence Centre Programme, the SHOK Programme in Finland (ended) and the COMET Programme in Austria.

The largest programmes as measured by the total public funding per year are TKI in Netherland, the SHOK Programme in Finland (ended) and the COMET Programme in Austria.

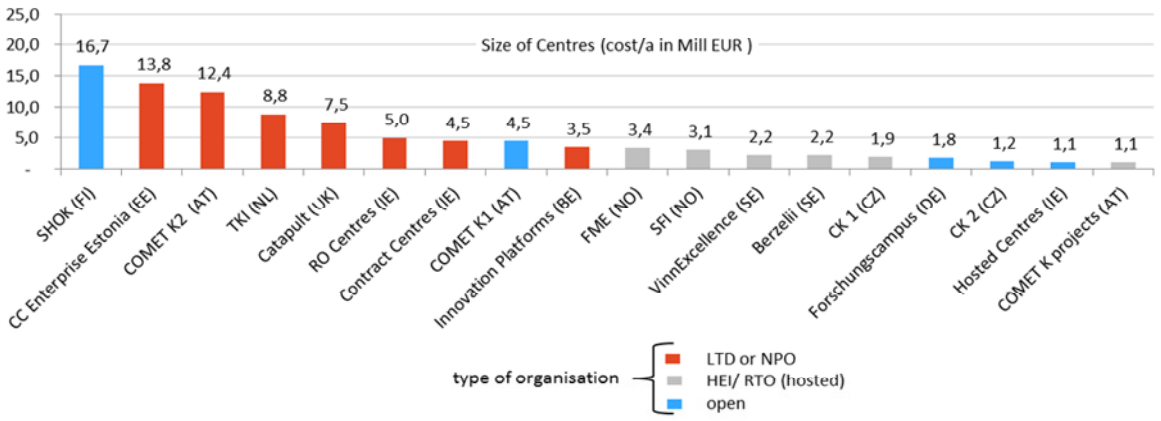
2.3.2 Average Size and duration of Competence Centres

Concentration and larger Centres might be able to support spill overs between partners, synergies, risk and resource sharing (critical mass) and realize economies of scale and scope. On the other side lock-in effects, coordination costs and other inefficiencies of scale can speak in favor of smaller Centres and separation.

The average size of Competence Centres is significantly different amongst the CCPs observed. Figure 10 shows the average size of Competence Centres of different CCPs in Europe. SHOK, Competence Centres Enterprise Estonia and COMET K2 show the largest individual units.

CCPs support the medium and long term coordination of collaborative research and innovation activities among a limited and defined number of partners. It seems to be the case that CCPs with larger Competence Centres are typically organized as independent entities (LTDs or NPOs).

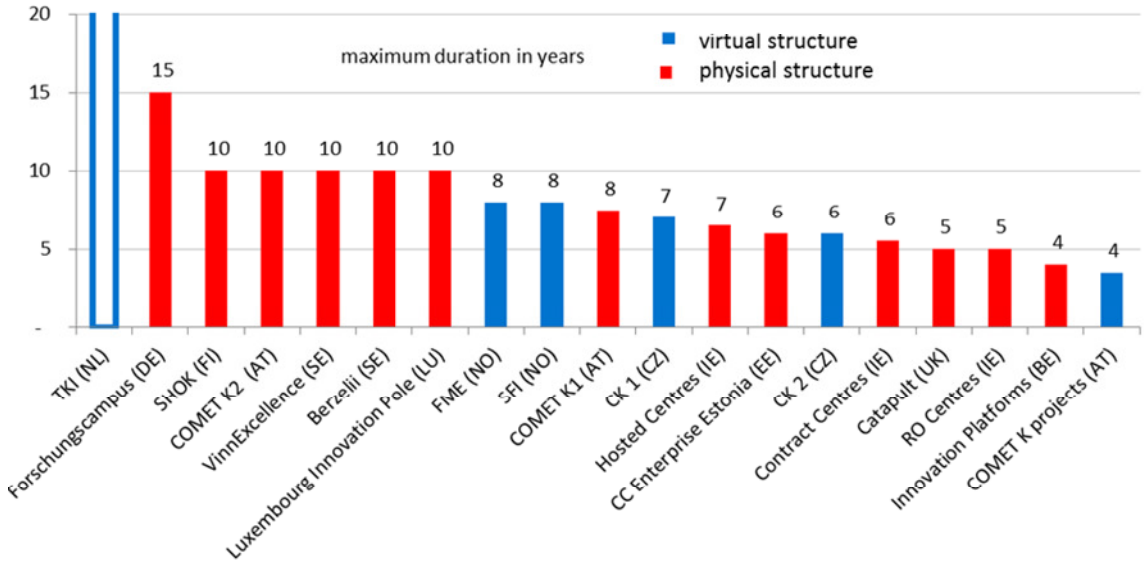
Figure 10: Size of Competence Centres (cost/a in Mill €)



6% share of the SHOK volume are administrative fees for Centres, 94% are channeled to the organisations taking part in the programme
Source: TAFTIE - Task Force on Competence Centre Programmes

The size, organisation and duration of Competence Centres in these programmes are associated with current needs and trends in research systems in Europe. It should be noted that larger Competence Centres entities (see SHOK, Competence Centres – EE, COMET) are located in countries with smaller HEI and RTO structures. Furthermore it is interesting to see that CCPs supporting large units have been introduced since 2005. CCPs more recently launched support smaller units.

Figure 11: Temporality or maximum duration of programme funding for Competence Centres and Type of structure



Source: TAFTIE - Task Force on Competence Centre Programmes

CCPs support time-limited research organizations. However, CCPs can be differentiated by their intended duration and continuity. The COMET Programme in Austria can be interpreted as a direct predecessor of the previous K-Programmes. Some of the Competence Centres have successfully evolved through more than one Programme and call. Other CCPs followed a more rigorous interpretation of duration.

In the Netherlands the duration is not pre-defined; however, it is dependent on evaluation results (open-ended). This was also the case for the SHOK Programme where the government made the decision to stop the programme in 2015. In the case of Forschungscampus (DE), SHOK (FI), COMET K2 (AT), Vinn Excellence (SE), Berzelii (SE) durations of 10 years or more are foreseen.

It can be expected that larger units need more time for constitution and establishment processes. With this in mind a certain correlation between duration and size can be observed which is plausible. However, Competence Centres Enterprise Estonia and maybe also Catapult are examples with centres of considerable size but relatively short duration also shows that the type of structure is not necessarily a matter of the expected duration of the competence centre.

2.3.3 Policy level, programme ownership and management: national versus regional focus

Most of the CCPs are managed at the level of the national government. However, in some cases the regional level is involved. The VLAIO CCP is basically financed by the regional level (29 Mill €/a).

In the case of COMET in Austria one third of the public funding (25 Mill €/a) is provided by regional governments ("Bundesländer"). In the case of the Vinn Excellence Programme in Sweden one third (12 Mill €/a) of public funding is provided by the Swedish government and one third by the HEI. This is co-funded with at least one third from private industry (usually more than this). The Swedish Berzelii Programme is covered with 50% by the Swedish government (5 Mill €/a) and co-funded by industry and HEI (25% each).

With the exception of the Belgium Innovation Platforms, which are run by the regional government of Flanders, the policy principals of all CCPs under consideration are national ministries or authorities. Reflecting the objectives concerning science-industry collaboration and mobilizing or the paving the way for industrial innovations the majority of programmes are therefore run by ministries for economic development or industrial policy. For the COMET programme in Austria, the SHOK-Programme in Finland but also the Catapult Programme in UK at a minimum the ministries dealing with science and research policy and economic and industrial affairs are involved. Selection processes as well as evaluations are accompanied by external experts and boards assigned by responsible authorities. Even if most programmes observed are managed by one central agency, activities and agents located either at the academic or industrial side are sometimes funded by different management agencies (e.g. Tekes and Academy of Finland in the case of the SHOK Programme).

2.3.4 Strategic orientation: industry and academia

The competence centre approach has a dedicated bridging function in the innovation chain. The collaboration between academia and business has always been much more complex than bringing the right partners together and motivating the commercialisation of research results (see Healey et al. (2014), SBMRC (2011)).

Discussions at the European level frequently use the concept of Technological Readiness Levels (TRL, see Figure 12) in order to illustrate the positions of institutions and programmes.

The TRL scale is a metric for describing the maturity of a technology introduced by NASA. The scale consists of 9 levels. Each level characterizes the progress in the development of a technology, from the idea (level 1) to the full deployment of the product in the marketplace (level 9).

According to the Task Force, the CCPs observed and the majority of activities funded therein refer to TRL 3 and 4. However, depending on the individual centres they can operate up to TRL 7 (Presentation of Technopolis, Boekholt). Overall, however, the positioning of CCPs is not defined by the maturity level of the technologies developed but the need for medium term strategically coordinated R&D collaboration between academia and business at different level of the innovation chain.

There are a range of different interests of both sides (academia, business) and forms of interaction going beyond the agreement on and collaboration in well-defined projects. Different types of motivations have to be considered: academic, economic but also institutional (see: D'Este and Patel, 2007). It has also to be considered that individual motivations of partners can change over time.

The specific position and focus of CCPs (this might be true for the most of policy/funding instruments fostering collaboration between academia and business) depends on the institutional setting of national innovation systems and underlying policy mix and environment. Therefore, it is interesting to consider which players are in the driver's seat and which mechanisms of coordination and control are implemented. Recent evaluations of CCPs (e.g. SHOK, COMET) describe the challenge of balancing interests and incentives between academic and industrial partners which is much more relevant and present in the context of medium or long term research agendas of Competence Centres than in the context of short term collaborative projects (Ramboll, Joanneum 2014, AIT Joanneum 2015).

Figure 12: The Technology Readiness Level explained

The Technology Readiness Level (TRL) is a measure of the maturity of a technology. Its purpose is to assist technology managers and investors in making decisions concerning the development and transitioning of a technology. As a technology is developed from the initial phase (basic principles observed, TRL 1), it progresses through a number of TRLs (the TRL scale) until it is finally deployed in an operational setting (TRL 7).

From its genesis in project management and systems integration, the TRL scale was intended to assist technology managers in identifying those elements and processes of technology development required to ensure that a project satisfies its intended purpose in a safe and cost-effective manner that will reduce life cycle costs and produce results that are defensible to expert reviewers.

As Technology Readiness Levels (TRLs) are used to define the different research and innovation steps going from basic research to the commercialisation of a product, they offer a clear indication of maturity of research conducted. In Horizon 2020, distinction is made between the following levels of maturity:

1. basic principles observed
2. technology concept formulated
3. experimental proof of concept
4. technology validated in lab
5. technology validated in relevant environment
6. technology demonstrated in relevant (industrially relevant) environment
7. system prototype demonstration in operational environment
8. system complete and qualified
9. actual system proven in operational environment (competitive manufacturing)

As a tool for assessing market orientation of the research centres, the TRL analysis of the current portfolios of has clear pros and clear cons. The cons were clearly described by EARTO and include the need for more attention to setbacks in technology maturity. We are aware that the analysis offers a picture that does not respect the strong dynamics in the centres in general and in certain projects in particular.

