

Enhancement of the next generation of Competence Centre Programmes (CCPs)

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Abstract

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

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

Against this background of a changing global R&I landscape, TAFTIE – the European network of innovation agencies – launched a task force on CCs, focusing on the enhancement of the next generation of CC programmes, including important aspects of internationalisation and monitoring via key performance indicators (KPI).

By comparing the logic models of CCPs in eleven countries in terms of their objectives, expected outputs, medium-term outcomes and long term impacts, the most important similarities and differences amongst these programmes were identified. Based on the consolidated mapping of CCPs along key dimensions such as funding levels vs. science/industry orientation, a more qualitative analysis was performed.

The corporate body and governance of CCs have a 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: The “Management” Model, the “Strong Entity” model, and the “Host” model.

These three models were used as analytical categories for summarizing the key findings. They were challenged against an identified set of future trends and challenges in R&I policy, which are not necessarily compatible with current objectives, focus and structures of the CCPs.

In order to ensure high quality performance of the CCs and best value for money, adequate monitoring systems have to be developed and maintained. The paper suggests and argues for a set of key performance indicators (KPI) relating to the main impact dimensions of the CC programmes.

Due to globalization, internationalisation aspects are becoming important issues for CCPs. The paper identifies the main drivers to engage in cross-border collaborations and concludes with best practice examples on centre and on programme level how to strengthen internationalisation.

Keywords

Competence centre, programme, science, industry, collaboration, governance model, international

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 via institutional funding or single, rather narrowly defined research and innovation projects and instead, increasingly more innovation system oriented approaches were deployed. Competence Centres Programmes present such approaches.

Competence Centres (CCs) are 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 interaction between science and industry, providing truly collaborative research with a medium to long-term perspective.

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Some programmes as well as centres have been running for almost two decades. However, new trends and challenges are influencing these programmes: globalisation requires new international approaches and national innovation system participants are confronted with several challenges and demands such as new ways of innovating, increased flexibility, more risky and radical research, and balancing between market orientation and scientific excellence.

Against this background of such a changing global R&I landscape, TAFTIE – the European network of innovation agencies – launched a specific task force, in order to support the enhancement of the next generation of CCPs .

2 Main features of CCPs

By comparing logic models of the CCPs observed 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 CCPs 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 (see fig.1). 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.

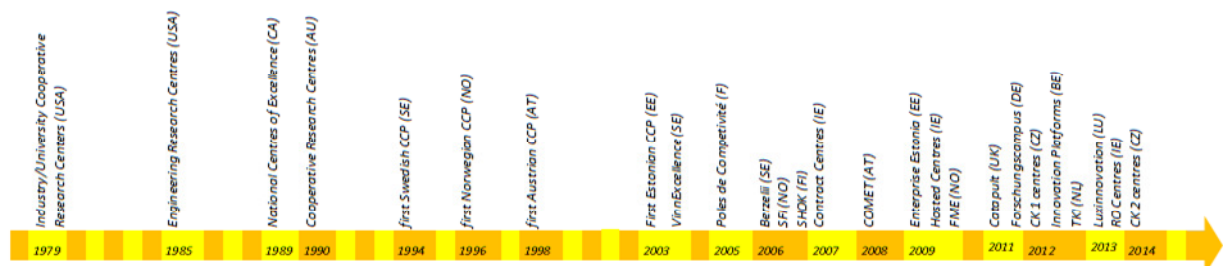


Fig. 1: Timeline of CCPs

The CCPs observed 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.

The average size of CCs is significantly different amongst the CCPs observed (see fig.2). 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.

