Governance of an externally funded research and development: a multiple case study analysis

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Abstract: - Externally funded research and development (R&D) can promote a value that is achieved in R&D projects. This value can be expanded and utilised by regional actors, networks and innovation systems, and it can contribute to education, management and regional development. The integration of externally funded R&D projects and higher education includes a phenomenon that a participant's interests and co-creative motivation is based on value and trust, such as the value gained from a R&D project and the value given to a R&D collaboration. The focus of this study is in the understanding of "steering forums" within R&D actualisations. In this study, the research findings of a multiple case study analysis describes value sharing and steering between 1) academic, 2) research, 3) empiric, and 4) education management. The contribution of the study is in the utilisation of knowledge, roles and motivation of actors at the regional-international R&D stage. The contribution is useful in the facilitation of: 1) research context; 2) R&D agenda and scope; 3) methodology; 4) regional capabilities; 5) R&D abilities; and 6) R&D integration in higher education.

Key-Words: - Case Study Analysis, Governance, Innovation System, Integrative Research and Development, Integrative Research Framework, Methodology, Regional Development.

1 Introduction

This article is positioned within the field of industrial engineering and management. In this context, the main research shares management sciences, service and product design and development, and the integration of activities of regional development and higher education. The continuum of this study is based on the increasing needs of applied R&D and integration of R&D activities in the Espoo and Helsinki region between universities of applied sciences (UAS) and many other competence and knowledge producers, such as firms, entrepreneurs, funding organizations, universities and other academic research institutions. In Finnish regulation, there are three statutory tasks for UASs, these are: 1) education, 2) research and development (R&D); and 3) regional development.

The focus of this study is in the analysis of student-centred R&D activities which actualise R&D and regional development, and shares the regional-national R&D capabilities, interests and R&D agenda in the R&D collaboration of higher education, regional innovation systems and integrative R&D environments, such as living labs and R&D-related learning environments. The key term "integrative model" refers to student-centred integration of regional development and higher education in the perspective of actualisations of study units within real R&D projects.

The study is a multiple case study analysis [30] of eleven cases regarding the externally funded R&D projects at Laurea UAS, by author, between 2008 and 2012. The research domain comprises the collaborative R&D networks, partnership of higher education, and mutual interactions and retentions of industry, service sector, security sector and higher education.

The continuum of research joins the five previous studies by the researcher, which are: 1) actualisation of regional development (including the two action research cycles), between 2001 and 2008 [20]; 2) development of research continuum (design research study of methodology), between 2003 and 2009 [23]; 3) design research study of integrative R&D environments, such as living labs and R&D-related learning environments, between 2005 and 2009 [26]; and 4) actualisation of quality (case study analysis), between 2007 and 2012 (in press); and in this article, 5) governance of an externally funded R&D (multiple case study analysis) between 2008 and 2012.

The theme of research is focused on the integration of regional development, R&D and education in a UAS. The common unit of analysis of the studies is as a sample of evidence in a UAS,

where the emphasis is on the integration of regional development and R&D [15]. The collected data is empiric, adaptable and reflective, and it provides lenses to everyday and practical activities [5]. Then, this study represents the idealist view of ontology and follows the hermeneutic tradition more than the positivist research tradition [19]. The experiences and samples of R&D processes are used as the main method of longitudinal evidence; thus, this continuum of research obviously represents the pragmatic view of epistemology [11].

In the continuum of this research as a multiple case study analysis, the main research question is: How can regional development be understood, designed, defined and actualised in higher education? This particular study concludes the research findings of a multiple case study analysis that addresses the regional R&D activities and collaborative R&D in the perspective of 1) understanding, 2) design, and 3) actualisation.

The study refers to integration of higher education, regional development and R&D, where the research data was collected in R&D studies of security management, services, and information systems programmes at Laurea UAS between October, 2007 and September, 2012. This analysis includes the data of R&D projects that develop academic knowledge, competences and regional capabilities for all networked participants by contributing to R&D in real-life and integrative contexts e.g. [26] and [21].

2 Theoretical foundation

As the theoretical foundation of this study, the Triple Helix indicates interactions between industrial business, government and higher education, which work as knowledge-sharing actors of regional innovation systems and clusters [10]. In this viewpoint, the Triple Helix model, as the theoretical background of the study, presents interactions of certain institutions at every stage of innovative service and product and service creation and development [26]. A funding organisation, actors from working world, and higher education institutions then interact in the initial stage, for example, the conception of promising ideas for regional R&D themes and consideration of profiled scopes for regional research [25]. Thereafter, the actors cooperate with a business in the development of artifacts and services, as well as sharing a body of knowledge [26]. Finally, a new product or service is commercialised in the market by a joint effort and vary R&D path depends [16] of a regional innovation system, funding organisation and respected collaborative actors [7].

In the context of this study, the overall situation is that regions are in a long transition from linear production economy to economy of knowledge, where the competitiveness of a region is required to be approached by competences, knowledge, services and applied technologies. Therefore, as reasoning, the R&D, which is carried out by higher education, would become a vital advantage in knowledge-intensive production of services, security and artifacts [20]. In this, open innovations [2], development paths [16], trust and collaboration take an active part in the strengthening of higher education, business and government [4].