Even though activities in the higher TRLs correlate with a strong industry involvement, activities in TRL 1, and TRL 2 do not automatically imply that industry is not involved. The benefits of the scales are also clear. The categories are widely used and understood. They give a structured and common understanding of the maturity of the research that is being conducted: the higher the TRL value, the closer a product or a service is to the market. In Horizon 2020 these categorisations are intensively used by the European Commission.

RTOs are generally active throughout the entire TRL scale. From TRL 4 to TRL 7, this is believed to be the most prominent RTOs area, according to EARTO.

Source: Technopolis (2015)

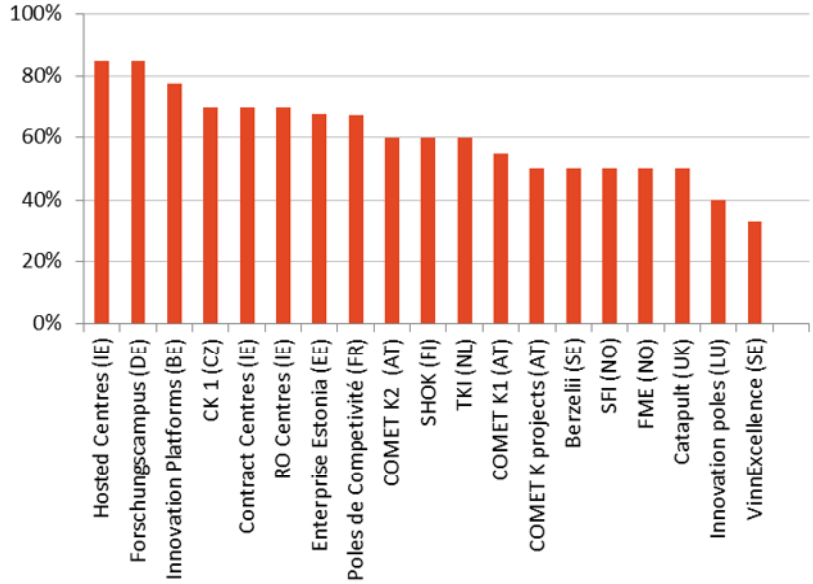
The dominance of specific partners is not necessarily indicated by the partners funded or related to the representation of academic vs industrial partners in unit-counts. The average funding rate is a function of national funding frameworks, the partner mix (e.g. SMEs, HEI vs. LE or, the cost-structure (e.g. infrastructure) and the share of the core grant, cooperative R&D (publicly funded) and contract research expected.

Therefore observed differences among the CCPs concerning average funding rates cannot be interpreted as an indicator for the differentiation of more academia driven vs. industry led centres. In principle, it can be assumed that the higher average funding rates, the lower the share of

industrial and experimental development activities or the higher the share of academic research involved.

Taking into account the limitations of available indicators the Task Force Members tried to qualify CCPs concerning leading position (industry vs academia) in CCPs.

Figure 13: Average Funding rate of Competence Centre Programmes in Europe



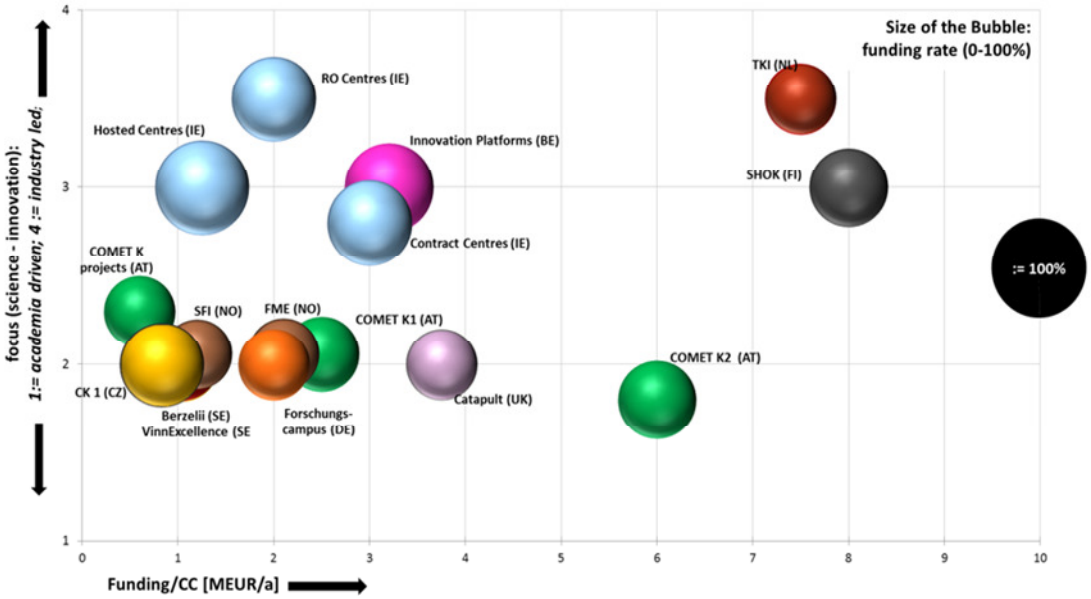
* For Flanders this only involves the percentage for the platform funding, and not for the individual projects.

** In all programmes funding rates follow the state aid rules; therefore no overall funding rate can be determined. For Germany the funding for Higher Education is 100% of direct costs plus 20% overhead flat rate. For companies the funding rate is 40%.

Source: Taftie Task Force on Competence Centre Programmes

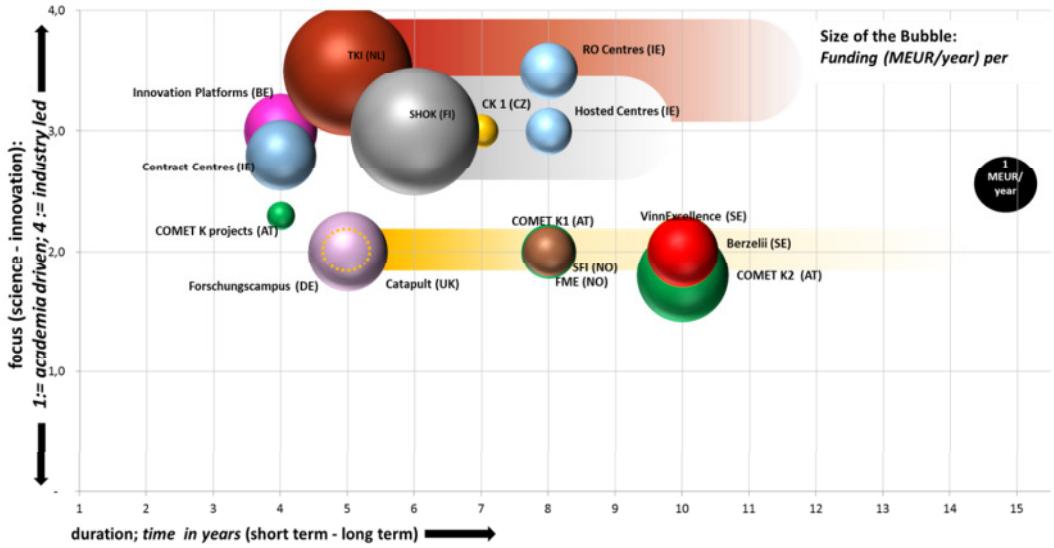
Figure 14 and Figure 15 compare the CCPs observed according to their driving position of industry or academia on the one side and funding conditions and scheduled duration of Competence Centres".

Figure 14: Focus (industry vs academia) in CCPs in the light of funding conditions



Source: Taftie Task Force on Competence Centre Programmes

Figure 15: Focus (industry vs academia) in CCPs in the light of funding conditions and maximum contract duration



Source: Taftie Task Force on Competence Centre Programmes

Figure 14 shows a very weak correlation between the funding rate and a leading role of the academic side. With the exemption of COMET K2 Centres in Austria, the largest centres are predominately industry led. When combing the industry/academic orientation with the duration of CCPs we can't see a significant correspondence between both dimensions.

A complementary and important dimension not covered by the previous illustrations is openness beyond the core-partnership both on the academic and the industrial side, which turned out to be a challenge for many of the CCPs discussed.

2.3.5 Selection process and evaluation

Selection processes of programmes supporting R&I and collaboration between academia and industry meet relatively high standards nowadays. The underlying selection mechanism of all CCPs observed was call-based (in most cases a two-step approach). In all cases considered, external experts have been included: in some cases in a panel or commission, in some cases as individual peer evaluators.

Following CCPs in Europe incorporate a bottom-up approach and are thematically open: COMET (AT), Vinn Excellence (SE), Berzelii (SE),SFI (NO), CK 1 and 2 (CZ), RO Centres (IE), Forschungscampus (DE), Catapult (UK), Luxembourg - Innovation poles, Hosted Centres (IE). However, even in the framework of these CCPs individual projects have to be defined within the parameters of the previously coordinated strategic research agenda.

Figure 16: Comparison of selection and evaluation mechanisms of CCPs

CCPs	Application and Evaluation					Selection					Programme Evaluation	
	full application	written evaluation	(internat.) reviewer	hearing	panel/ jury (external experts)	decision by agency or board of agency	decision by board of agency	decision by ministry	decision by govern-ment	decision by commission	interim/ accompanying evaluation	Evaluation at the end of the funding period
COMET K2 centres (AT)	x	x		x	x			x			x	x
COMET K1 Centres (AT)	x	x		x	x			x			x	x
COMET K projects (AT)	x	x			x			x			x	x
Innovation Platforms (BE)	x		x	x	x				x		x	x
VinnExcellence (SE)	x	x	x	x	x	x					x	
Berzelii (SE)	x	x	x	x	x	x					x	
SFI (NO)	x	x	x		x		x				x	
FME (NO)	x	x	x		x		x				x	
CK 1 (CZ)	x	x			x		x				x	
CK 2 (CZ)	x	x			x		x				x	
Hosted Centres (IE)	x	x	x	x	x	x					x	
Contract Centres (IE)	x	x	x	x	x	x					x	
RO Centres (IE)	x	x	x	x	x	x	x				x	
SHOK (FI)	x	x			x			x				x
Forschungscampus (DE)	x		x	x	x			x			x	
CC Enterprise Estonia (EE)	x				x	x						
Innovation poles (LU)	x								x		x	x
Catapult (UK)	x	x			x		x				x	

Source: Taftie Task Force on Competence Centre Programmes

Following CCPs show predefined thematic corridors coordinated with national priorities and needs: TKIs (NL), SHOK (FI), Enterprise Estonia, FME (NO), Contract Centres (IE), Innovation Platforms (BE), This means that in some cases application was restricted to certain actors, which were invited to participate (e.g. BE).

In the case of all CCPs evaluation and monitoring procedures are foreseen. The evaluation and monitoring mechanisms follow national procedures and put different weight to peer reviews/panel assessments and Key Performance Indicators:

- In the cases of Swedish CCPs peer review assessment seems to have much higher weight than in other countries.
- Even if accompanied by qualitative assessment in the case of the Austrian COMET monitoring and Key Performance Indicators play a significant role.
- Another example is the CCP Forschungscampus in Germany, where accompanying research and evaluation plays a significant role.

Figure 16 provides an overview of selection and evaluation approaches of the CCPs observed.