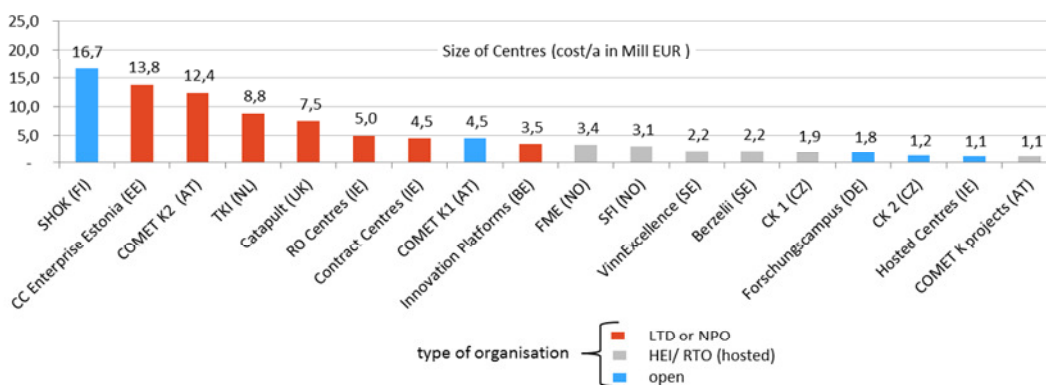


Fig. 2: Size of CCs, type of organization

Usually CCPs support time-limited research organisations. However, CCs can be differentiated by their intended duration and continuity (see fig. 3). 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 most of the programmes the duration varies between 4/5 years up to 10 years. CCs with long-term durations are typically based on physical structures and are divided into several funding periods.

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.

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.

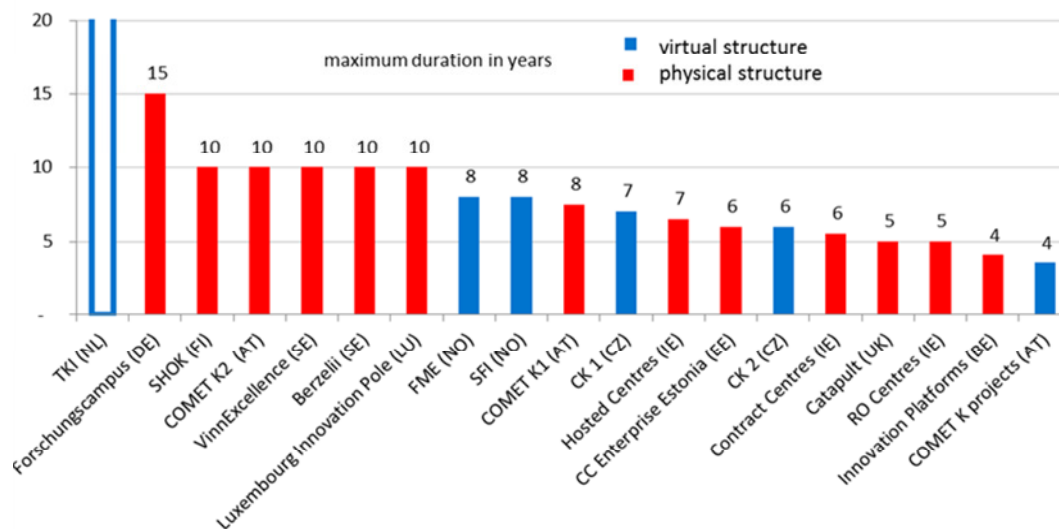


Fig. 3: Duration of funding for CCs and type of structure

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.

A wide 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 collaboration in well-defined projects and often involve the development of human resources.

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. In this regard the CC's management plays a crucial role.

