Corporate Governance: The evaluation based approach to the governance and business models of the EPIC Centre of Excellence in Production Informatics and Control (EPIC CoE)

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Abstract

The Centre of Excellence in Production Informatics and Control (EPIC CoE) was established by an international consortium with the objective to be a leading, internationally acknowledged and sustainable focus point in its field, representing excellence in R&D&I related to Cyber-Physical Production. This 7-year project is funded by the European Horizon 2020 Teaming Programme. By the end of this period, the newly created EPIC CoE is expected to become fully self-sustainable in its regional operation that is planned to cover both advanced and emerging countries in Europe. Main objective of this paper is to describe the organisational development and transformation process of an Industry 4.0 oriented state-of-the-art organisation. These circumstances determine the approach how to address the issue of governance closely related to the business model and processes that will be implemented. However, this task has to be facilitated as part of the evolution process envisaged for the upcoming years. First the vision, mission and concrete targets of the EPIC CoE are analysed to build the strategic basis for the derivation of the management and organisational structures enabling the participating partners to harmonise their experiences, skills and competences. By these efforts, the EPIC CoE is conceived as a synergic combination of two entities, i.e. one existing, acting in basic and applied research while the other one is a new company focussing on knowledge transfer and dissemination. In this paper, the special aspects that led to the concrete representations of the governance structure for each of the planned three operational phases will be outlined. These phases are (1) the establishment and start-up of the EPIC CoE, (2) followed by the phase of the evolving and maturing operation (3) to be concluded by the self-sustained one.

For the definition of these phases, it is indispensable to define the different levels of the management functions and responsibilities to ensure efficiency, reliability, transparency, clear accountability as well as high-quality services to EPIC CoE's clients and partners. Being service oriented is specifically a key issue, therefore the processes that will be highlighted are grouped into: the core processes embodying the daily businesses, the management processes that ensure the effective flow of all processes that are aided by the supporting processes.

Key Words: *Corporate governance, Business processes, Organizational structure, Industry 4.0, EPIC, Concept Development*

1. Introduction

The Centre of Excellence in Production Informatics and Control (EPIC CoE) was established with the objective to be a leading, internationally acknowledged and sustainable focus point in its field, representing excellence in research, development and innovation related to Cyber-Physical Production (CPP). The big challenges of the new technological era when information and communication technologies are fundamentally transforming and revolutionizing production will be responded by concentrating the multidisciplinary, partly overlapping, partly complementary competences of CoE partners from Hungary, Germany and Austria. The project has received

funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 739592.

Main objective of this paper is to describe the organisational development and transformation process of an Industry 4.0 oriented state-of-the-art organisation in the sense that its key features are innovativeness and adaptability simultaneously able to satisfy the robustness requirement of the smart business models (Grey, Walters 1998).

These circumstances determine the approach how to address the issue of governance that is closely related to the business model and processes that will be implemented. However, this task has to be facilitated as part of the evolution process envisaged for the upcoming years.

First the vision, mission and concrete targets of the EPIC CoE are analysed to build the strategic basis for the derivation of the management and organisational structures enabling the participating partners to harmonise their experiences, skills and competences.

In this paper, the special aspects that led to the concrete representations of the governance structure for each of the planned three operational phases will be outlined.

2. Mission and vision of the EPIC CoE and the conclusions we've derived from them

The *mission* of EPIC CoE - as a leading-edge knowledge centre of cyber-physical production systems - is to accelerate innovation, realize industrial solutions, train new generations of highly qualified professionals and support the development of a sustainable and competitive European manufacturing ecosystem.

In our *vision*, the future of manufacturing in the efficient and sustainable cooperation of all partners along the product life-cycle, in the value creation chain, and within the enterprise is foreseen. The convergence of manufacturing, information and communication sciences has established not only the key cyber-physical enabling technologies for tomorrow's production, but has also initiated a fundamental, revolutionary change affecting science, industry, education and society alike. EPIC will be in the European forefront of this move by identifying, addressing and, responding to main challenges in the service of smart, competitive, sustainable and cooperative manufacturing. This vision will be pursued in the following directions:

- Research, development and innovation: EPIC will conduct cutting-edge theoretical and experimental scientific explorations in all main research fields related to cyber-physical production systems in a multi- and interdisciplinary setting.
- Technology transfer: EPIC will establish institutional channels for transferring state-of-the-art research result from academic and university research laboratories to innovative industrial applications. Special attention will be paid to advanced but affordable services for small and medium size enterprises. It is also foreseen that sectors like smart cities and energy will take up relevant scientific results.
- Attracting talents and training professionals: Beyond directly contributing to graduate and postgraduate education, EPIC will create new job opportunities by training knowledgeable professionals to find and fit their right place in cyber-physical production. Through EPIC's network of exchange relationships, the training programs will provide a broad and up-to-date European perspective.
- Ecosystem formation: In collaboration with regional innovation clusters EPIC will shape the local ecosystem of manufacturing so as to improve innovation performance, foster interoperability and compliance with emerging standards; to build and maintain trust between business partners and, to elaborate incentives for competitive, but at the same time cooperative and sustainable manufacturing.

The EPIC consortium as a whole has all the assets that are essential to make the above vision a reality: the critical mass and momentum, multi- and interdisciplinary research background, international scientific network, industrial experience, well-proven innovation and technology transfer culture, educational practice and potential to impact on policy-making. EPIC will respond not only to the needs of its home country, Hungary, but especially through the cooperation with the German and Austrian Fraunhofer partners it will have a cross-border regional character and will support Central East Europe (CEE) as well.

What makes EPIC CoE specific and thus creates unique circumstances to take into account when designing its management and organisational structure, is that the EPIC CoE in its final status, i.e. not considering the transient steps leading to this point, is conceived as a *synergic combination* of two pillars. One of those pillars was existing from the very beginning, acting in basic and applied research while the other one is a new company focussing on knowledge transfer and dissemination:

- MTA SZTAKI, Institute for Computer Science and Control, Hungarian Academy of Sciences as an existing Centre of Excellence of the EU in Information Technology, Computer Science and Control whose current principal basic research profile focuses on cyber-physical systems (CPS). This pillar is to be upgraded on the one side by deepening its basic competency in fundamental research and strengthening its reputation in the applied research and, on the other side, by extending its scope of activity to become a CEE hub in the field; and
- the new EPIC InnoLabs Nonprofit Ltd. established in Hungary as a new legal entity on the basis of the formal Fraunhofer-SZTAKI Project Centre for Production Management and Informatics (PMI) that has been formed in 2010 in collaboration with the Fraunhofer Institute (FhG) for Manufacturing Engineering and Automation (IPA), Stuttgart and Fraunhofer Austria (FhA), Vienna. Through the current consortium, two additional institutes of FhG, the Institute for Production Technology (IPT), Aachen and the Institute for Production Systems and Design Technology (IPK), Berlin have been included into the cooperation. As the name stipulates, the main focus in this respect is to manage and facilitate the transfer of the research and innovation results to the industry through complementary developments and other value-added services.

Furthermore, the former academic relationships between SZTAKI and the Budapest University of Technology and Economics (BME) have been formalized by inviting two of its faculties, i.e. the Faculty of Mechanical Engineering (GPK) and the Faculty of Transportation Engineering and Vehicle Engineering (KJK) into the consortium resulting in the widening of the scientific and educational scope and approach pursued.

3. The harmonisation concept

Thus, EPIC has two fundamental, cooperating entities or pillars (SZTAKI CoE and EPIC InnoLabs Nonprofit Ltd.) yielding a solid basis for its operation. However, for the outside world EPIC has to appear as a single integrated entity acting coherently and uniformly on all forums and in all its spheres of interest. How is this ambitious goal to be accomplished? First of all, by adopting an approach of addressing the issue of governance in a closely related manner to the business model and the processes that will be implemented. Moreover, this task has to be facilitated as *part of the evolution process* envisaged for the upcoming years.

3.1. The Operational Phases of EPIC CoE

Following the plan described in the EPIC teaming project, three main phases in the operation of EPIC CoE will be distincted over the time span of 7 years (Grey, Walters 1998; Nyström, Starbuck 1981; French, Bell 1978).

Operational Phase 1: Establishment and Start-up of the EPIC CoE

Currently the project is in the middle of this stage, as the EPIC InnoLabs Nonprofit Ltd. has recently been established and a ramp-up phase is foreseen in the second year. At the end of this period the most important milestone is that the company is founded and the legal process has terminated, the company is part of the EPIC Teaming consortium, the internal structure and staffing having been set up with the most basic internal processes already in place.