2.4 Governance models of Competence Centre Programmes

In the course of the analysis and discussions of the task force it became obvious that the organizational setting and governance model have significant influence on collaborative arrangements, strategic focus and investment.

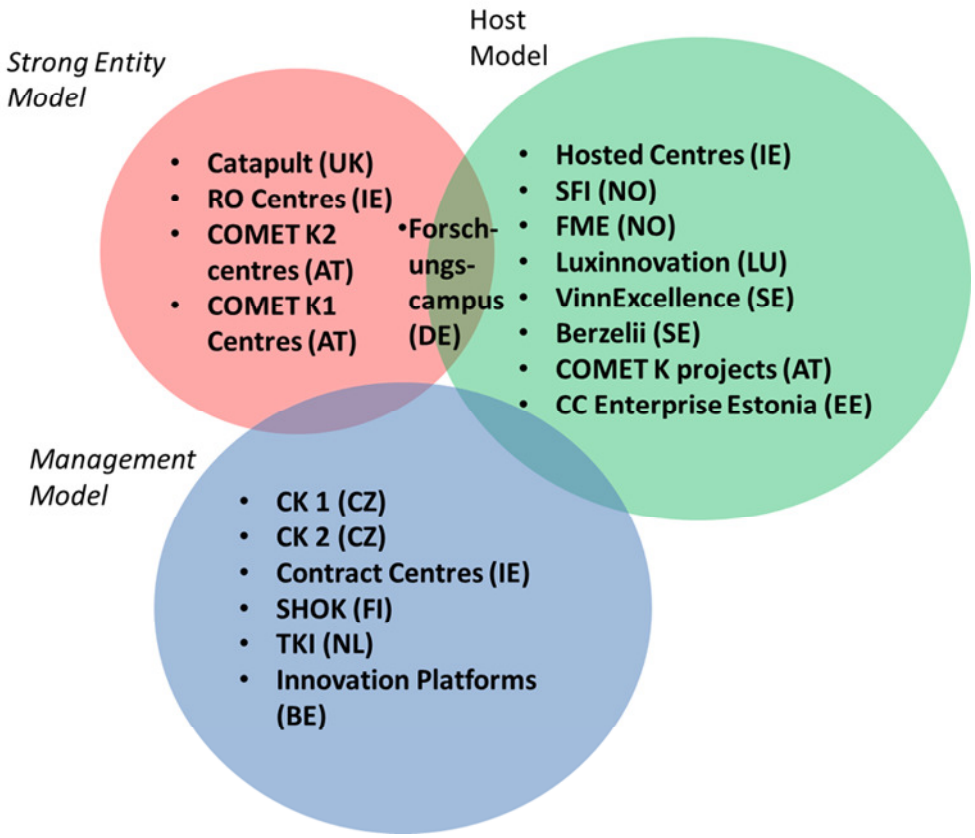
A set of basic programme governance models was derived from the logic charts analysis (see chapter 2.1) as well as from the previous experience of the group. These basic governance models also emerged from the qualitative data on governance models at the centre level and will therefore be used as analytical categories for summarizing the key findings. The models are the following:

- Model A: “Management” Model
- Model B: “Strong Entity” Model
- Model C: “Host” Model

Figure 17 classifies the CCPs observed on the basis of the three Governance Models.

It became obvious that the host model and the management model are the most common governance designs among CCPs in Europe. The following sections provide a brief description of the three types proposed.

Figure 17: Governance Models of CCPs



Source: Taftie Task Force on Competence Centre Programmes

2.4.1 Model A: The “management” model

In this model an administrative unit (e.g. 6-8 FTE) receives the funding. This unit organises the individual research projects which usually result from additional calls outside or inside the centre. These centres tend to be selected top-down (e.g. by sector structures), tend to be more industry-driven and show some similarities to cluster activities.

Examples which might fit into this scheme are the innovation platforms in Flanders (run by VLAIO) and the TKI in the Netherlands (run by RVO). The following main features of model A were identified:

- Top down decision: e.g. by using a sector structure
- Research is organised through an intermediary, the administrative unit
- The centres are virtual and make use of an existing infrastructure
- They cover no or lesser levels of educational aspects
- IPR follows the projects (on a case-by-case decision)

Policy goals which are more strongly related to this model are SME involvement, joint programming and international competitiveness of the companies involved.

2.4.2 Model B: The “strong entity” model

In this model the full centre including research programmes/projects receives the funding. The centre is a strong legal entity (such as ltd. company) and has its own employees. The funding decision usually results from an open call. These centres are selected bottom-up.

Examples which might fit into this scheme are the Irish RO centre (Enterprise Ireland), the Austrian K1- and K2-Centres, the Finnish SHOK programme or the centres in Estonia.

The following main features of model B were identified:

- Bottom-up decision: by open calls
- Strong legal entity (Ltd.)
- The centres show less flexibility (due to their legal structure)
- The centres invest in own infrastructure (or share with others)
- They cover more educational aspects than model A
- They have a long-term perspective
- They have a rather narrow focus (because of branding reasons)
- Difficult to exit/close down

Policy goals which are more strongly related to this model are to strengthening of cooperation between science and industry, to increase the innovative capacity of enterprises, to sustain employment and turnover.

2.4.3 Model C: The “host” model

In this model a University or RTO usually acts as host. These centres tend to be more science-driven. They neither have a strong legal entity nor have own employees. The funding decision usually results from an open call. These centres are selected bottom-up.

Examples which might fit into this scheme are the Irish contract centres, the Berzelii/ Vinn Excellence centres in Sweden (VINNOVA) or the Norwegian SFI/FME centres (RCN).

The following main features of model C were identified:

- Bottom-up decision: by open calls
- Consortium, no legal entity
- Easier to tap into other research funds (e.g. H2020)
- Educational aspects are important
- They have a long-term perspective
- Academic culture/agenda makes it less flexible
- Easier to exit

Policy goals which are more strongly related to this model are to strengthen the cooperation between science and industry, scientific reputation, economic impact – turnover/employment and increase private investments in R&D.

3 Monitoring and performance indicators for CCPs

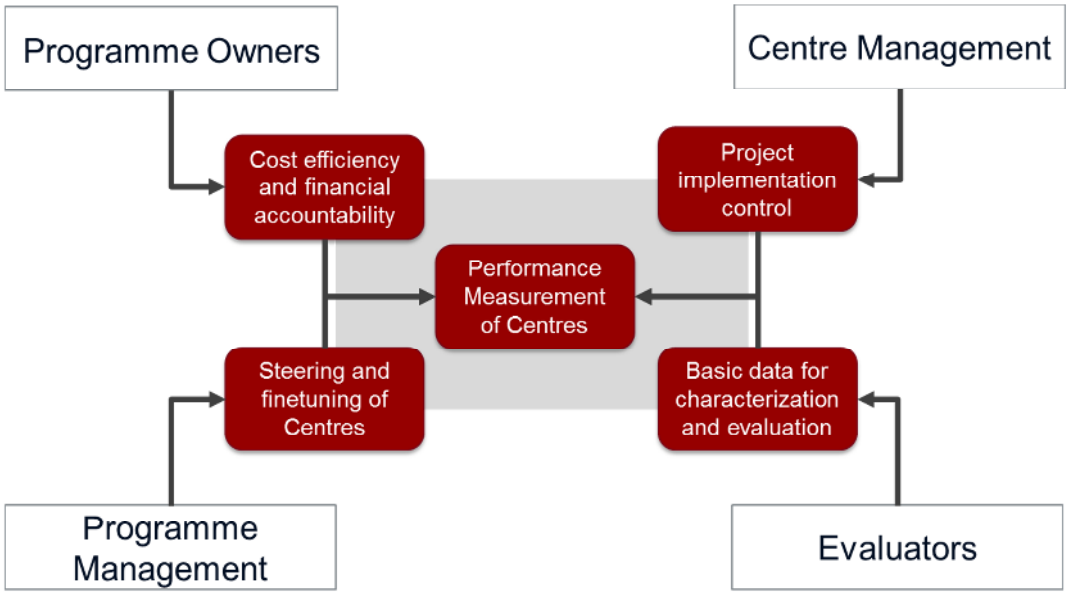
The programme management of CCPs has responsibilities associated with the provision of public funding and has therefore a duty to ensure high quality performance and best value for money (cf. CREST 2008). Creating monitoring systems is an important task for the programme management in this regard. The provision of monitoring data and Key Performance Indicators serves the purpose of scientific and financial control. Monitoring data should also inform evaluations on key achievements of programmes. Emphasizing performance aspects, monitoring can be defined as a continuous assessment of key programme functions organised internally by programme management (or a monitoring unit) and carried out on an on-going basis; as such it entails setting up a data collection system for compiling key data on programme activities, participants, interim achievements, and results (Dinges et al. 2011).

When designing monitoring systems of research and innovation programmes, key user needs should be taken into account. In the case of CCPs, four types of stakeholder with different types of needs concerning performance information can be differentiated (see figure below).

For programme owners, financial accountability and cost efficiency of operations are key, whereas for evaluators, monitoring data should at least provide basic data for characterisation of centres/networks and activities performed within these networks (Dinges et al. 2014). For programme and centre management, monitoring systems should further provide a continuous overview of progress made towards target, and hence allow for steering and fine-tuning of the development of centres (ibid).

In designing monitoring systems for CCPs, the TAFTIE working group recommends that the logic models of CCPs should serve as a starting point for devising indicators that inform the different stakeholders about the different functions of the programmes and centres.

Figure 18: Customers and use of competence centre monitoring data



Source: Dinges, M. (2014)

For characterising CCPs and individual centres/networks, the following two different types of indicators (Holzapfel 2014) can be distinguished and should be taken into account[2]:

- **Descriptive indicators** describe a situation or change and provide information that is not connected to a concrete target. These indicators respond to the question: "What's happening?"
- **Performance indicators** are quantitative metrics measuring the progress towards reaching a goal or an objective over time that is represented by a target value relative to a baseline. These indicators respond to the question: "Does it matter? Are we reaching targets?"

Both descriptive and performance indicators are of relevance for measuring progress towards reaching target set in the objectives of the programmes and for learning about the positioning of Competence Centres within the national innovation system. According to the OECD/DAC terminology, the following performance monitoring indicators should consider the following stages:

- **Input indicators** measure the financial, human and material resources used. Example: The budget allocated to a particular activity.
- **Activity indicators** measure the actions taken or work performed as a result of which inputs are mobilised to produce specific outputs.
- **Output indicators** measure the products, capital goods and services which result from the activities. Example: Number of graduates from CCPs.
- **Result indicators** measure the likely or achieved short-term and medium-term effects of an intervention's outputs. Tentative example: Proportion of Master graduates that have started a business.
- **Impact indicators** measure the positive and negative, primary and secondary long-term effects produced by the activities, directly or indirectly, intended or unintended.

2 Indicator definitions stem from Holzapfel, S. (2014). The role of indicators in development cooperation: an overview study with a special focus on the use of key and standard indicators. Available at SSRN 2546242.