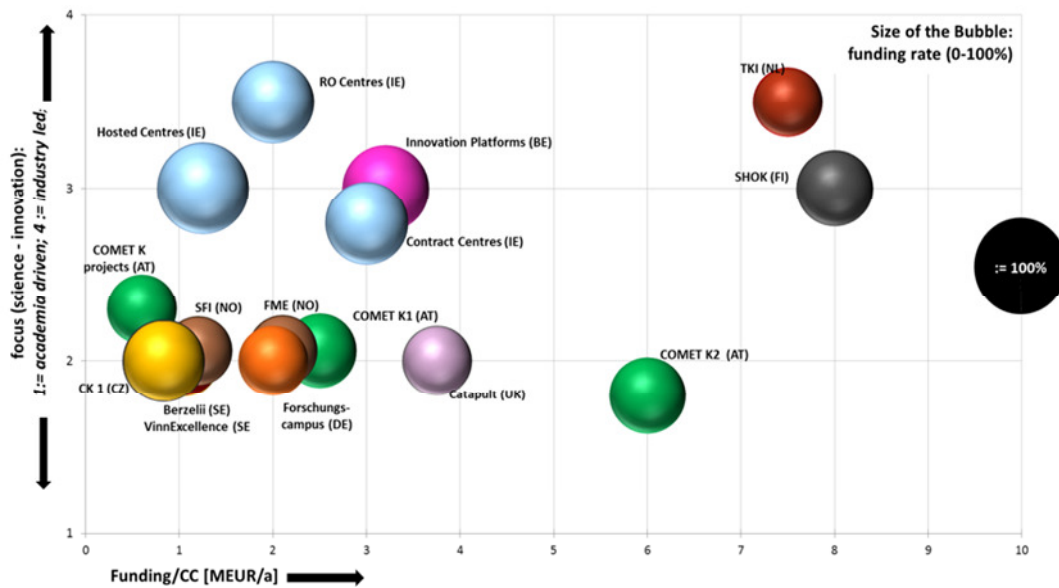


Fig 4: Strategic orientation: Industry / Academia driven vs. funding volume

Fig. 4 presents the result of a mapping exercise, comparing the CCPs observed according to their driving position of industry or academia against the funding conditions. From this mapping three overlapping groups of CCPs were identified and used for a more qualitative analysis presented in chapter 3.

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.

The selection mechanism of all CCPs observed was call-based. In all cases external experts have been included.

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

The corporate body and governance of CCs have a significant influence on collaborative arrangements, strategic focus and investment. Thus, a set of 3 basic governance models for CCs was derived from the analysis as well as from the previous experience of the group.

- › The “Management” Model:

In this model 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 more industry-driven and show some similarities to cluster activities.

The following features are related to CCs of this type: 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 are: SME involvement, joint programming and international competitiveness of the companies involved.

› The “Strong Entity” Model:

In this model 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 following features are related to CCs of this type: 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 are: to strengthening of cooperation between science and industry, to increase the innovative capacity of enterprises, to sustain employment and turnover.

› 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. Also here the “full” centre receives funding.

The following features are related to CCs of this type: 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 are: to strengthen the cooperation between science and industry, scientific reputation, economic impact – turnover/employment and increase private investments in R&D.

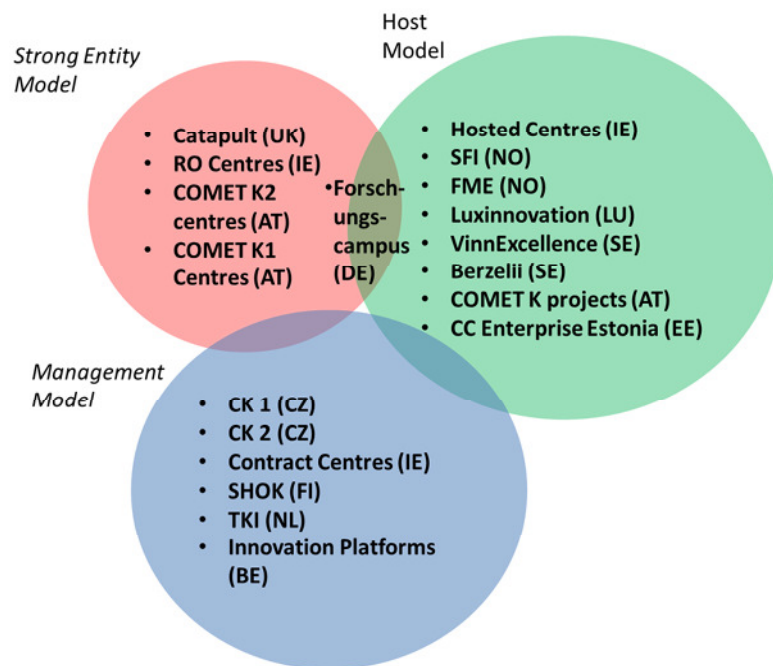


Fig 5: Governance Models of CCPs

Fig 5 tries to fit the CCPs observed to one of the models. It has to be pointed out, that this is not a 100% fit, as the models are derived from theoretical assumptions, while in practice overlaps are the normal case.