Operational Phase 2: Evolving and Maturing EPIC Operation

As EPIC CoE is moving on, with its operation fully geared towards the realization of its principal objectives, first the evolving then the maturing periods in approximately the 2nd to 5th and the 6th to 7th years are foreseen. A consolidated research programme and a well-functioning portfolio of common client relationships are set in place and operational. Following the business plan, EPIC CoE is getting a widening acceptance in both the industrial and the R&D&I community and is to be more and more recognized as a leading organization in the

field of the Cyber Physical Production Systems (CPPS) (Monostori et al 2016). Tailored education programmes and dedicated technology transfer actions will produce tangible results internally as well as externally.

Operational Phase 3: Self-sustained Operation

This is the consolidated status of the EPIC CoE as conceived by the Consortium: with a well-established and solid position in research and industry it has an unrivalled reputation and financial stability ensuring long term survival and continuous and organic growth.

3.2. The Business Model as Product of an Evolutionary Process – Dependence on the Operational Phases

Although a clear vision of the business model to be adopted for the EPIC CoE is well described it is evident that its actual shape is *to a great extent dependent on the operational phase* the EPIC CoE actually happens to be in. The individual phases with different scale of activity, different R&D&I intensity and different staff size obviously require different management methods, different approaches to the relationship with the stakeholders and also different HR policies (Dobák, 2001).

In the first phase, i.e. that of *establishing and starting up the EPIC CoE* everything is focused on creating the entity itself and launching its operation successfully which is invariably on a low scale yet. By the time the legal process has terminated and the new entity is inaugurated – with the internal structure and staffing having been set up with the most basic internal processes already in place – and elementary research work, i.e. basic research in the most important strategic areas and complementary applied research, underpinned by a stock of client contracts will have already been started or, taken over from the preceding operations (i.e. SZTAKI). It can be stated that at this point traditional models and patterns may be used to operate the organisation and gain more and more impetus for the boost in the next phases.

As the CoE is moving on through the next *evolving, then maturing phases and finally the self-sustained one* and gets acceptance in both the industrial and the R&D&I community the business model has to be enhanced and become ever more sophisticated to be able to cope with the needs of flexibility and adaptability and deal adequately with the expanding activity and as a consequence thereof, with the increasing responsibility. Indeed, the growing responsibility towards the professional reputation and financial sustainability of the CoE on the one hand, and towards the societal community on the other hand, is the most compelling factor to apply the policy of continuous self-check, search for new paradigms and introducing new elements in the business model.

Thus, a regular review of the factors that influence both the business model and those of related stakeholders is a must, including keeping close tabs on shifts in technology, sociodemographic trends, macroeconomic influences, ecological factors and the legal/political framework as well as listening to the internal and external stakeholders and accommodating the views of the trend and technology researchers, suppliers and even our customers' customers. These aim to pick up the eventual warning signals long before they become relevant to the competitive marketplace. Alongside them, early strategic reconnaissance must also be able to detect any “blind spots”. These are key factors of influence that companies' strong inward focus often causes them to overlook.

In general, business model innovation may basically take one of three approaches (Roland Berger 2011) (Figure 1):

- *Skill based business model innovation*: is a new way to satisfy existing customer needs by using new skills, technologies and core competencies in addition to the capabilities a company already masters.
- *Demand based business model innovation*: happens when hitherto unsatisfied or newly emerging customer requirements can be met using existing skills and capabilities.
- *Lateral business model innovation*: seeks to accommodate new customer requirements by applying new skills and/or technologies.

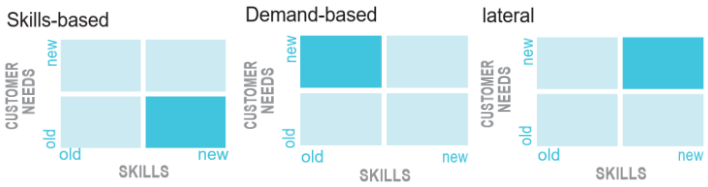

Figure 1: Comparing Business Model Innovation approaches depicted in the Ansoff matrix

In this approach these three principles have been combined and have been used to define the HR strategy and infrastructure strategy accordingly (Hecklau et al 2018).

The same approach defines three steps in the renewing or evolution of the business model which is to applicable to the EPIC CoE:

- *Step one* involves an audit to determine whether a business model needs to be modified. The audit describes in detail both a company's existing business model and the models operated by competitors. The most important – and most difficult – part of this step is not finding the right answers, but asking the right questions.
- *Step two* is then to develop the new business model. The acid test, ultimately, is the ability to generate customer benefits superior to those offered by the competitors.
- Lastly, *step three* involves preparing to implement the business model. The main question is whether the old and new models are to coexist for a transitional period, or whether a clean break between the two should be scheduled for an appointed date.