Further, expected outreaches of the collaborative R&D include: “co-creation” of innovative activities, knowledge transformation and bringing the concepts of science and innovation closer to users and citizens through living labs, focused R&D learning environments, clusters and regional innovation systems [7]. In this view, competences are created and facilitated with knowledge for the well-being of its people [3]. In this activity, the networked expertise, co-created competence, knowledge and professional growth take place by using a body of knowledge in action [17].

In this study, the term “networked expertise” refers to competences that arise from social interaction, knowledge sharing, and collective problem-solving, and it is actualised in the shared competence of communities and organised groups of experts and professionals [22]. In turn, the term “innovation” is agreed here in perspective of [2]: as open view to “the creation of new products; processes; knowledge or services by using new or existing scientific or technological knowledge, which provides a degree of novelty either to: the developer; the industrial sector; the nation or the world; or to succeed in the market place” cf. [24] and [25].

One advantage of collaborative R&D in an innovation-driven region is that intelligent activity, cognition and knowledge reserves are not limited to an individual’s mental or as consumers’ processes. Rather, the shared R&D activities are based on socio-culturally developed practices, new or improved artifacts, services, methods and knowledge [1]. Then, this view’s advantages as a continuum are: 1) individual’s development, 2) organisation’s development and 3) region’s development. Here, the term “regional development” is delimited and related to the integration of the education, R&D and regional development in higher education.

The second advantage is that the R&D activity builds bridges between technologies and applications, so that results can be turned into competence, knowledge and economic success, and innovation alliances can be made between various stakeholders, particularly in science, business and politics [3]. In the integration of R&D, vertical cooperation, namely lead innovations is geared toward certain services, applications and branches with specifically coordinated support contributions from technological areas [12]. In R&D cooperation, "technological alliances" pursuing technological objectives are jointly created with science and business through shared service platforms [3]. In the operative environment of study, the major part of innovation system actors are located in the Helsinki metropolitan area; thus, the role of actors concentrates particularly on its ability to network and share information and competence between various regional centres and their players.

In our metropolitan area, additionally, one limitation is the amount of participating students in R&D in higher education. The mobilisation question is whether the region includes enough critical mass to promote collective and networked research-entrepreneur activities for regional and national purposes [20]. Then, in this integrated R&D environment with its multiple players, the strategic choice is to participate consciously in R&D programmes that bring various interested parties together and improves handling of critical mass and students' networked mobilisation; for this, the focused and international R&D learning networks and living labs are logical responses [26].

Almost without exception, the R&D projects cooperate with the numerous R&D programmes related to centres of expertise and regional centres in its area of operation, including the Members of the International Service Design Network, the Strategic Centre of Science (SHOK) and the European Network of Living Labs (ENoLL). These kinds of "steering forum operations" are accessible to international businesses and act as major innovation system actors, and they also improve the innovativeness of their own organisation, products and processes. Simultaneously, the R&D projects work on promoting collaboration and as collective "steering forums" between 1) public sector bodies; 2) businesses and 3) higher education in innovation work [26].

According to previous studies, there are two imperative assumptions of R&D sources, such as: 1) R&D community-led sources, as innovation-driven, industry-based lead innovations and 2) student-, user- and researcher-driven creations and designs [26]. The first assumption was that if the lead R&D agenda and "strategic steering" are used in higher education, then action creates deeper and more relevant knowledge and competence for expertise communities than a workplace's, student's, user's or individual's own themes or areas of interest [22]. This "collective steering assumption" is particularly reasonable because the innovation topics and research areas for innovation centres are deeply analysed and verified, also from a future and proactive perspective. In addition, this "thematic type of R&D steering" does not include any major contradiction with creativity fostering by individuals or education. As advance, it is possible to keep the creative scopes and themes of the innovation centre flexible, motivating and creative enough for students in the integrative R&D process and actualisations.

The second empirical and imperative viewpoint of R&D sources takes relative high resonance in the form of the R&D case, the security and ICT cases, SATERISK, which is currently as one of our R&D profiles. Here, the idea, foundation, focus, themes, topics and spirit of SATERISK were triggered and elaborated by two students, [18] and [29]; Hence, SATERISK is purely a student's innovation and creation. This gives the implication that student- or user-driven creations and designs can also lead to the initiation of promising "innovation triggering" and that the objectives by innovation centre may be co-creative creations by students, individual users or citizens e.g. [20] and [20].

Alongside the collaboration between higher education, industry, service sectors, and government and region, another benefit has been found: it is efficient to integrate action and values [20]. This view is obviously founded and drawn by analysis because an individual participant's interests and motivation is based on how they share and may co-create a value within their R&D project. The related questions of participants consisted of: What value do we receive from my network? What value should be given to the cooperative network? This item of research foundation was then conceptualised by the wording "participants have a value relation to a R&D network and actors". This type of networked activity was called the value network [20].