3 Analysis of the operation and challenges of CCPs

Based on the consolidated mapping of CCPs (see fig. 4) a more qualitative analysis was performed. Three overlapping groups of CCPs were identified: One group of programmes/centres was pointing at the larger initiatives. 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

Industrially oriented large CCPs

Industrially-oriented large CCPs are best exemplified by the Dutch TKI or the Finnish SHOK. Their governance and incentive structures tend to be of the more top-down kind. Initial sectoral priorities have been set by ministries, even though the centres also work closely with the agencies that fund them in setting specific strategic priorities, defining KPIs and monitoring progress. Further, the centres that run these types of programmes are also often strong and independent entities. For example, the SHOK centres in Finland have been limited companies with shareholders mainly from industry.

The adaptability to new RDI, market and social trends of these CCPs is mainly ensured through continuous open and competitive calls launched by the funding agencies to ensure dynamisms and the evolution of strategic priorities of the centres. The activities within some programmes tend to focus on R&D in response to industrial needs, combined with 'traditional' activities such as contract research, workshops, and technology transfer to valorize the fruits of R&D in industry. Thus, the programmes are not characterized by a broadness of activities although there also are differences in the profiles of centres. The level of experimentation with new activities largely depends on the area or industry that the centres address.

These CCPs are generally open although in some cases their more top-down governance and stronger industrial orientation also create some limitations to their openness to new actors and networks e.g. due to issues related to ownership structures, dominating companies. Most of these centres do not have a clear exit strategy for gradual withdrawal of public funding, the exception being the Austrian Comet K2 centres. For example, in Finland the SHOK programme has been discontinued in 2016 and the non-existence of an exit strategy created challenges for all involved.

Balanced medium-sized CCPs

Balanced medium-sized CCPs are best exemplified by the Belgian Innovation Platforms, by the Irish Hosted Centres and ROs and by the Austrian Comet K1 centres. They show more variety in their governance and incentive structures and tend to operate more bottom-up in the sense that priorities are set more independently by the centres themselves in respond to demand from their stakeholders. These types of programs often serve as contact points for a broader network of companies, researchers and other actors, and they have often tailored their governance model accordingly.

The adaptability to new RDI, market and social trends is higher compared to the more industrially-oriented CCPs due to their more open-ended governance and varied incentive structures. The centres run more open and flexible R&D programs, and are more flexible in changing practices during the duration of programs. If the centres have been hosted at colleges or universities some challenges have been detected related to how resources, training for PhD fellows and publication activities are shared between the centres and their hosts.

The decentralized and bottom-up model of operation of these CCPs, as well the co-location of the centres at colleges or universities, has implied that they have a high degree of broadness of activities. The centres run R&D projects but also work with standardization bodies, engage in teaching at universities, other organizations of conferences, act as central contacts or e.g. demonstration platforms for a broad range of companies. The downside of this broadness may often be that companies find it harder to link their specific needs to the activities. Further, evaluation and monitoring of progress through KPIs is more challenging and complex.

A greater variety in governance and incentive structures, and a higher broadness of activities, also implies that these medium-sized CCPs also appear to be rather open to new actors and networks. However, the openness also depends on the sector and topic that the centres are engaged in. For example, traditional industries sectors with well established companies and networks yield more closed programmes while new and more dynamic sectors, such as ICT and software, tend to yield more open-ended programmes.

Finally, these centres also typically lack explicit exit strategies for gradual withdrawal of public funding e.g. due to limited success in open calls. Exception to this are Irish centres with a two-year phase-out procedure as well as the Austrian K1 centres with a one-year phase-out procedure. A key issue in this context is the degree to which the centres manage to broaden their funding base (e.g. also through EU funding) and avoid becoming overly dependent on one funding agency.