In addition to this, the simultaneous application of the elements of the Roland Berger (2014) approach by developing a vision of the industry in the years leading up into 2020s will put us immediately into the Horizon 2020 context and beyond and allows to take appropriate action:

- Accelerating the continuous evolution of the existing business model
- Injecting from time to time revolution into the new organisation by launching new business models as demands have arisen and are recognised.

Also, the model has been adapted to the challenges incorporated in the VUCA (Volatile – Uncertain – Complex – Ambiguous) principle (Stiehm, Nicholas 2002) describing the new reality of a fast-changing world (Figure 2).

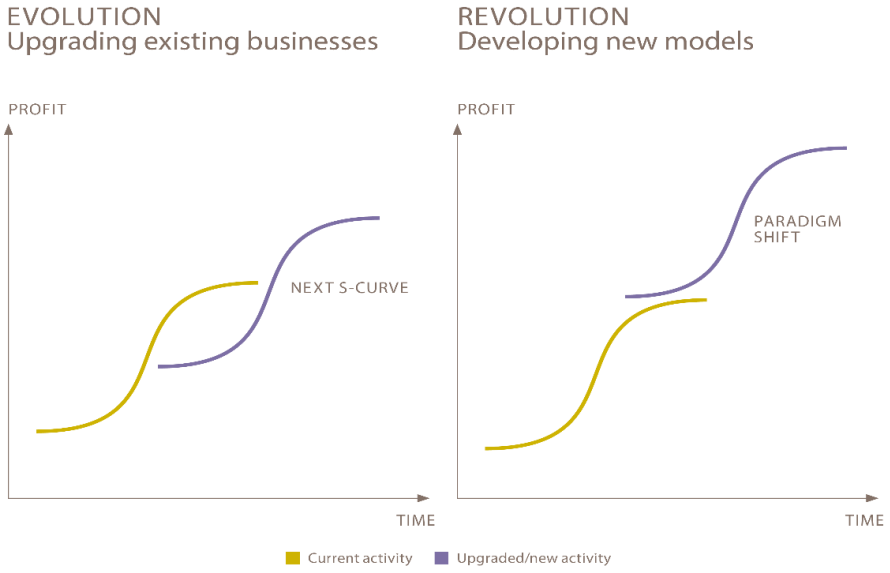

Figure 2: Meeting the challenges of the VUCA world

In this context in the recent history of SZTAKI the evidence for the applicability of this principle could be clearly identified ,i.e. which, by adopting a revolutionary strategy in pursuing business while maintaining obviously the evolutionary endeavours as well has created significant benefits (Figure 3).

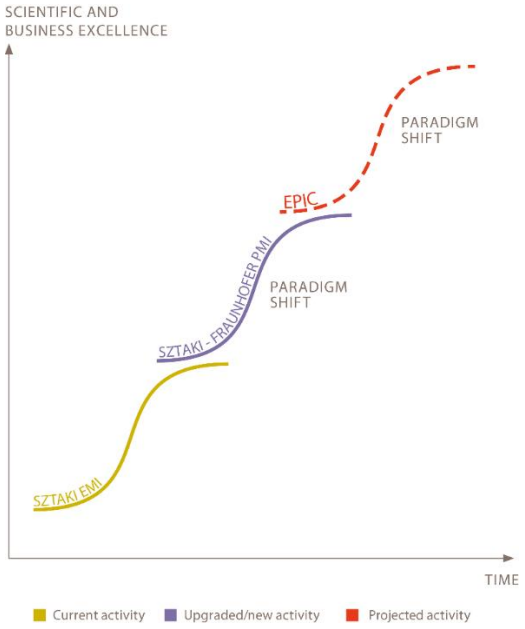

Figure 3: The EPIC paradigm in the VUCA world

3.3. Organizational structure, main roles

Interestingly, the EPIC CoE organisation has two distinct, although inseparable aspects. *From the EU financing and monitoring perspective*, it is a project that should be structured and managed as any high-value projects. *From the final goal's point of view* it is an entity deemed to be a future key actor on its own field of designated operation. This fact is reflected in the design of the organisational structure.

Here, by contrast, only the project aspect for the very first project phase is shown (Figure 4) while the project independent phase is demonstrated by the matured organisational and management structure (Figure 5).