According to [13], in an empiric perspective of study, the role of customers has changed dramatically. Customers are taking a more active role in value creation, and the focus of the value creation processes is rapidly transiting from a supplier-company-centric view to a more customer-centric approach that aims to support customer experiences and joint value co-creation. Related ref. [13] states, still, relatively little is known about how

customers engage in value co-creation, especially in business to business (b2b). It is crucial to thoroughly know one's customers, their business models and processes, and on this basis, to develop new ways to create value with customers and other actors. Companies are moving from business models in which the value came mainly from physical goods to models where value comes more or less from intangible things such as services, knowledge and relationships [13]. In this shift, customers should be seen as co-creators of value rather that as passive recipients of goods and services. The CoCo research project, as one cross-case, focuses on creating new knowledge in the service science by studying the development of competitive value co-creation approaches in services [13]. In this context, the term "co-creation" can be understood particularly in perspective of value creation as co-creation of mutual related values. The term "co-creation" is then based on value and "co-created evidence". Here, the one noteworthy viewpoint to development of the capabilities, abilities and professional competences of individuals, teams, organizations, overall regions and emergent international externalities within an integrative model is in the understanding of co-creativity and motivational continuums in the activity theory [9].

In the "approach of steering", the two influencing systems coexist in the recent and future actualisations of the knowledge creation processes: 1) Gibbons' "mode-1," which represents "the ideas, methods, values and norms that have grown up to control the diffusion of the Newtonian model of science to more and more fields of enquiry and ensure its compliance with what is considered sound scientific practice" [12]; and Gibbons' "mode-2," meaning "knowledge production carried out in the context of application and marked by its: transdisciplinarity; heterogeneity; organizational heterarchy and transience; social accountability and reflexivity; and quality control which emphasizes context- and user-dependence; the results from the parallel expansion of knowledge" [12].

In our view, the term "transdisciplinarity" involves a research strategy that crosses many disciplinary boundaries to create a holistic approach; it applies to research efforts focused on problems or scopes that cross the boundaries of two or more disciplines, such as research on effective information systems; the term "transience" describes a temporary or short-term activity, such as triggering; transient data is a type of data that is relevant for a limited time period; creative cycles, trials and ideas are often quick and temporary in nature; and in turn, the related term "transparency" is allowing actors to see through so that objects and activities behind can be seen clearly.

Here, the theoretical binding of activity theory is in collaborative R&D work, with the purpose shared by others, as in the thematic R&D community or in a focused university [3]. In this view, the R&D activity is accepted by people as subjects who are driven by a purpose or towards the solution of an object or research scope, which is mediated by instruments, artifacts and services used in order to achieve the outcome, such as result and impacts. The activity is constrained by cultural factors and paths [16] including conventions such as regulation and rules and social organisation, such as working life within the immediate context and framed by a broader social world of production, consumption, distribution and exchange [9]. As a large approach of theoretical bindings, the activity theory provides a conceptual framework, from which we can understand the inter-relationship between activities, actions, operations and artifacts, subjects' motives and goals, and aspects of the social, organisational, regional and national contexts within which these activities are framed.

3 Research Method

The data collection of this continuum of five studies is cumulative, and it was systematically used for a qualitative analysis [5] between 2003 and 2012. Our first externally funded R&D project was RIESCA [26], between October, 2007 and March, 2010. Therefore, the data of the externally funded R&D project has been collected since 2008, and the timeframe of this analysis is between January, 2008 and September, 2012.

The data was collected at Laurea UAS and included five themes: 1) data of funded R&D projects, (n = 11) as cross-cases; 2) management data, (n = 89) files, which includes strategies, drafts of visions, legislation, papers of regional focus, scoreboards and indicators; 3) data of development days and reviews, (n = 420) files, which includes data displays, evaluations, reviews, learning diaries, development proposals and reports; 4) data of FINHEEC evaluations regarding the regional development and R&D, (n = 4) evaluation reports; and 5) feedback data from students, (n = 164) reports from the INKA system, which is the information system for feedback from students during different phases and areas of studies.

In this analysis, that multiple case studies follow replication logic and selected cases serve in a manner similar to multiple experiments, with similar results, a literal replication or contrasting results in a

theoretical replication predicted explicitly at the outset of the investigation [8]. In this, the case study analysis is bringing an understanding of a complex issue or object and can extend experience or add strength to what is already known through previous research. Here, case studies emphasise a detailed contextual analysis of a limited number of events or conditions and their relationships, when the relevant behaviour is not manipulated. In this study, the multiple-case study method is used for research; the used method is well known and explained in [30].

4 Cross-cases and main findings

This multiple case study takes an analysis of the research data regarding the eleven cases of funded and actualised R&D projects at Laurea UAS, between 2008 and 2012. The R&D projects have involved the participators of regional innovation systems, higher education, industry and service sectors. The eleven empirical R&D projects used as the cross-cases are presented with the most outstanding research findings (RF) as follows:

1) Rescuing of Intelligence and Electronic Security Core Applications (RIESCA) (October, 2007 to March, 2010) was the first of our externally funded R&D projects. The research of RIESCA addressed a number of systems, such as transport and logistics, power and telecommunication, hydropower and nuclear power stations that are critical to the day-to-day functioning of any technologically advanced society such as Finland.