Smaller initiatives CCPs

‘Smaller initiatives’ CCPs are best exemplified by the Swedish Berzelli and VinnExcellence centres, the Austrian Comet K projects, the Czech CK1, Norwegian SFI and FME and German Forschungscampus programs. Their governance and incentive structures are defined on a contractual basis where funding agencies and other stakeholders (e.g. companies, academia) participate as observers in steering boards to guide programs. These steering boards are the main governance mechanisms between the funders and the centres and progress is monitored through KPIs. Governance is thereby delegated to the level of program- and project-level and the set-up is thereby more bottom-up by nature.

The steering groups are also the main arenas for ensuring adaptability of these CCPs to new RDI, market and social trends. Progress reports and external evaluations provide insights on how the centers adapt to these trends and the steering groups work as sparring partners. Some challenges have been observed concerning the balance between adaptability of the centres and their ability stay on a longer-term strategic course. The centres mainly undertake R&D activities and they engage in related communication, dissemination and branding activities. Thus, the broadness of activities is lower compared to the more open-ended medium-sized CCPs.

The ‘smaller initiative’ CCPs may often struggle with achieving openness to new actors and networks while maintain their strategic R&D focus and specialization. The contrac-

tual model of governance (e.g. related to IPs, administrative issues), as well as an overly reliance on one public funder, can also considerably constrain the degree of openness that the centres can achieve. Good practices for maintaining openness of such centres include putting aside resources for actively scanning and searching for new strategic partners, developing and branding clear and distinct profiles, as well as covering also precompetitive R&D and increasing visibility both nationally and internationally.

For these types of CCPs exit strategies are often embedded in a formal sustainability plan to ensure the centres longer-term continuation. Therefore it is considered a key issue that the university management is engaged in the steering boards and in planning of the centers in cases where these are co-located to universities.

4 Aspects of internationalisation

Due to globalisation, aspects of internationalisation are becoming an important issue both on centre level and programme level. The main drivers to engage more actively in cross-border collaborations come from

- › the centres' stakeholders facing various international challenges, i.e. emerging global science and technology value chains,
- › the developments within science and technology that require critical mass and excellence
- › 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.

The ability to internationalise depends strongly upon the maturity of CCs and existing network partners (Boekholt 2009). 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. Some centres have explicit internationalisation strategies in place and are frequently evaluated by international peers. In order to enable researcher 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.

The analysis concluded that, over time, the CCs might be able to position themselves as distinct nodes in research networks at international level.

However, there are some obstacles to internationalisation. Legal conditions might sometimes be impeding. National funding legislation in some countries requires that research funding should be spent predominantly at a national level. In some cases, the consortium agreement regulations might hinder inclusion of international partners.

There are ways to overcome the obstacles and to stimulate internationalisation both on programme level and on centre level. 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.

Some funding agencies offer 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.

Horizon 2020 and EUREKA are suitable arenas for CCs to internationalise their research activities. The possibility to use these programmes depends to a certain degree upon the legal structure of the competence centre programme and also demands resources and a long term perspective which are typical of CCs. 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 can thus function as a catalyst for a project idea and a node for participating partners.

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

5 Monitoring and performance indicators

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 maximized return on State investment. (CREST report). The creation of adequate monitoring systems is an important task in this regard. The provision of monitoring data and Key Performance Indicators (KPI) enables programme management to assess the performance of CCs in real time as they develop in relation to the quality of research, financial performance and control, management and governance and progress towards programme goals (Elias, Dinges et al 2011).

When designing monitoring systems of R&I programmes, user needs should be taken into account. In the case of CCPs, four types of stakeholders with differing needs concerning performance information can be identified: programme owners (State), programme management (Agencies), centre's management and evaluators. Each of these stakeholders has a range of needs for information on a real time basis and also in the longer term for evidence of return on investment. Therefore, the range and complexity of potential KPI that can be applied to a CCP is large.

In designing monitoring systems for CCPs, it is recommended 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.

The creation of performance monitoring tools should primarily be seen as a learning tool for advancing the effectiveness of implementation of CCs and the tools should evolve to reflect programme evaluations and emerging best practices.