In devising Key Performance Indicators for CCPs the TAFTIE working group on CCPs recommends that Key Performance Indicators need to be measurable in 'real time' in order to know whether the competence centre programme or the centres therein are on track. The creation of performance monitoring tools should primarily be seen as a learning tool for advancing the effectiveness of implementation of Competence Centres/networks and core questions to be considered for devising Key Performance Indicators are therefore:

- **Timeliness:** is the monitoring system delivering results when they are needed?
- **Comparability:** can the information of individual centres be compared across centres, with similar programmes, other funding mechanisms, and
- **Feasibility:** what burden does a monitoring system pose on its constituents?

The TAFTIE working group acknowledges that impact can only be properly assessed in the longer term and ex-post and should therefore be assessed by formal independent reviews by external consultants. Attribution problems and timing are the main reasons why outcomes and impacts are rarely considered in programme monitoring, but as Competence Centres frequently have a life time of more than 5 years, reporting systems may also take into account innovation impacts achieved at the level of participants, in particular related to capacity building for different types of product/process innovations, capability to introduce organisational innovations, increased creativity and skills, and economic results achieved through participation in the competence centre network (Dinges et al 2014).

Figure 19: Key Competence Centre Indicators suggested by Taftie Task Force on Benchmarking R&I Programmes

Logical Framework Element	Indicator	Detailed (sub-) Indicators
Input Indicators		
Budget	Contracted budget	Total amount of funding in euro contracted in year x: - Total - All enterprises - SMEs - Knowledge institutions
Activity Indicators		
Managing and operating Competence Centres	Number of Beneficiaries	Number of unique organisations active in R&D-projects in the Competence Centres: - Total enterprises - SMEs - Knowledge institutions Number of Competence Centres supported in year x
Output Indicators		
(Collaborative) R&D Projects	Private contributions	Total private contributions in euro contracted in year x
Outcome Indicators		
More innovations	Innovations	Share of enterprises that introduced an innovation (new to the firm) within two years after the project - Share of firms introducing an innovation - Share of firms introducing a product innovations (either service or good) - Share of firms introducing a process innovations - Share of firms introducing an organisational innovation - Share of firms introducing a marketing innovation Potential Sources: Survey among beneficiaries or CIS survey data

Improved R&D capacities & capabilities	Higher R&D Expenditure	Increase in R&D Expenditure of beneficiary enterprises: - R&D expenditures 1 year after closure of the project - R&D expenditures 1 year before start of the project. Increase in R&D FTE of beneficiary enterprise: - R&D FTE 1 year after closure of the project – R&D FTE 1 year before start of the project. Source: BERD survey or beneficiary survey during ex-post evaluation
Increased cooperation Between firm and knowledge institutes	Increased co-operation	Increase in expenditure on external R&D: - external R&D expenditures by beneficiary enterprises 1 year after closure of project – external R&D expenditure by beneficiary enterprises 1 year before start of the project Source: BERD survey or beneficiary survey
Impact Indicators		
Better economic performance of firms	Turnover increase	Percentage increase of turnover between 1 year before the start of the project and 3 years after closure of the project. Source: National Business Statistics or beneficiary survey
Structural higher research intensity and rate of innovation in firms	Research intensity of enterprises	Percentage point increase of share of R&D expenditure in enterprise turnover between 1 year before the start of the project and 3 years after closure of the project. Source: BERD survey or beneficiary survey
More innovative firms	Innovation behaviour	Percentage point increase of share of turnover related to innovative products. Source: CIS survey or beneficiary survey

Source: TAFTIE Task Force on Benchmarking R&I Programmes

A first baseline for establishing monitoring systems for CCPs was provided by the TAFTIE Task Force on Benchmarking Impact, Effectiveness and Efficiency, which identified a baseline logic model for CCPs and suggested using a number of indicators along the results chain of the programme as a starting point for benchmarking CCPs (Technopolis 2015).

The list of indicators suggested therein has a strong focus on effects on industry and places somewhat less emphasis on the variety of objectives and activities which competence centre pursue[3]. The TAFTIE work group on Competence Centres therefore suggests mapping Key Performance Indicators relating to the main impact dimensions of the programmes.

Apart from increased competitiveness, these domains may include the dimensions international reputation, human capital, scientific reputation, societal effects, and professional culture of research, may be taken into account.

3 The list of indicators is provided in the Annex of this paper.

Figure 20: Key Competence Centre Indicators suggested by Enterprise Ireland

Outcomes/ Impacts	Activity KPIs	Process KPIs	Output KPIs
Turnover/Jobs/ Savings/ New Companies	®Company Members ®Co-funded Projects ®IDFs & Patents ®Company Co-funding	®New Partners join ®Commercialisation ®Increasing funding over time ®Industry-led project selection	®Licences ®IPR Transfers ®Spin outs/Spin-ins ®Informal IP Transfers
International Reputation	®International Funding ®International Members ®International Company Projects ®Standards	®International Networking ®Centre Formal Agreements ®Committees' Representation	®FDI ®New Markets for Companies
Human Capital	®PhDs ®Masters ®Formal Training of Staff ®Formal Company Training	®Project Supervision ®Training Accreditation ®Research Management ®Awards developed	®Staff transfers ®Improved ability for new staff ®Improved ability for existing staff
Scientific Reputation	®Publications ®Citation indices ®Other Media	®Researcher Selection ®Partner Selection ®Bottom-up project selection	®H Factors etc ®Global Research Rankings
Societal: Health, Environment, Security	®Clinical Trials ®C02 Monitoring ®Water monitoring ®Energy monitoring ®Threat monitoring	®Societal Partners included ®State Partners included ®Cost-Benefit or Business Models established	®Wellness outcomes/Healthcare standard improved ®Reduced energy/CO2 ®Reduced pollution/water consumption ®Risks reduced/lives saved
Professional Culture of Research	®Business Interaction ®Staff training	®Governance ®Project Management ®Senior Staff recruitment	®Increase in level of Open Innovation

Source: Enterprise Ireland

The selection of Key Performance Indicators for each competence centre programme is not trivial and no one-size-fits-all solutions may be applied. It depends upon the actual relevance of each domain and also the type of competence centre programme: for example, a monitoring of third party funding may only apply for centres having their own legal entity. The list of indicators suggested by the TAFTIE Task Force on CCPs is therefore considered to be a starting point for reviewing, commenting and mapping of their own system.

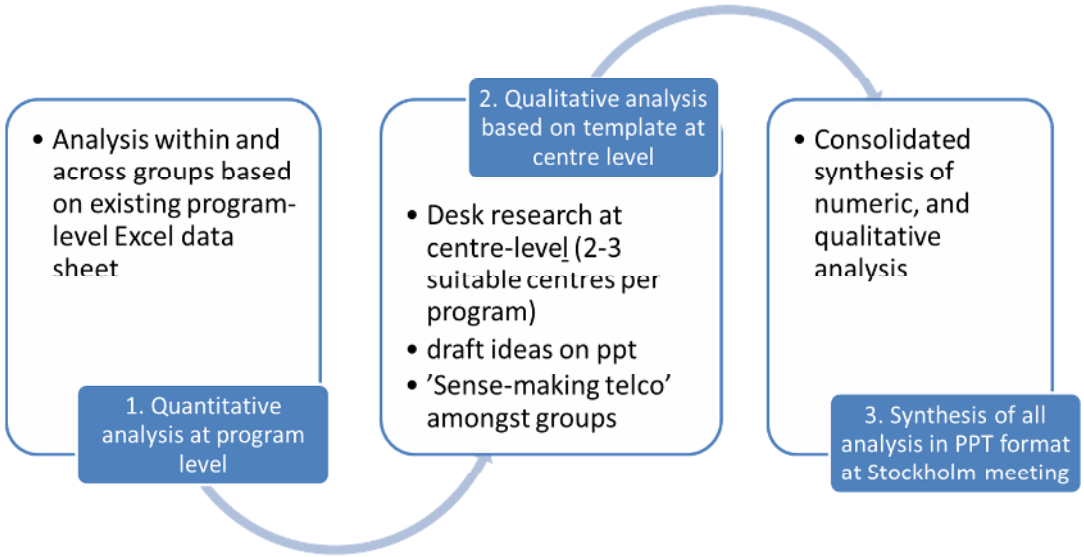
4 Analysis on the structure and purpose of Competence Centre Programmes

The mapping of Competence Centres provided an initial basis for discussion of similarities and differences across programmes and the parameters discussed in the previous sessions. Based on this consolidated initial mapping a more qualitative analysis was performed. On the basis of the analysis portrayed in section 2.4, three overlapping groups of CCPs (see Figure 17) were identified:

- One group of programmes/centres (TKI/NL, COMET K2/AT, SHOK/FI) was pointing at the larger programmes and centres, with two programmes being rather industry driven.
- Another group including RO and contract Centres (IR), Innovation platforms (BE), COMET K1-Centres (AT), was referring to medium-sized centres, more on the industry driven side.
- A third group included the "smaller" initiatives such as the Swedish centres (VINN Excellence, Berzelii) the Norwegian centres as well as the Forschungscampus (DE) and COMET K projects (AT), being partly more science driven.

The analysis for these clusters was then broken down into three stages as shown in Figure 21.

Figure 21*:* Process for analysis of Competence Centre Programmes



Source: TAFTIE Task Force on Competence Centre Programmes

In the first phase the initial mapping was enriched and updated by more recent and reassessed data for each programme.

In the second phase each partner also collected qualitative data on 2-3 centres for each of the national programmes based on a pre-designed template and reported the findings to the other group members for a reality check.

In the third phase the Task Force coordinator produced a consolidated synthesis of both the quantitative and qualitative data for discussion at the Stockholm meeting in June 2015 where the findings were also assessed across the different competence centre programme groups.

In the following, the main qualitative findings from are reported across the three clusters for a first overview on how centres and programmes seem to differ from the viewpoints of the size and industrial orientation of the programmes.

The analysis is structured around a number of themes relevant for CCPs:

1. Governance and incentive structure
2. Adaptability to new RDI, market and social trends
3. Broadness of activities (e.g. for 'open innovation', tech. transfer etc.)
4. Openness to new actors, potential to extend networks
5. Internationalisation
6. 'Exit-strategy' for gradual withdrawal of national public funding

4.1 'Industrially oriented large' Competence Centre Programmes

Governance and incentive structure

These larger and industrially oriented programmes tend to be more top-down governed and with the exception of the Austrian programme COMET (K2-Centres), sectoral priorities have initially been set by ministries. While the centres often work closely with the funding agencies in defining strategies, the monitoring of progress made are based on a definition of Key Performance Indicators and the definition of strategic visions at centre level.

The centres are often strong and independent entities (e.g. limited companies), which sometimes provides barriers for the development of exit strategies and ensuring adaptability. In order to allow for a certain degree of adaptability, the dynamics of centres in this group/cluster are maintained through competitive calls for funding for specific RDI projects. On the other hand, the status of the centres themselves is guaranteed and funded on a more long-term basis.

This has tended to lead to a situation where the centres sometimes have become too dominant in their respective areas, too dependent on one or a few public funders and may not be open for newcomers.

Adaptability to new RDI, market and social trends

The main mechanism for launching RDI within these centres is continuous open and competitive calls. In these calls flexibility is needed to allow for new visions. The activities within these programmes tends to focus on RDI in response to industrial needs and to cover 'traditional' types of activities such as contract research, workshops, technology transfer and valorization etc. IP issues tend to be problematic and competition between companies is also an issue that may inhibit collaboration in more strategic areas.