(RF1): In RIESCA, the understanding and design of the R&D continuum as a driver and relationships of trust-based networked expertise were founded; it was our first integrated and externally funded R&D project, which was particularly actualised in study units in an interoperative and student-centred way, and it represents the beginning of student-centred R&D discursion and the sample of evidence series in the publications of Laurea [26];

2) SATERISK (SATEllite positioning RISKs) was initiated by two security management students at Laurea UAS, and that has evolved into a substantial three-year R&D project, between 2008 and 2011. SATERISK was funded by the Finnish Funding Agency for Technology and Innovations (TEKES), and it was collaboratively shared with universities, industry and service partners. The funding of SATERISK was secured on 14.11.2008 and allocated for the period 1.9.2008 to 31.8.2011 and documented in [29].

(RF2): SATERISK proved that a students' expertise itself and a student-workplace relationship steering can be seen as a knowledge bridge, trigger and driver of externally funded R&D projects. As towards future continuums and activities, there are two derived spin-offs of SATERISK, the AIRBEAM FP7 and PERSEUS FP7;

3) MayFly is the driver project in the field of security and public safety fields. The R&D collaboration is shared with the University of Arizona (USA) and the University of Information Technologies, Mechanics and Optics, ITMO, in St. Petersburg, Russia. The R&D of MayFly is addressed to the investigation of novel uses of Micro Air Vehicles (MAVs) for use in the security and public safety fields. MAVs are miniaturized remote-control and autonomous air vehicles, which can collect imagery and other information from the air and send it back to ground stations or mobile networks, allowing users to understand and respond to a variety of critical scenarios. The scope of R&D of MayFly includes developing of service models and business cases for a variety of MAV applications, including police, border control, rescue services, customs, and industrial surveillance. The R&D plan includes a demonstration to test the University of Arizona's Dragonfly MAV in Finnish winter conditions. The uses on MAVs of novel electro-optical sensors developed by ITMO are also included in the R&D plan.

(RF3): The steering of MayFly was initiated in the SATERISK project, and it was furthered for continuum of gaining new expertise in the field in a proactive sense. MayFly was an R&D trigger-driver; it was first funded by Laurea's own budget, and then later it inspired the externally funded spin-off, the AIRBEAM, in March, 2011;

4) Open Rendering Environment (ORE) (June, 2008 to December, 2009). Rendering is the process of generating 3D images and movies on computers. The ORE project aims to bring the Berkeley Open Infrastructure for Network Computing-based Big and Ugly Rendering Project distributed rendering service to Finland. This goal was realised by the opening of the "Renderfarm" service in June 2009. The Renderfarm service is the world's first publicly distributed rendering service, advocating the use of Creative Commons licenses. The ORE project also aims to help companies and universities adopt the open source 3D-modeling suite Blender into their everyday workflow. While creating new information about social behaviour and distributed computing, Laurea and the project also function as a pilot project for TEKES as it researches the possibility of using higher education as supporting structures for bringing new technologies into the reach of small and medium-sized enterprises.

(RF4): ORE is the pure creation of a student, and so far, it has one spin-off company. ORE implicated the importance of understanding, building, improving and testing of an open scope related and own path depended R&D environments. ORE as a one sample of evidence is inspired by empiric domains of movies, games and animations, and it represent as one sample of open innovations;

5) Laurea Living Labs (LLL) is a member of the European Network of Living Labs (ENoLL). ENoLL has a Europe-wide platform for providing user-driven innovation capabilities and services to small and medium-sized enterprises, international corporations, public sector agencies, academic institutions and individual citizens. LLL is an approach to stimulating and accelerating industrial and societal innovation. It is also a way of connecting and empowering users to participate in research, development and innovation.

(RF5): This steering model and partnership was related to the actualisations of hospitality management and information systems studies since 2008, and as an influenced steering forum in this study, it has advanced to the acceptance of the ITEA2-DiYSE and ITEA2-GUARANTEE as a living lab for R&D;

6) ITEA2-DiYSE (March, 2009 to December, 2011) stands for Do It Yourself Smart Experiences. The project has enabled people to direct their everyday environment (and the objects, sensors, devices and media therein) into a highly personalised, meaningful communication and interaction experience that can span the domains of home and city. The project aimed to create a sustainable marketplace for user-generated applications for an Internet of Things World, in which non-technically skilled people can participate by using well-abstracted components, capabilities and devices. As such, it goes beyond web, mobile or multimedia applications. A Finnish consortium, it is aimed to develop and evaluate technologies that empower elderly and disabled people, as well as young children, to create interactive experiences like quizzes, collaborative school assignments or educational games.

(RF6): The R&D scopes of DiYSE have been integrated into the actualisations of study units since 2009. It was produced evidence to the integrative R&D model. The DiYSE was initialised and is a continuum of LLL and RIESCA;

7) ITEA2-GUARANTEE (September, 2009 to August, 2012) provides a technical solution for personal safety in the home environment. It introduces local and network-supported decision making for safety applications on the basis of sensor input and with immediate response and feedback to the people concerned. Technology and services will be researched and developed addressing the specific personal safety needs of individuals in residential environments.

(RF7): The R&D scopes of GUARANTEE have been integrated into the actualisations of study units since 2009. GUARANTEE is related to the LLL collaboration and RIESCA;

8) The target of a Finnish national research, development and innovation program, 'Mobile Object Bus Interaction (MOBI)' (September, 2010 to October, 2013) is to create a common ICT hardware and software infrastructure for all emergency vehicles. This infrastructure includes devices for voice and data communications, computers, screens, printers, antennas and cablings. Additionally, the interlinking with factory-equipped vehicles' ICT systems is researched. The project utilises the results of the related research project and aims to develop product concepts, which have potential in both domestic and export markets.