Indicators can either describe a state of progress or the actual measurable progress towards a target. In designing indications it is proposed that the indicators should capture both aspects and that in order to do so the indicators need to follow the progress of an individual CC over its evolving maturity. Therefore the types of indicator that are of importance are the Inputs (e.g. financing), the Activities (e.g. project progress), the Processes (e.g. new company partners join) the Outputs (e.g. research staff transfers), the Results (e.g. new company formations) and finally the Impacts (e.g. value to the State of attributable increased company activity).

Core questions to be considered for devising KPIs 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?

The authors suggest mapping KPI relating to the main impact dimensions of the CCPs. Apart from increased competitiveness, these domains may include the dimensions international reputation, human capital, scientific reputation, societal effects and professional culture of research. However, the actual assessment of impact is only properly established through ex-post evaluations and therefore the KPI selection needs to focus on those Activity, Process and Output indicators that map to the desired programme impacts. Fig. 6 suggests one such mapping.

Outcomes/ Impacts	Activity KPIs	Process KPIs	Output KPIs
Turnover/Jobs/ Savings/ New Companies	<ul style="list-style-type: none"> • Company Members • Co-funded Projects • IDFs & Patents • Company Co-funding 	<ul style="list-style-type: none"> • New Partners join • Commercialisation • Increasing funding over time • Industry-led project selection 	<ul style="list-style-type: none"> • Licences • IPR Transfers • Spin outs/Spin-ins • Informal IP Transfers
International Reputation	<ul style="list-style-type: none"> • Internat. Funding • Internat. Members • International Company Projects • Standards 	<ul style="list-style-type: none"> • Internat. Networking • Centre Formal Agreements • Committees' Representation 	<ul style="list-style-type: none"> • FDI • New Markets for Companies
Human Capital	<ul style="list-style-type: none"> • PhDs • Masters • Formal Training of Staff 	<ul style="list-style-type: none"> • Project Supervision • Training Accreditation • Research Manage- 	<ul style="list-style-type: none"> • Staff transfers • Improved ability for new staff • Improved ability for

	<ul style="list-style-type: none"> • Formal Company Training 	<ul style="list-style-type: none"> • Awards developed 	<ul style="list-style-type: none"> existing staff
Scientific Reputation	<ul style="list-style-type: none"> • Publications • Citation indices • Other Media 	<ul style="list-style-type: none"> • Researcher Selection • Partner Selection • Bottom-up project selection 	<ul style="list-style-type: none"> • H Factors etc • Global Research Rankings
Societal: Health, Environment, Security	<ul style="list-style-type: none"> • Clinical Trials • CO2 Monitoring • Water monitoring • Energy monitoring • Threat monitoring 	<ul style="list-style-type: none"> • Societal Partners included • State Partners included • Cost-Benefit or Business Models established 	<ul style="list-style-type: none"> • Wellness outcomes/Healthcare standard improved • Reduced energy/CO2 • Reduced pollution/water consumption • Risks reduced/lives saved
Professional Culture of Research	<ul style="list-style-type: none"> • Business Interaction • Staff training 	<ul style="list-style-type: none"> • Governance • Project Management • Senior Staff recruitment 	<ul style="list-style-type: none"> • Increase in level of Open Innovation

Fig 6: Possible KPI selection (Source: Enterprise Ireland)

The selection of KPIs 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. In particular careful consideration needs to be given to the perverse incentive effect, whereby individual CCs behavior is driven to produce KPI levels where that KPI does not truly map to the desired programme impacts (e.g. IP licence revenues as a KPI where open dissemination is the desired impact).

6 Conclusions and recommendations

A set of trends and challenges in R&I policy was identified, which is not necessarily compatible with current objectives, focus and structures of the CCPs:

- › 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 three identified governance models: the “Management” model, the “Strong Entity” model and the “Host” model. All three 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 following trends and challenges were regarded as being key for the future enhancement of CCPs and therefore are discussed in more detail.

(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 IPR.

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 manage-

ment 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.

(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.

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. 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.

The following are some general recommendations when setting up or enhancing CCPs:

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. 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 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 CCPs 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.

The orientation towards industry or academia needs to be dependent on the distinct objectives of the CCPs. 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, there is 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.

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