A key challenge is that these centres are sometimes limited in their operations due to their fixed governance structures (limited companies) while being still too dependent on public funding. Achieving openness and ability to include new partners is a key challenge as there is risk of domination by a few actors. At the same time, the centres do not have an explicit 'exit strategy' for a situation where public funding may be phased out, this is currently a challenge in Finland where dedicated funding to the SHOKs is ending.

Broadness of activities (e.g. for open innovation, technology transfer etc.)

The centres perform rather regular types of activities including contract research for industry, training and education, participation international conferences, representation in standardisation boards and other advisory groups, technological road-mapping, international collaborative activities, and valorisation and utilization of research part of the RDI project activities.

The level of experimentation with new research and innovation activities depends by and large on the centre and the area/industry that they address. In this respect, some incentives for 'strategic projects' need to be developed. However, funding regulations sometimes limit the scope of activities that can be performed by centres (e.g. limitations to fund non RDI activities that are closer to markets and commercialization).

Openness to new actors, potential to extend networks

The centres are in general open to new actors, but the openness also depends upon the centres ownership structure and in particular IPR issues. Despite the objective of many centres to bundle core companies or even sectors, competitive issues may sometimes hinder the entry of new firms. This holds true in particular, if centres are dominated by a few major players in the sector concerned.

'Exit-strategy' for gradual withdrawal of national public funding

Most of the centres do not have an explicit exit strategy and centres are overly dependent upon future calls for Competence Centres. Programme owners need to take care to formulate/define phasing-out processes if evaluations are negative or centres are unsuccessful in calls. In this regard, the Austrian Programme COMET has collected distinct experiences with phasing-out processes.

4.2 'Balanced medium-sized' Competence Centre Programmes

Governance and incentive structure

These medium-sized programmes show more variation in their governance structure and are in general, less centralized. They operate more in a 'bottom-up mode' compared to the first cluster. For example, the innovation platforms in Belgium are operated via a management unit organised in a non-profit organisation (association, cluster type activity) with max. 6 FTE (funded max. 80%). They have to acquire projects, partly by having access to dedicated project funding. But also the RO centres (IRL) and K1-Centres in Austria, which are organised as ltd. Companies represent a more bottom-up activities than programmes in the first cluster.

Programmes in this cluster are particularly valuable for serving as a contact point for a number of companies, in particular SMEs, due to their demand driven focus. However, this bears the risk of having only limited impact on the long-term innovation capacity of firms due to a strong service orientation.

Key success factors and good practice in terms of governance structures that have been identified are:

- Trustworthy and well-balanced centre boards
- Appropriate methodologies for selecting research programmes and projects
- Centre manager from industry (strong management)
- open engagement models for companies

A downside and challenge of the open-ended and platform-oriented engagement model used in this type of centre is that the evaluation and monitoring is challenging and complex, as there are no well-defined physical centres with a core set of research activities and level of involvement of industry stakeholders may vary significantly.

Adaptability to new RDI, market and social trends

The adaptability and dynamics of the centres are supported by the openness of the platforms that they support, although there is also variation across the centres e.g. depending on the sectors that they cover. In general, means for adaptation that are employed by these programmes are:

- (thematically open) calls
- open/flexible research programmes with overall objectives fixed, but details not yet fully defined
- changes of practices and adaptation of research programmes at the time of the mid-term evaluation

Good practices and success factors that have been identified include:

- The creation of smooth running centre boards which decide on changes in the work programme and the respective trust of funding agencies (e.g. accomplished by yearly visits to the centres)
- The use of annually reviewed business plans
- The conduction of company satisfaction surveys

Challenges that have been identified relate to expectations of host colleges/universities in terms of resources, publication activities and training of PhD fellows, as well as training and qualification practices in general. Furthermore, the platforms differ a lot and are difficult to compare. Finally, on the individual project level, evaluations need significant extra resources.

Broadness of activities (e.g. for open innovation, technology transfer etc.)

The decentralized model of operation implies that the centres typically engage in many different types of activities including contract research for industry, work with standardisation bodies, lectures at universities, organisation of conferences and acting as central contact points for industry platforms etc. However, the total activities of this type of programme are sometimes difficult to connect to specific product development activities and other industrial activities.

The programmes in this cluster also appear to be able to remain open to newcomers but the openness of the centres also depends strongly upon the sector/topic of operation (traditional sectors are less open than e.g. the IT sector).

A key issue for this programme cluster is to build and sustain competences. In order to allow for building of competences it was therefore considered as good practice to perform real strategic R&D projects with approx. 15-20% of budget, in order to build up new knowledge which should allow for development of more radical innovations. This is the case for the K1-Centre programme in Austria.

Another challenge is the demand for demonstration and infrastructure but this was considered to be very difficult to support financially.

Exit strategies

Similar to the larger and more industry-oriented programme cluster, the centres in this cluster do not have explicit exit strategies. This also creates some challenges for some of the centres. Overall, no truly independent centres exist yet.

The main existing exit strategies are the conducting of open calls and the allowance of phasing out phases for transition or closure of centres. In this regard Ireland allows a phasing out phase of 2 years to close down operations and the Austrian K1-Centres have a phasing out phase of 1 year. Without funding from CCPs, some centres will disappear, some will shrink or do more applied (contract) research. Some centres might also be integrated in other organizations (universities, RTOs etc.)

The means to increase chances for successful transition are to increase independence from single public funding sources. This can be achieved by programme target requirements to acquire additional funds from third parties (EU, industry and other funds) during the funding period. The TAFTIE group considers it as a good practice if centres have approx. 30% other incomes. This is the case in the Austrian programme K1-Centres.

4.3 'Smaller initiatives' Competence Centre Programmes

Governance and incentive structure

Within the smaller initiatives programme cluster all CCPs have contract(s) between partners. Steering boards with both academic and industry members, including observer status for funding agencies are the main governance mechanism of centres alongside operational business plans. The main incentives to achieve impact come from evaluations and the definition of Key Performance Indicators.

Good practice that has been identified for steering Competence Centres in order to achieve impact includes:

- the use of boards for strategic matters and portfolio management
- an increased personnel mobility between academia and industry in order to better understand needs
- leadership training measures for managerial staff
- incentives that allow application for increased funding (e.g. positive review results)

Key challenges identified in this area include the definition of coherent project work packages which lead to the same vision and the definition of multilateral project portfolios to increase cooperation between academia and industry and hence facilitate technology transfer.

Adaptability to new RDI, market and social trends

The cluster of small programmes shows similarities in mechanisms to ensure adaptability. Steering boards of centres should provide inputs for integration of new trends. Progress reports and external evaluations provide insights on how market trends and social trends are adapted by the centres.

Identified good practice for ensuring adaptability includes:

- Rigorous business/operational plan review process
- Long-term engagement of centres/partners

Challenges that have been identified by the Task Force concern the balance between adaptability and reaching the long-term goals of the centres and mechanisms to include new partners in a straightforward manner.

Broadness of activities (e.g. for open innovation, technology transfer etc.)

In addition to defined R&D projects, the activities of the centres comprise strategic communication activities, dissemination of results and branding activities. The centres aim to act as focal points should allow for the building of networks and facilitates different interactions.

Good practice activities that have been identified by the Task Force include:

- scenario planning
- innovation awards
- incentives for multi-lateral projects
- long term engagement

Challenges concerning the breadth of activities comprise:

- limited resources for new activities, once the money has been allocated,
- the creation of synergies between different centres (new agreements concerning joint actions between competence centres)
- tensions between requirements of classical scientific methods and new and more experimental ways of working

Openness to new actors, potential to extend networks

In order to evaluate openness to new actors and expansion of networks the programmes in this cluster rely upon the evaluation of centers concerning this aspect. However, openness is considerably constrained by contractual regulations and the availability of public funding.

Good practice for increasing openness that has been identified by the Task Force include: business development resources to search for strategic partners, development of clear and distinct profiles for the centre, focusing on excellence in precompetitive research, and thereby increasing visibility nationally and internationally.

Challenges for this type of programme comprise: higher administrative burden with increasing number of partners (>15), time needed for approval processes (e.g. receiving letters of commitment from company management), sharing of existing intellectual property by existing industry and research partners.

Exit strategies

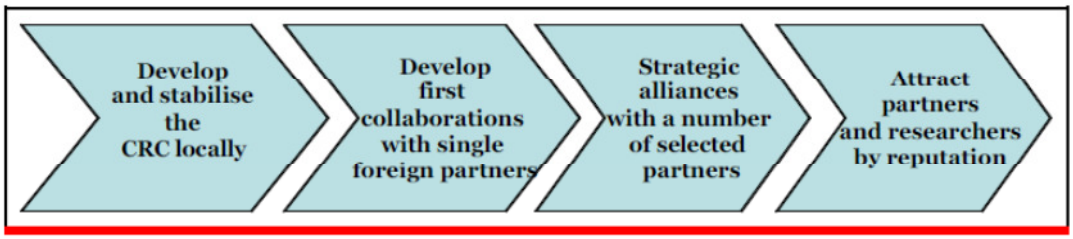
Usually, programme management agrees a formal sustainability plan including exit options. Thereby, it has been identified as a key issue that university management gets strongly involved in the strategic planning of the centres. This will lead to better internal support and increases chances for sustainability.

5 Internationalisation of Competence Centre Programmes

Internationalisation is becoming an ever more important issue for competence centre programme managers. The main drivers to engage cross-border collaborations come from a) the centres' stakeholders facing various international challenges, b) from developments within science and technology that require critical mass and excellence and c) from the European, national and regional policy making bodies that see the potential for opening up to international partnerships (Boekholt et al. 2009). Internationalisation of centres and programmes may also encourage efficiencies in public funding by leveraging synergies between national and European funding instruments. Furthermore internationalisation is seen as a means of quality assurance. The acquisition of funds from international funding sources such as Horizon 2020 provides independent, external feedback to the quality of research agendas/proposals of Competence Centres and demonstrates competitiveness in the international arena.

However, there are also obstacles to internationalisation. First of all, it needs to be acknowledged that the ability to internationalise depends strongly upon the maturity of Competence Centres and existing network partners (see figure below). Young centres and programmes first need to build-up their national networks and gain reputation before being able to internationalise. The identification of the right foreign partners and building of trust with these partners can be a daunting task, depending largely upon personal networks of national centre managers, academic and industrial partners. Also in legal terms, arranging national public funding for foreign partners to work within one or more competence research centres is still difficult in most countries (Boekholt et al. 2009).

Figure 22: Life cycle of internationalisation of Competence Centres



Source: Technopolis (2009)

Therefore, TAFTIE CompAct also analysed the status-quo and strategies regarding internationalisation of CCPs in order to identify good practice for mutual learning.

The analyses performed by the Task Force comprised a short qualitative survey and used information stemming from the mapping of CCPs at programme and centre level. Information was provided by the following funding agencies: FFG (AT), VLAIO (BE), PtJ (DE), Enterprise Estonia (EST), Enterprise Ireland (IE), RCN (NO) and VINNOVA (SE).