(RF 8): The R&D scopes of MOBI have been integrated to the R&D actualisations since 2010. The one most inspiring spread of MOBI is in "last-mile R&D environments", which would contribute dissemination and R&D results, such as new products, services, and business models, and which have potential in international markets. Hence, MOBI demonstrates rather a R&D network of externalities than regionally concentrated R&D. MOBI is a spin-off of RIESCA;

9) The FROM Co-PRODUCTION to Co-CREATION (CoCo) research project is an on-going TEKES-funded project in the service field (October, 2010 to December, 2012). Laurea holds the ownership and the administrational responsibility for this project. The project is carried out in conjunction with five companies. The scope of CoCo is that companies are moving from business models in which value comes mainly from physical goods to models to those where value comes more or less from intangible things, such as services, knowledge and relationships. Moreover, within this shift, customers should be seen as co-creators of value rather than as passive recipients of goods and services. For this transformation, traditional marketing and strategy literature lack explanatory power. Therefore, the CoCo research project focuses on creating new knowledge and co-created innovations in the service field by encouraging the development of competitive value co-creation service concepts. The aim of R&D is to develop a conceptual framework of value co-creation in business to business (b2b) services, which offer

tools for co-creation. The research is accomplished using action research. In the first phase of the empirical research, the current state of the business approach is analysed in the case companies. The second phase of research will focus on the value co-creation development based on the needs identified in the current state analysis.

(RF 9): So far, CoCo has been one of the most student-intensive and student-centred R&D projects at Laurea. In this cross-case, implications of steering address the conjunction with companies and a novel phenomenon of service domain. Here, the new R&D theory development and advances to the service domain ontology are involved with the relative new terms such as co-creation and co-creativity [13].

10) Protection of European borders and Seas through the Intelligent Use of Surveillance (PERSEUS) is coordinated by INDRA Sistemas with 29 partners (January, 2011 to December, 2014). In this context, PERSEUS represents the first demonstration project implemented by the FP7 Security Research Theme.

(RF 10): Demonstration programmes represent a novelty and steering for the EU Framework programmes. They are aimed at large-scale integration, validation and demonstration of novel security systems and represent European flagships, providing a federative frame to join research and steering in areas of significant European interest. PERSEUS is expected to deliver tested, demonstrated and validated recommendations;

Finally, 11) AIRBorne information for Emergency situation Awareness and Monitoring (AIRBEAM) is a Seventh Framework Programme (FP7) project related to crisis management (March, 2011 to February, 2015). The goal is to develop a multi-platform approach to situational awareness for crisis management, especially utilising Unmanned Aerial Vehicles (UAVs), aerostatic platforms and satellites. In addition to EADS, the AIRBEAM Consortium includes 22 partners, including some of the largest high-tech companies in Europe.

(RF 11): The role of Laurea is as coordinator of Work Package 1 of AIRBEAM, which focuses on studying potential concepts of use and specifying end-user requirements; this works closely with end-user organisations and conducts interviews and panels to better understand the needs of authorities in field of crisis management.

5 Research contribution

How can the regional development be 1) understood, 2) designed and 3) actualised in perspective or collaborative R&D projects? In this cross-case study, the producers of new knowledge, services and artifacts include higher education, research institutions and business enterprises as actors (networks and systems) and all the five data collections for answering the research question were analysed: 1) data of funded R&D projects; 2) management data; 3) data of development days and reviews; 4) data of FINHEEC evaluations regarding the regional development and R&D; and 5) feedback data from students. The research contribution is described in the following: the first sub-chapter extends the research foundation; the second sub-chapter describes new concept of steering forums; and the third sub-chapter, refer to an evaluation design for the steering forums. The research findings extend the continuum of research foundation regarded to the externally funded R&D projects and management.

5.1 Advances to research foundation

According this study, the integration of externally funded R&D projects and higher education as eleven cross-cases produced findings for the research foundation, these are: 1) cases were rooted to communities of expertise and work, and targets of funded research programmes by national innovation system or European level R&D; 2) cases were larger than regional view, rather regionally and internationally networked bindings which included knowledge of international externalities; 3) most advances were achieved in a multimethodological way and as a continuum of research; 4) cases were working as a promoter of international knowledge bindings and pipelines and participator of knowledge diffusion; 5) cases produced professional growth and new capabilities in “live interactions and transitions”, such as interfaces between empiric live, small-medium firms, international enterprises, living labs and R&D environments. The advances of the multimethodological approach of research were regarded as the preeminent research paradigm, because it seems that no one research methodology is sufficient by itself, as anticipated in [17]. Then, the suggested core would be in the prediction of research impacts, e.g. by way of using the “last-mile research”, “last-mile R&D environments” which includes three phases: 1) proof of concept, which has closeness to exploratory sciences; 2) proof of value as the view in experimental sciences; and 3) proof of use as an instance of applied sciences and engineering [17].

In situations of genuine and real R&D, the goals of the cases are often not possible to clearly define in advance, but are refined throughout the R&D process; the results and future impacts cannot be

clearly formalised or predicted in advance. In the cross-cases, the research continuum comprised the following approaches: 1) case study research for understanding; 2) design research for artifacts, services and methodology; 3) action research for research of organisational change and epistemological utility; and 4) new incipient "last-mile" research for general utility production and value co-creation.

According to the data of cross-cases, especially in MOBI, ORE and CoCo, the integrative model provides a multi-disciplinary forum for researchers and practitioners in the field of entrepreneurship, small and medium sized firm development and for those studying and developing the regional and national context in which new entrepreneurs emerge, innovate and establish the new economic activities, which can trigger and drive economic growth and create new employment and economic growth. For this, it is distinguished that "last mile research" and "last mile R&D environments" would need more focus and R&D activities and empiric analysis is in future [17].

Then, as implications: 1) a concept of focused university [3] produces the new knowledge, which is produced in closeness and in relation to its R&D scopes and projects; 2) the focused university is focusing on its body of networked and externalities related knowledge, and a course of research implicates the direction of new knowledge; 3) according to data of all cases, the knowledge was expanded and reflection was used also in the social context [1], cf. activity theory [9]; 4) a knowledge creation needs new understanding and forms of quality assessment and repositioning: e.g., "modes" by Gibbons [12]; 5) the scopes of R&D studies were formulated by: a) the needs of working life; b) the needs and steering of international markets; c) regulation compliance; d) observing needs of knowledge reserves, new competences and capabilities; and e) recognised advances of related studies as a continuum of research; 6) the studies were cross-disciplinary in nature between such fields as: safety, services, welfare and information systems; and finally 7) all cases implicated an incipient contribution of the central factors in economic development, entrepreneurial vitality and innovation at the regional and across international levels; the eleven cross-cases connect the diverse and complex characteristics of national and regional economies, which should be better realised and which could lead to more entrepreneurial vitality and providing the large and small enterprises with international competitiveness.

5.2 Steering forums

In this analysis, the mutual functions in the integrative model can be identified as purposes of steering from macro-level to micro-level. The four recognised functions were: 1) triggers, such as thinking, ideas, R&D issues, R&D scopes and R&D agenda; 2) collectors, such as regional planning, regional R&D profiles, focused R&D themes, networking, focused universities, research institutions and R&D concentrations; 3) drivers, such as actualisations, R&D processes and production; and 4) enablers such as a funding, proofing of quality and evidence of R&D. This functional proposal as continuum is drawn into the middle of Fig.1.

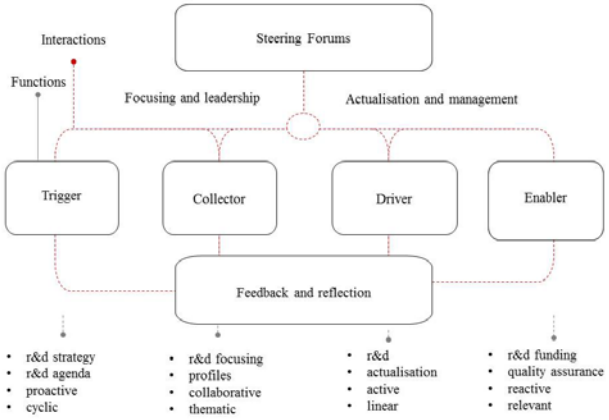

Fig.1 Steering Forums

Beginning at the most macro level, the integrated concept of steering and value concentration makes implication with the view that the Finnish national innovation system is as an extensive trust-based entity, which includes the producers and users of new information, knowledge and know-how and the various ways and culture in which they interact. As a role of "macro level steering", a key task for science, technology and innovation policies is to ensure the balanced development of an innovation system and the strengthening of cooperation within it [20]. Here, this entity is seen as macro-level steering for all four functions as facilitator of: triggers, collectors, drivers and enablers for national R&D and steering forums.

On right-hand side of Fig.1, the operative, business and quality scenario comprise: 1) actualisation of R&D; 2) results and quality of advances in business opportunities; 3) increased innovations and entrepreneurship by way of collocation and profiles; 4) innovation stimulation in early stages of higher education; 5) familiarity,

relationships and knowledge bridges between actors in regional innovation systems; and 6) agile networking of R&D environments and living labs for already-understood, community-led and user-centred incipient innovations. Here, there is resonance in management approaches for collaborative R&D in the viewpoints of integration and knowledge creation: Gibbons' disciplinary "mode-1" [12]. Gibbons' "mode-1" is based on a disciplinary setting as the drivers and enablers in the right hand site of Fig.1. In this "mode-1", the creativity of an individual is the driving force of development and is operated through disciplinary structures of identifying and improving the management and that collective perspective. "Mode-1" includes control aspects as the consensual figure of the scientific community [12].

On the left-hand side of Fig.1, the integrative view comprises the strategy scenario; it is focusing on the sense of leadership, which is aimed to facilitate the concentrated expertise and value to: 1) entering new markets; 2) developing of new products and services; 3) fostering of regional advantages; 4) co-creation of regional R&D profiles and strategies; 5) networking of critical mass for starting of new business; and 6) flexibility of competitive response. The role of regional innovation system is expected as triggers and collectors of R&D, which includes collocation of regional R&D as the steering of inspiration and settings of networked R&D profiles, R&D agenda and R&D funding. In this study, this trigger-driver is assimilated as the trust-based Triple Helix [10]. In this viewpoint, the trust and steering were shared with academic, research, education, and empiric parties in the cross-cases of this study. Here, the Gibbons' "mode-2" involves the intellectual quality setting in management, adapted as the triggers and collectors on the left-hand side of Fig.1. The creativity is collective as a group co-creativity phenomenon with the individual's contribution. In "mode-2," the management is being exercised as a socially extended process, which accommodates a variety of interests in a process [12].