Programme goals for internationalisation

The analysis of the intervention logic showed that clear internationalisation strategies and outcomes are not prominently placed in the large industrially oriented programme cluster, whereas the balanced medium sized programme cluster tends to be more international and in the smaller initiatives programme cluster centres strive to be visible nationally and internationally and therefore develop clear and distinct profiles.

In the TAFTIE survey on internationalisation, only the Austrian and the Estonian Programme reported to have specific internationalisation objectives at programme level.

The Austrian competence programme formulates the overall objective to strengthen the Austrian research location for the long term, by advancing and bundling existing strengths and by integrating international research expertise. It is therefore a specific programme goal, to establish a number of centres, which achieve international visibility through top-level research as well as by integrating internationally distinguished researchers and companies. The Estonian programme relates internationalisation to the goals of becoming a self-sustainable organisation which may only be achieved if centres are competitive and recognized at a worldwide level.

Overall, both programmes see internationalisation as means to increase impact on the national research location and as means to increase national competitiveness of research and innovation activities. In addition, the German Forschungscampi and the Norwegian SFI and FME programme reported to have complementary internationalisation objectives at the centre level, such as recruitment of young researchers or internationalisation (Forschungscampi), or the ability to be a) successful in international research cooperation (e.g. as a player under the EU framework programmes), b) engage in active collaboration with international research groups and c) attracting outstanding international researchers, including research fellows and senior staff, as visiting researchers.

Specific requirements and evaluation criteria

Although internationalisation is only a programme goal in a limited number of CCPs, internationalisation of CCPs is deployed by many agencies at a centre level by means of formulating specific requirements and criteria.

The set of requirements most prominently includes the formulation of objectives and targets for internationalisation at centre level, the requirement for international steering and advisory boards in governance structures, and the creation of indicator systems aiming at the identification of international visibility, awareness and reputation. For example in Norway, centres applying for CCPs have to describe in their proposals for funding their international research cooperation efforts including statements on how such cooperation will benefit the centre, why the centre will be an attractive partner for cooperation with international research actors and plans for international researcher exchange. Also in Austria, internationalisation plans have to be addressed in the call for proposals. Accordingly, internationalisation is addressed in centre evaluations and at the application stage. Evaluation criteria in this respect relate to:

- Planning and implementation of international strategy: The centres' objectives and concrete strategies/plans for international cooperation.
- International integration: The participation of international partners (from the research community and the business sector) and appropriateness concerning the topic; active integration of international industry, scientific partners, and scientists.
- Top-class implementation and increased international visibility: increased international status of participating institutions within the thematic research areas / Probability to advance to a leading position in terms of scientific excellence and technological leadership.

In several CCPs, e.g. in Sweden, Ireland and Austria, it is also strongly advised that centres should have an international advisory committee/board affiliated.

As a consequence of including objectives and plans for internationalisation at a centre level, in particular in the medium sized programme cluster, centres tend to be more international. They

often have explicit internationalisation strategies in place and are frequently evaluated by international peers. In order to enable exchange on an international level, centres allow internships, guest stays etc., and also the organisation of international conferences is part of some of the centres activities.

A key challenge identified for some programmes however, is to allow funding for international partners.

In order to be able to identify international visibility/awareness and reputation, competence centre programme management may also gather indicators on internationalisation of CCPs. In this regard, the Austrian competence centre programme mentions the following indicators in the survey:

- Amount and number of participations of international partners with relevance for the centre (scientific and company partners)
- Award of international research funds (amount of additional funding money of H2020 etc...as project partner or coordinator)
- Activities in international committees and events

Support and stimulation of international cooperation

Most funding/management agencies offer some services and initiatives for supporting centres in their internationalisation strategies. The main services include legal and partner search support for participation in European Framework Programmes. In some countries, international research partners can be supported in the research projects under certain conditions. A general piece of advice to centre managers offered by the Task Force is to “free/set aside money in the centres for international collaboration”.

International partners at centre level

In a number of programmes there are some international partners, but overall participation of international partners is limited and dependent on funding requirements, geographical proximity and activity of the foreign enterprise/organisation in the host country.

Geographical proximity and maturity of centres plays a strong role in the Austrian programme, in which by now about 1/3 of total partners are international, however most of them (approx. 2/3 of that third) are German partners, the rest are mainly from neighboring EU countries, only little oversees. Also in Ireland and Sweden most centres have foreign company partners. Both programmes also emphasize the relevance of maturity of centres for being able to attract international partners. In the case of Sweden, most international partners are subsidiaries of international companies and many have become "foreign" by acquisitions of formerly Swedish-owned businesses, whereas only a smaller number of centres have "true foreign" company partners with no background in Sweden.

Horizon 2020 and similar initiatives as arenas for Competence Centres

Most programme managers of the TAFTIE working group estimate that international programmes like Horizon 2020 and EUREKA are suitable arenas for Competence Centres to internationalise their activities. However, the possibility to use these programmes depends by large upon the legal structure of the competence centre programme and working in these arenas also demands resources and a long term perspective which are typical of Competence Centres.

In Austria, Belgium and Ireland centres can apply for funding in H2020 or similar initiatives for conducting research, as they are legal entities. In Austria and Ireland the acquisition of EU funding is also a specific program indicator and both agencies have the national responsibility for

achieving national H2020 targets, which means that agencies have to support centres to achieve national targets as well.

In other countries like in Sweden, centres cannot participate per se in H2020, it is however very common that partners from a centre participate in, or lead, H2020 projects. Centres are thus functioning as a catalyst for a project idea and a node for participating partners. In this regard, centres can also be an excellent branding platform if presented properly.

Successful internationalisation and main obstacles

Many programme managers were able to describe good practice for successful internationalisation efforts of Competence Centres. They point to two the following directions:

- Firstly, over time, Competence Centres might be able to position themselves as a distinct node in research networks at international level. Some Competence Centres managed to act as consortium leader in European Framework Programmes, ERA-NETs and large projects in the framework of the Joint Technology Initiatives.
- Secondly, Competence Centres may play a role for developing/agreeing upon international standards. In many industries, standards need to be widely adopted for the research to become industry relevant and therefore internationalisation is a key pre-requisite. In Sweden, one project has led the development of new an ISO standard in their field and Swedish competences were also able to engage in respective European policymaking processes and subsequently influence the work programme development of Horizon 2020.

There are, of course, also a number of obstacles concerning internationalisation of CCPs:

- Firstly, limited time and resources are the first clear challenge identified. For example, if centres are financed on a 4-year project basis only, it is difficult to achieve long term commitment. In order to be able to internationalise, centres need a certain international reputation, in order to attract international partners.
- Secondly, legal conditions are impeding internationalisation. National funding legislation in some countries require that research funding should be spent predominantly at a national level and also rules for reporting can be demanding for international partners.

Challenges also comprise consortium agreement regulations that may hinder factor inclusion of international partners and attraction of visiting researchers from non-partners working within the centre programme (due to the consortium agreement and legal issues regarding IP).

Overall, internationalisation activities require a clear strategy, resources and sufficient time. Therefore, incentive and support structures need to be present if programmes want to spur internationalisation. In this regard, the Swedish “Global Links Initiatives” showed that centres participating in strategy development measures, managed to internationalise better than most others due to the fact that they have analysed and acted on potential obstacles.

6 Options for future Competence Centre Programmes

The TAFTIE Task Force identified and discussed major trends and challenges in R&I policy, which are not necessarily compatible with current objectives, focus and structures of the programmes. These relate to:

- New ways of innovating and creation of new business models
- The need for more flexibility and entrepreneurial spirit
- The promotion of more risky and radical research
- The emergence of global value chains/networks and possibilities to strengthen international activities
- Tension in balancing increasing need for market orientation and scientific excellence
- Addressing grand societal challenges
- Use of large infrastructures
- Need to increase SME involvement
- Strengthening training & gender aspects

Figure 23 provides an overview how design options and characteristics of CCPs fit to these challenges. Four challenges were regarded to be of specific importance and have been discussed and analysed in more detail.

In the following, we initially provide an overview on general design options for CCPs. Then, we provide a more in-depth analysis on how future CCPs may deal with the most relevant challenges that have been identified by the Task Force.

6.1 Design options of Competence Centre Programmes

CCPs developed different **governance models** at the level of programme management and at the centre level. These governance models define degrees of freedom and commitment at different levels. This report discussed three main governance models used by European CCPs: a “Management Model”, a “Strong Entity Model” and a “Host Model”.

All CCPs governance models were deemed to be appropriate to ensure commitment among partners and implement medium to long-term strategic research agendas but according to the Task Force each governance model has different strengths and weaknesses:

- The Management Model is characterised by a direct bargaining process between CCPs members from scientific and industry communities. The overall adaptability of this CCPs model to new trends and challenges is considered to be high, but the capacity to engage in a broad number of activities including for example structured educational training programmes is limited. Distinct advantages of the Management Model are its openness to new actors and flexible and straightforward exit strategies.
- The Strong Entity Model is seen to be frequently dominated by industry and characterized by rather limited adaptability to new trends and openness to new partners. On the other hand this type of governance model is expected to create truly long term partnerships among different actors and it facilitates the creation of physical research infrastructures that are jointly used by partners. This allows implementation of a wide range and depth of activities with high commitment of individual partners, including intensive skills development and pursuit of internationalisation strategies.

- The Host Model is seen to be frequently dominated by scientific partners. Due to its distinct personnel structure and research focus this model is characterized by limited adaptability to new societal challenges but a rather high openness towards new company actors. As Host Model CCPs are embedded in existing research structures such as universities they are further characterized by rather flexible exit strategies, whereas room for international collaboration is seen to be somewhat limited to scientific partners and dependent on existing relationships.

The appropriate **size of the CCPs** is dependent on the overall purpose of the CCPs and the framework conditions of the National Innovation System. CCPs with a clear focus towards global competition and excellence need to be larger and last longer than CCPs with a distinct regional focus or a focus on SMEs in low and medium-tech industries. In order to avoid crowding out and duplication of efforts, CCPs therefore need to clearly define their role, capabilities and relationship. This also includes consideration of existing permanent research infrastructures at HEIs and RTOs. Hence, when defining and building up CCPs, the endogenous potentials of centres and the balance between university and non-university research systems and their capacities need to be considered.

The majority of CCPs in Europe are understood to be of limited **duration,** aimed at compensating medium-term gaps in strategic science-industry collaboration. The overall duration and exit strategies of CCPs are seen to be closely related to the governance model (e.g. strong entity vs. management model), the size of the centres and the selected focus. Strong entity CCP models require clearly prescribed phase-out strategies as, most likely, physical infrastructure has been built and researchers with permanent work contracts have been employed.

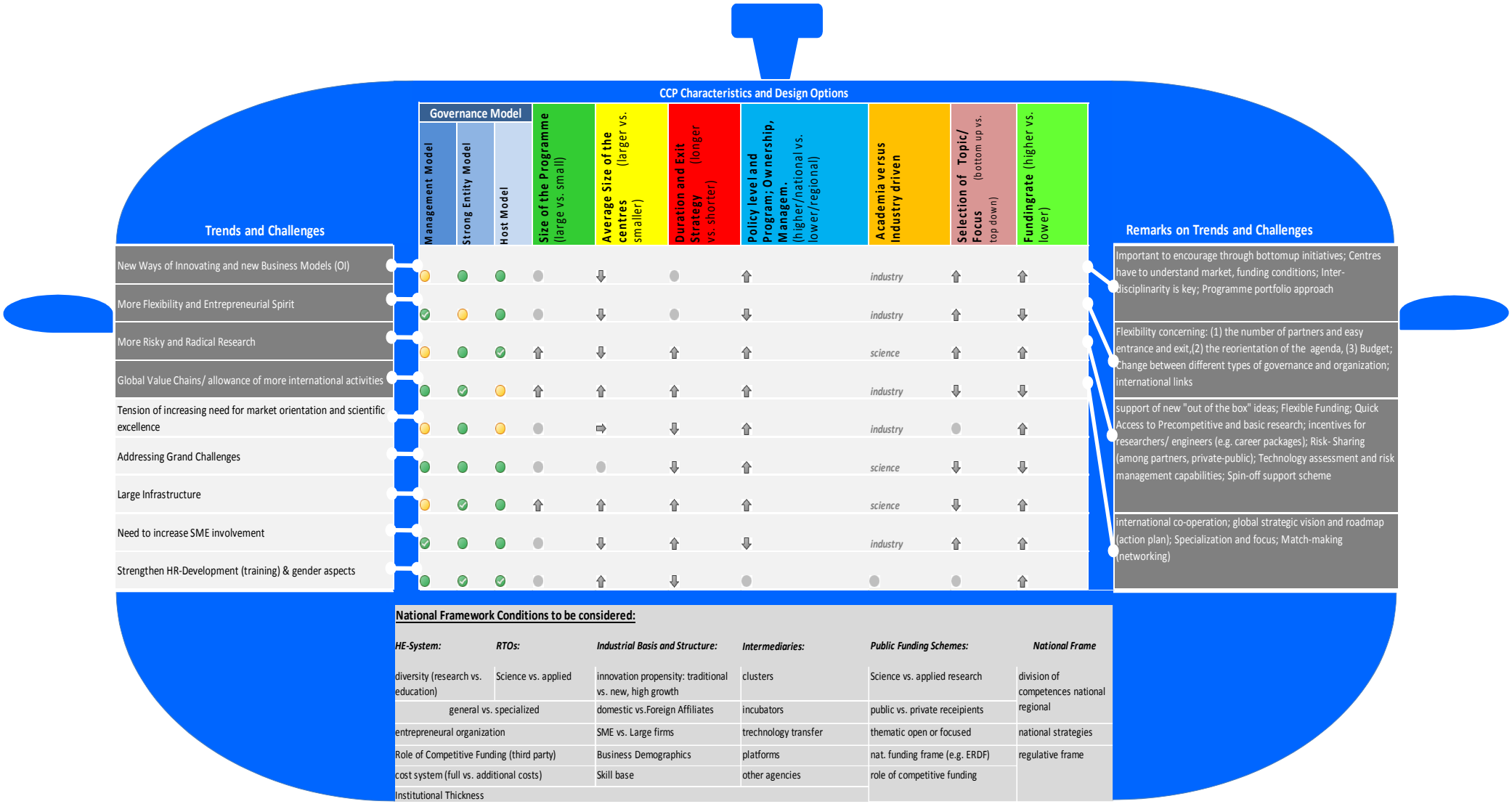
European countries show significant differences concerning STI policy governance and public responsibilities for HEI, RTOs, funding schemes or intermediaries (Cluster, Technology Transfer, Incubation etc.). Thus no general rule can be applied whether CCPs should be governed at **national or rather at a regional level**. However, institutional governance principles of subsidiarity, coherence as well as smart specialisation should be considered when designing CCPs in order to avoid systemic incoherence. Furthermore, policy makers need to clearly decide whether CCPs should be devoted to global competitiveness or regional development as both strategies may not easily be achieved at the same time.

The **orientation towards industry or academia** needs to be dependent on the distinct targets and roles of the CCPs. When setting these targets, the readiness of industry and academia for pursuing these objectives needs to be considered in terms of availability, capacity and connectedness.

Accordingly, also the appropriate average **funding rate** of activities for CCPs is dependent on the objectives of the programme as well as the underlying cost accounting schemes (full costs vs. overhead flat rates etc.) and the possibility of CCPs to use other support schemes than the CCPs itself. Usually in CCPs different funding rates for different types of activities and partners are foreseen and several programmes support complementary funding by several public sources. Overall, the Task Force sees a need to increase flexibility for funding different types of activities, but in some instances this also requires a new framework for CCPs, which is not too narrow and not too broad.

Finally, concerning the choice of topics a clear trend towards **thematically open** (bottom-up defined) CCPs was observed by the Task Force, which considers it as necessary to allow for flexibility concerning the reorientation of research activities and flexibility concerning agenda setting.

Figure 23: Trends and design options for CCPs



Text: green points: ● high degree of compatibility, yellow: ● medium degree of compatibility, grey points: ● neutral
↑: supporting character, ↓: weakening character

Against the outlined background of overall design options for CCPs the following sections outline the thinking of the Task Force concerning the four most relevant policy challenges that CCPs currently face.

6.2 New innovation models

6.2.1 The Challenge

New innovation models that promote a more open and interactive process of innovation (Chesbrough, 2003; Von Hippel, 2005; Howe, 2008) have been introduced and are applied as part of business and innovation strategy and companies in various industries are increasingly seeking diverse forms of cooperation with research institutions, start-ups, suppliers, competitors and customers (Sundic and Leitner 2013).

Open and User Innovation is a way of conceptualising inter-organisational collaboration and it scrutinises the logic of incoming and outgoing knowledge flows within a (private) organisation. Open Innovation moves towards networked innovation ecosystem, where specific innovation activities cannot be seen as an isolated single-firm activity but innovation actors at least partially open up access to their intellectual property.

As a result, the boundaries of activities of different actors in innovation ecosystems are becoming blurred and CCPs, which exist as network nodes for bringing together industrial actors and research actors around areas of mutual interest, need to be able to open up and, for higher degrees of freedom and flexibility concerning, allow the integration of new partners, in order to follow new ideas introduced during the co-creation process.

Figure 24: Challenges concerning new ways of innovating and new business models

- What incentives can CCPs provide in order to increase openness in R&I?
- How can CCPs contribute to overcome reservations against such new approaches (conflict with contracts etc.)?
- What are the consequences in terms of Intellectual Property regulations for CCPs?
- How to deal with start-ups in a global society? Should the number of start-ups become a KPI?

6.2.2 Governance and design options for future CCPs

Actual policy goals of CCPs, as derived from the logic chart analyses described in chapter 2, comprise the overarching goals to a) strengthen science and industry cooperation by means of joint programming, b) strengthen national research location, c) improve innovative capacity of enterprises, c) strengthen human resources and gender aspects, d) involve SMEs, e) increase private/business investment in PPP and R&D), f) increase economic competitiveness of companies, and g) to achieve international visibility and increased attractiveness for international investments.

However, at present, CCPs do not have the specific objective of promoting Open and User Innovation approaches. First steps to nurture new modes of innovation and “opening up” would be to explicitly require cross-sector collaboration to competence centres/networks and demand the development of respective actions in Strategic Research and Innovation Agendas of networks/centres.

Opening up also requires rethinking of the role of research and innovation activities of CCPs in terms of Intellectual Property Rights (IPR). The NSF/Industry University Cooperative Research Centers Programme shows that CCP partners may share IPR for all partners (Gray 2015). Receiving private co-funding and sharing IPR is feasible because research activities of these centres have been valued by industry partners for their potential for application, but are still in a pre-competitive phase. Hence, the closer CCPs that research activities are focused on commercial outcomes for individual companies, the lower will be the chance of opening up.

The different governance models of CCPs do not pose a barrier for encouraging more open and user innovation approaches for CCPs, but at the centre level strategic plans should be developed in order to bring these approaches to the fore. The strong entity governance model and the host model may be able to develop these plans for their core partners on a longer term level.

A management model might be able to include new partners in a more flexible manner and follow Open and User Innovation approaches on an individual project basis. Projects for joint development approaches might be proposed and developed by scientific partners. In project selection processes using live feedback from industry partners, joint actions between a number of industry partners, potential clients and research institutions could be developed.

At the European and also the OECD level, new platform oriented models of governance are increasingly discussed, which seem to be complementary to the three main models presented in previous sections. The idea of platform models as an alternative or complementary extension of existing competence centre models is supported by two strands of thinking: open innovation and systemic innovation. Platforms are relevant instruments which help to include external stakeholders beforehand and to define a common agenda. Important elements of platform models are (parallel) experiments which test different solutions in systemic surroundings (ecosystems). Platforms support the initiation of new technological developments, may contribute to coordination concerning the development of standards, and evaluation of different technological approaches. Platform model are clearly associated with market orientation and openness towards new partners end users.

As a prerequisite for implementation, the platform has to have clear visions and a roadmap for implementation. Activities are organized via experiments and sub-programmes (supported by public funding and infrastructure). Furthermore, for the implementation and evaluation of activities external stakeholders and users need to be involved.

The idea of platform models as an alternative or complementary extension of existing competence centre models is nourished by to strands of thinking: open innovation and systemic innovation. Platform models are clearly associated with market orientation and openness towards new partner's end users. Technology based platforms can be relevant instruments which help to include external stakeholders beforehand and define a common agenda. Important elements of platforms are (parallel) experiments which test different solutions in systemic surroundings (ecosystems). Open Source (infrastructure etc.) and virtual character of platform models are possible, but not a necessity.

6.3 More flexibility and entrepreneurial spirit

6.3.1 The challenge

Growing awareness concerning the role of new and knowledge intensive businesses for knowledge transfer, innovation and structural change has been observed throughout the last decade. Universities are increasingly inspired by the idea of the 'entrepreneurial university' (Etzkovitz 2008) and in some countries specific support schemes have been developed in this regard.

However, neither the scientific community nor private incubators are currently able to serve the fluid development from R&D or innovation projects to demanding new businesses and business models adequately.

In general, CCPs do not put specific attention on creation of academic spin-offs and new business ventures. This is rooted in the very basic understanding of objectives of CCPs, which are to create cooperation structures between existing science and industry partners and a focus on research and innovation activities that might be used by existing companies.

Figure 25: Key questions concerning entrepreneurial spirit and new business models

- How can CCPs allow for more entrepreneurial spirit?
- How to deal with start-ups in a global society?
- Should the number of start-ups become a performance indicator for CCPs?

6.3.2 Governance and design options for future CCPs

Although CCPs cannot be seen as a main instrument from which to demand/expect creation of new business ventures, CCPs may contribute to the creation of more entrepreneurial milieus at academic institutions, in which young researchers develop ideas for new business ventures.

Active collaboration between research organisations and enterprises in the area of entrepreneurship education, business model competitions based upon innovative ideas stemming from centres' activities etc. provide scope for broadening up activities, if funding for these types of activities is permitted.

Increased flexibility for CCPs is therefore definitely needed, but this requires a new strategic framework for CCPs. Flexibility is also needed in the education system (e.g. universities), as a stronger mobility culture is needed. At the same time, a certain degree of stability in terms of strategic orientation, objectives, funding criteria and budget is needed as existing stakeholders have to be committed for the longer term.