Fig.1 is titled as the "steering forums", in which the steering functions integrate a shared value and interest relations and R&D activities between 1) academic, 2) research, 3) empiric, and 4) education domains. Hence, the 1) intellectual vale, such as politic or art; 2) value of new knowledge, such as results of world class academic research; 3) value of competitiveness, such as transformation of knowledge to innovations; and 4) business value, such as relevance to work and commercial purposes, are concentrated in the steering forums. Then, the term "steering forums" can be identified; it covers everything that is steering the R&D, as insiders, outsiders, interests, trust, networks and systems.

In Fig.1, the reflection and feedback include such perspectives as: 1) results and impacts on the domain; 2) improvements to R&D agenda and scopes; 3) questions of methodology; 4) advances of regional capabilities; and 5) evaluation of focused education within collaborative R&D projects. Then, as a continuum to the integrative model, a funded R&D can promote a value that is achieved or "co-created" in an R&D project. This value can then be expanded and utilised by participants or actors, and it can contribute to education and regional development [9]. The view includes: 1) R&D in a proactive sense, as triggers and collectors; 2) R&D for success as drivers; 3) R&D by feedback as enabler; and 4) learning by failure as Popper's falsification [28].

In Fig 1, a continuum of functions corresponds particular as a similarity to the activity theory [9], which is avoided, to a large extent, in organizational development, as it assumes that activity starts as grasp or input, which is related to a change in social practice. Here, in the integrative model, the grasp, issues and even "speaks or listened in elevator" are understood as a triggers. The activity theory integrates a distributed cognition view and presents an analysis of a meeting where the different participators drive the different stages [9]. Here, in Fig.1, the actor stages were, for reference: 1) triggers; 2) collectors; 3) drivers; and 4) enablers. Then, in perspective of bottom-up thinking, as through expansive way and activity theory, a participator, as an actor or networked member, would start the R&D transaction by expressing their own cyclic thinking or new understandings of an R&D scope, which then triggers questioning by another R&D group member, followed by a third member or actor who poses the next phase, such as an analysis of the R&D scope and value of the theme. Then, this R&D continuum takes an expanding of value; from individuals or work groups into whole R&D organizations, or networks such as a continuum of R&D processes in regional-national-international innovation systems. In this expansive view, the reflection and feedback on the process is the step between implementation to experimental action and in consolidating the new practice, service, artifacts and methodology. Therefore, in addition to the continuum of the integrative model, the research findings are expanding a funded R&D into a social process that develops new forms of activity and practice [14]. The beginning of the R&D cycle can also be related to the inquiry [6] and problem-based

orientation [27]: as in the first step, a problem emerges that requires a solution; in the next step, the problem is shared (as collector function) and analysed (as one driver function); based on the created understanding of a problem, a solution model is created or co-created (driver), its characteristics are studied, and a solution can be implemented. Here the "enabler" represents such things as funding, innovation system, R&D budget and quality assurance system.

5.3 Evaluation design

In light of this study, there is no easy or single way of determining the validity of regional and integrated R&D activities [19]. According to the data of this study, the evaluation design of regional R&D includes both qualitative and quantitative data, which can be interpreted in the forms: 1) results, 2) direct impacts, 3) indirect impacts and 4) feedback. This revised form of evaluation design [26] which joins steering forums to the evaluation process is presented in Fig.2.

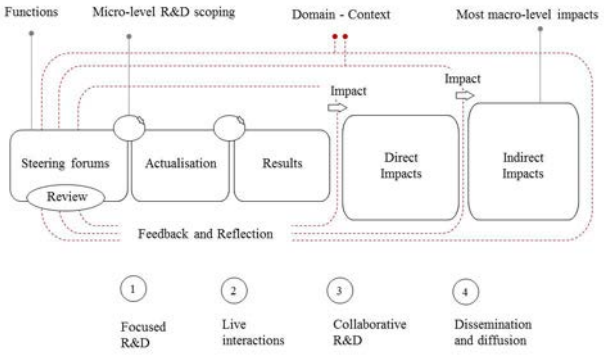

Fig. 2 Evaluation design

In this study, the strength of the construct validity in the analysed R&D cases addresses the statistical nature of the analysed units, such as: the theses which are based on projects or R&D, the publication number produced and the external funding of R&D. The one identified weakness of the construct validity of the collaborative R&D projects lies in the integration of education measures, in where the estimation nature of the criterion based analysed units were used, such as the number of credits completed in R&D, but nevertheless these units are complementary in nature and vital to the perspective of R&D dissemination in higher education.

This study reconsiders that the development of multiple methods in multiple environments "over actors of a region" for the measuring of impacts is needed, because the impacts would exist in actualisation, research environment, working life or regional-societal networks, and during the time of actualisation, or long after that [20]. For advancements, the measuring of impacts would need the integrated view of regional, national and global factors, see expanded design in Fig. 2.