In terms of governance structures, the management model and the host model are most suited to allow more flexibility in activities of CCPs. Management models may more easily gather a number of different academic and industry partners around low level entrepreneurship activities, which are not oriented at the provision of typical R&D activities of CCPs. The host model approach may allow the performance of concerted actions within one institution throughout the life-time of the CCPs. In principle, these activities can also be performed by strong entity CCPs. This requires the definition of joint activities between participating industry partners and higher education institutions.

Relevant design features of CCPs for allowing more flexibility and entrepreneurial spirit are means to a) funding, b) size and c) strategic orientation:

Allowing new activities to be designed and implemented requires additional financial and human resources. These need to be provided and allowed for.

Larger CCPs with considerable management capacities may design more long term oriented activities for CCPs partners whereas smaller programmes/units may only provide incentives such as top-up funding for activities to partner organisations, for launching these new activities.

More academic driven CCPs located at universities can be expected to be more closely involved in teaching and training activities. Joining forces with industry partners in this regard might be easier for these centres – if incentive mechanisms for industry partners are also provided. For instance, mobility schemes for doctoral students performing part of their research with companies constitute a pool of potential new employees.

6.4 More risky and radical research

6.4.1 The challenge

Research and innovation risk (market failure therein) is a main justification for public schemes supporting innovation activities. There is clear need for radical and breakthrough innovation providing a basis for future competitiveness in Europe. In addition, recent analysis concerning the determinants for major innovations in Europe (see EC 2015) illustrates the high relevance of technological novelty, the creation of interfaces between different disciplines but also data availability and management for most of the major innovations analysed. In specific cases outstanding scientific knowledge or a technological breakthrough turned out to be of outstanding relevance.

However, existing funding schemes do not necessarily provide proper incentives for “out of the box” thinking, high risk undertakings and breakthrough innovations. CCPs require high commitment and trust of Competence Centres partners to agree to medium and long term strategic research agendas. Thus it is conceivable that trade-offs would exist between fostering entrepreneurial spirit and the quest to allow for major impact innovations stemming from long term R&I activities performed in partner organizations.

Figure 26: Key questions concerning more risky and radical research

- How to increase radical innovation?
- How to deal with disruptive technologies?
- How to allow freedom to be creative, to find new ideas and new collaborations?
- How to deal with choosing the best technologies and remain broad? What about missing trends?

6.4.2 Governance and design options for future CCPs

Future CCPs need to be aware that on the one hand close market orientation and on the other hand a need for more excellence in research activities is demanded at the same time. Both calls for market orientation and excellence are justified but national CCPs need clear guidance in which way they should position themselves. For both types of orientations risk orientation and innovativeness are key prerequisites for future success of competence centre programmes.

In order to allow for more risky research, CCPs need support for new “out of the box” ideas:

- Funding agencies may increase their flexibility and can allow for variations in terms of funding rates which may provide incentives for allowing for more risky research. Apart from having core targets set, there is also a clear need to allow for flexibility in terms of increased flexibility it concerns funding, duration, scope, content and the involvement of new partners (e.g. end users). Certain programmes already have flexibility in certain areas and would like to keep for instance a roadmap, budgetary freedom for the board, keeping an open space in the research agenda. In this regard, also new solutions/radical approaches are needed and more interdisciplinary work with new people (or new combinations of persons) should be encouraged.
- Measures to increase risk-sharing among public and private partners need to be enhanced.
- Long-term strategic projects that are run by CCPs could be subject to technology assessments.
- Risk management capabilities at competence centre level could be enhanced.
- Incentives for researchers and engineers (e.g. career packages, prizes etc.) need to be elaborated.

Allowing for more risky research also requires quick access to new technologies and precompetitive research. CCPs operating as “host models”, which are located at higher education institutions, and “strong entity models” may provide easier access to new sources of knowledge than “management models”.

Also the size of the CCPs, the duration of the CCPs and the funding rate play a distinct role concerning riskiness. The TAFTIE Task Force sees academic driven larger programmes, with longer programme duration and higher funding rate more apt to follow more risky research approaches than smaller, industry driven programmes.

6.5 Internationalisation and global value chains

6.5.1 The challenge

Internationalisation and the emergence of global value chains/networks were considered as one of the major challenges for the future development of CCPs. While there is at present cooperation at an international level within EU-funded projects, there is a perceived need to provide more incentives and measures to allow CCPs to operate at an international level, in order to further increase the quality of research performed within centres.

Figure 27: Key questions concerning internationalisation

- How to deal with internationalisation? How to increase it?
- How to balance the risks with national interests? Should Competence Centres be open for international companies?
- How to increase EU-collaboration?

6.5.2 Governance and design options for future CCPs

Apart from legal and partner search support for participation in international research programmes, a general piece of advice from the TAFTIE Task Force is to free/set aside money in the centres for international collaboration. Good practice for supporting internationalisation of CCPs was proposed by VINNOVA, which employed a specific measure call "Global Links for Strong Research And Innovation Milieus". The measure aims to help centres to develop a strategic approach to internationalisation at centre/milieu level. In two separate, competitive calls in 2008 and 2011 the agency selected around 20 projects and provided funding (60-75 k€ per project over approx. one year) as well as other support. Funds were provided to assist internationalisation of centres, such as: planning and benchmarking, study trips to select countries through foreign-based Swedish representations (S&T office at 5 embassies), introduction to legal issues in international cooperation and meetings to share experiences between the projects. The result for all projects funded has been a "strategy" or "roadmap" adopted by the governing structure (i.e. Board). The impact of the initiative varies but for some centres it has led to new collaboration, a stronger Swedish position in EU matters, international standard development and new contacts in Asian countries.

In order to allow for internationalisation strategies of competence centres, time is needed. Over time, Competence Centres may be able to position themselves as a distinct node in research networks at the international level. Some Competence Centres managed to act as a consortium leader in European Framework Programmes, ERA-NETs and large projects in the framework of the Joint Technology Initiatives (JTIs).

Competence Centres may also play a role for developing/agreeing upon international standards. In many industries, standards need to be widely adopted for the research to become industry relevant and therefore internationalisation is a key pre-requisite. In Sweden, one project has led to develop a new ISO standard in their field and Swedish stakeholders were also able to engage in respective European policymaking processes and subsequently influence the work programme development of Horizon 2020.

As the investment and reinvestment in research infrastructures is a key for the competitiveness of European knowledge and innovation hubs, the development of shared infrastructures may also provide interesting potential concerning internationalisation. Some CCPs currently support infrastructure investment, e.g. via PPPs. Relevant topics to be considered here are the reliability of infrastructures, incentives for sharing of infrastructures, modes of access and cost structures.

At a centre level, cooperation between centres, in particular within EU-projects, but also concerning exchange of staff could facilitate a greater integration of centres. In this regard, also participation in Knowledge and Innovation Communities of the EIT could be considered.

Overall, larger programmes, with a longer duration, operated either in the management model type or the strong entity model are deemed to be more appropriate for developing successful internationalisation strategies.

In case of the Austrian COMET programme (which applies for K1- and K2-Centres a strong entity model), the participation of international partners – industry and academia – is fully open. However, this is possible because all partners as well as the funding agency finance the centre (a limited company). Therefore no public funding is directed directly towards private companies, neither Austrian nor international ones.

On a programme level more international collaboration on ministerial/agencies level is also required. National money needs to be used for international collaboration and if joint calls are to be implemented, models for collaboration have to be developed. Experiences in this regard already have been shown in calls of the Member State driven Joint Programming Initiatives (JPIs) and ERA-NET Plus calls.

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List of abbreviations

- AT: Austria
- BE: Belgium
- BERD survey: The biennial Business Expenditure on Research and Development Survay (Ireland)
- C02 Monitoring: Carbon Dioxid Monitoring
- CC: Competence Centres (Competence Centre Programme at beginning of the Task Force)
- CCP: Competence Centre Programme
- CCPs: Competence Centre Programmes
- CIS survey: Community Innovation Surveys of Europe
- CompAct: Taftie Task Force on Competence Centre Programmes
- cost/a in Mill €): Costs per year in a million EUR
- CRC: Competence Research Centre(s)
- CREST: European Union, Scientific and Technical Research Committee; CREST is an advisory body whose function is to assist the Council and the Commission in performing the tasks incumbent on them in the sphere of RTD.
- CZ: Czech Republic
- DAC: Development Assistance Committee
- DE: Germany
- e.g.: for example
- EARTO: European Association of Research and development Organisations
- EC: European Commission
- EE: Estonia
- EI: Ireland
- EIT: European Institute of Innovation and Technology
- Enterprise Estonia
- Enterprise Ireland
- ERA-NET Plus: The ERA-NET instrument under Horizon 2020 is designed to support public-public partnerships in their preparation, establishment of networking structures, design, implementation and coordination of joint activities as well as topping up of single joint calls and of actions of a transnational nature.
- ERDF: European Regional Development Fund
- EU: European Union
- EUREKA: publicly-funded, intergovernmental network, involving over 40 countries
- FDI: Foreign Direct Investment
- FFG: Austrian Research Promotion Agency
- FI: Finland
- FTE: Full Time Equivalent
- H2020: Horizon 2020, EU Research and Innovation programme
- HEI: Higher Education Institutes
- IDFs: Intermediate distribution frames
- Innovate Luxembourg: National Agency for Innovation and Research
- IPR: Intellectual Property Rights
- ISO: International Organization for Standardisation
- IT: Information Technology
- K1-, K2-Centres: Austrian Competence Centres (COMET)
- KICs: Knowledge and Innovation Community (funded by EIT)

- KPI: Key Performing Indicators
- LE: Large Enterprises
- LTD: Limited Liability Company
- LU: Luxembourg
- M: Milestone
- MAP: Multi Actor – Multi Measure Programmes
- NASA: National Aeronautics and Space Administration of USA
- NL: The Netherlands
- NO: Norway
- NPO: Non-Profit Organisation
- OECD: Organisation for Economic Co-operation and Development
- PhD: Doctor of Philosophy
- PPPs: Private Public Partnerships
- PtJ: Projektträger Jülich
- R&D: Research and Development
- R&I: Research and Innovation
- RCN: Research Council of Norway
- RO: Research Organisations in Ireland
- RTI: Research, Technology and Innovation
- RTO: Research Technology Organisation
- RVO (NL): Netherlands Enterprise Agency
- S&T offices: Swedish Science and Technology Offices in embassies
- SBMRC - Science-to-Business Marketing Research Centre (2011) The State of European University Business Cooperation, European Commission
- SHOK: Strategic Centres for Science, Technology and Innovation in Finland
- SME: Small and Medium Enterprises
- STI (policy): Science, Technology, Innovation (policy)
- SWE: Sweden
- TACR: Technology Agency of the Czech Republic
- Tekes: The Finnish Funding Agency for Innovation
- The NSF: The National Science Foundation USA
- TKI (NL): Topconsortium voor Kennis en Innovatie
- TRL: Technology Readiness Level(s)
- UK: United Kingdom
- Vinn Excellence Centers: Competence Centres in Sweden
- VINNOVA: The Swedish Funding Agency
- VLAIO: Flanders Innovation and Entrepreneurship
- WP: Work Package
- WS: Workshop

CompAct - Taftie Task Force on Competence Centre Programmes, 2016

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