The one advanced finding of the study is that UASs can take more entrepreneurial, living lab, new business, and focused R&D design, see e.g. "live interaction and transition" in Fig. 2. The UASs can develop a set of "steering" that guide and rationalise the structural change that provide a stronger R&D capability, and it can build a networked and co-creative steering capability to make larger choices that benefit the UASs' focus [3].

Then, more research for understanding, building, improving and testing of "dynamic of regional profiles", "last mile research" [17] and investigation of the role of focused higher education is required. The concept of the focused university [3] in evermore turbulent and agile settings can become stronger if UASs develop leadership abilities, R&D capabilities and improve their collaborative R&D, see (3) in Fig. 2. This strategy and selection can be built around a flexible focus, such as entrepreneurial, living lab, new business, and focused R&D profiles, if UASs choose this way, they will have to assert themselves in new ways at the environment-university interface.

6 Discussion

The integration of regional development, R&D and higher education would include the three design-, quality- and management-related activities: 1) support for triggers; 2) development of sustainable drivers and collectors for higher education and R&D; and 3) shaping of enablers to R&D-related education, collaboration, and cooperative action, so that support itself does not prevent or hinder creativity.

As one implied finding for continuum of discursion, the used management model shares the insider positions and role, as well as participating intensively in the management of R&D and regional collaboration. This combined leadership and management, as a union of Gibbons' "mode-1" and "mode-2," affects quality in such as the planning of R&D agenda, co-creation of regional strategy, forming of profiles, and leadership of R&D activity.

In the analysed cross-cases, the model of management was based on a bottom-up, vision-based and relationship management model; it was

also based on an orientation and management culture and philosophy, where the management focus was on variations of power and authority relations and in the relationship management. The management model was then suitable for enabling agile scopes in the R&D and education processes, so that the "ecosystems" of different stakeholders can come up with new creative ideas. The focus of management was on a co-creative discursion and its power, such as enablers and emancipatory activities.

The regional collaboration and management model, with externally funded and evaluated R&D, also needs greater flexibility in the future, because the amount of different standards used by various R&D actors, the European Union and other institutions, are increasing and entering into the collaborative and regional R&D processes. "These standards are required to be frequently revised, and this change in turn requires institutional flexibility" [12], ability and capability to change, and trust-based management.

In this R&D environment, a process of sharing in social communities made sense with shared cognitive processes, values, relations, trust, identity creation and situated learning [14]. For example, due to long specialization careers and positions of networked students; they can advance the networked expertise and international externalities of different requirements in the workplace and then represent the expertise organizations as a body of knowledge in a particular R&D domain. In this view, teachers in higher education may share and facilitate a new advantages and R&D discursions and bridges. The R&D participation and shared trust may improve work groups, R&D communities, networks, and cultures as an expertise units.

The study has significant implications for further research of quality in regional context. The first implication addresses the collaborative and co-creation activities of regional development. This question would extend to: 1) what are the characteristics of the dynamic and core capabilities and abilities in a region; 2) how would the regional capabilities be linked to the competences, education modules, and R&D and innovation activities within quality assurance; 3) how could future research be used more effectively in exploring potential regional development and co-creative environments, such as living labs and last-mile research in the perspective of business models; 4) how could enough shared and co-created vision be built in a region, the regional development network consisting of actors with different backgrounds and quality and business aims; 5) how can we co-create a portfolio of strategies in a region to enable a successful future development path to take place; and 6) how should the significance of regional innovation networks be thoroughly analysed as part of regional, national, and sectorial innovation systems with collaboration and R&D activities?

Second, the development of organizational culture, agility-profile relations, and trust-commitment-based management between all actors would be in the interests of future research. The implication in this study includes two relative different views: 1) how to understand the everyday line management quality in this situation and 2) how to conduct and save agility-, trust-, motivation-, creativity- and vision-based profiles, triggers, drivers, and enablers in a higher education institute with its collaborative networks.

Third, the study has implications for further research for a deeper understanding in the measuring of results and impacts as the evaluation design in Fig.2 anticipates; the future research question would include: 1) how to understand conceptualization of information and its quality in the union of regional innovation networks and higher education, 2) how to measure achieved impacts such as longitudinal impacts over regional actors in the perspectives of success or failure; and then 3) how can the focused university [3] utilise the continuously expanding knowledge growth and increasing information flow into an advances of the region.

7 Conclusion

In this study, the asked the question was: How can the regional development be understood, designed and actualised in the perspective or collaborative R&D projects in higher education? In addressing this question, theoretical approaches were formed for the integration of regional development and R&D in the context of a UAS. The research findings were described trough 1) research foundation, 2) the concept of steering forums, and 3) the evaluation design. The analysis was based on the empiric and longitudinal data collection in a UAS, which was elaborated in combination with the real R&D studies of masters, bachelors, and degree education in information systems, security management, and service programmes at Laurea between 2008 and 2012. The study provided insights into the integration of regional development and higher education in viewpoints of action logic and design of the integrative R&D for bridging a world of cyclic strategies, visions, thinking and imagination-creativity activities to linear R&D methods and development-based education, as well as integrating UASs with an emergent value network.

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