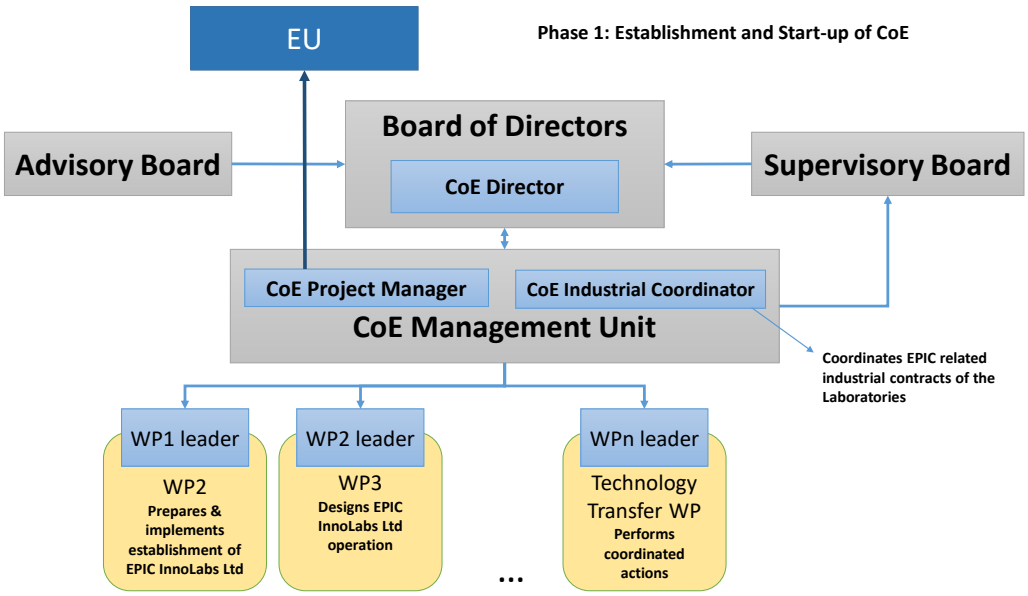

Figure 4: The EPIC Project management structure in Phase 1

It is important to emphasise that in this project phase the everyday activity of SZTAKI is carried out on a *"business-as-usual"* basis, i.e. the laboratories are pursuing their R&D work, liaise with their industrial partners. However, in order to integrate this latter activity into the future dedicated technology transfer function of EPIC, the separate and independent position of a CoE Industrial Coordinator will be created who will coordinate all EPIC related partner relations and contracts of the SZTAKI units. However, the professional activity with the participation of the cooperating consortium partners have already been initiated.

Figure illustrates the organizational structure of EPIC CoE entity. As the organization and the management structure of EPIC CoE involves several levels and managing roles a glossary of relevant definitions is provided in Table 1. Both Figure and the table below includes only the organizational structure of the Centre of Excellence and does not show the connection of the partners within the Teaming Consortium.

Table 1: Glossary of EPIC bodies

EPIC CoE	The object of the Teaming Proposal; which is the establishment of a leading state-of-the-art Centre of Excellence in the field of Production Informatics and Control, more concretely in the field of CPPS in the region.
SZTAKI CoE	The main research oriented pillar of EPIC CoE, at the same time part of the legal entity MTA SZTAKI and being an existing Centre of Excellence of the EU (since 2001), to be substantially upgraded during the EPIC EU Project.
EPIC InnoLabs Nonprofit Ltd.	The newly established Nonprofit legal entity owned by the MTA SZTAKI and FhG. Its main function is to acquire, organize and accomplish the CoE's industrial projects constituting the mainly the development, innovation and technology transfer pillar of the Centre.
Advisory Board	A consultative board comprising invited representatives of EPIC's stakeholders holding yearly meetings and providing advice to the EPIC Board in strategic and professional issues.
Supervisory Board	The supervisory Board of EPIC InnoLabs Nonprofit Ltd. including three members delegated by the owners of the company with the main duty to supervise the operation of EPIC InnoLabs Nonprofit Ltd.
EPIC Board	The highest decision making entity of the EPIC Centre of Excellence – as appropriate and applicable –, it consists of delegates of the EPIC Teaming consortium members and is headed by SZTAKI's Director.
Research Unit (RU)	A group of qualified staff in SZTAKI CoE to perform specialized research tasks; consists of senior and junior researchers, developers, IT experts, doctorate students, etc. Each unit in this pillar is lead by a leading researcher of the given field.

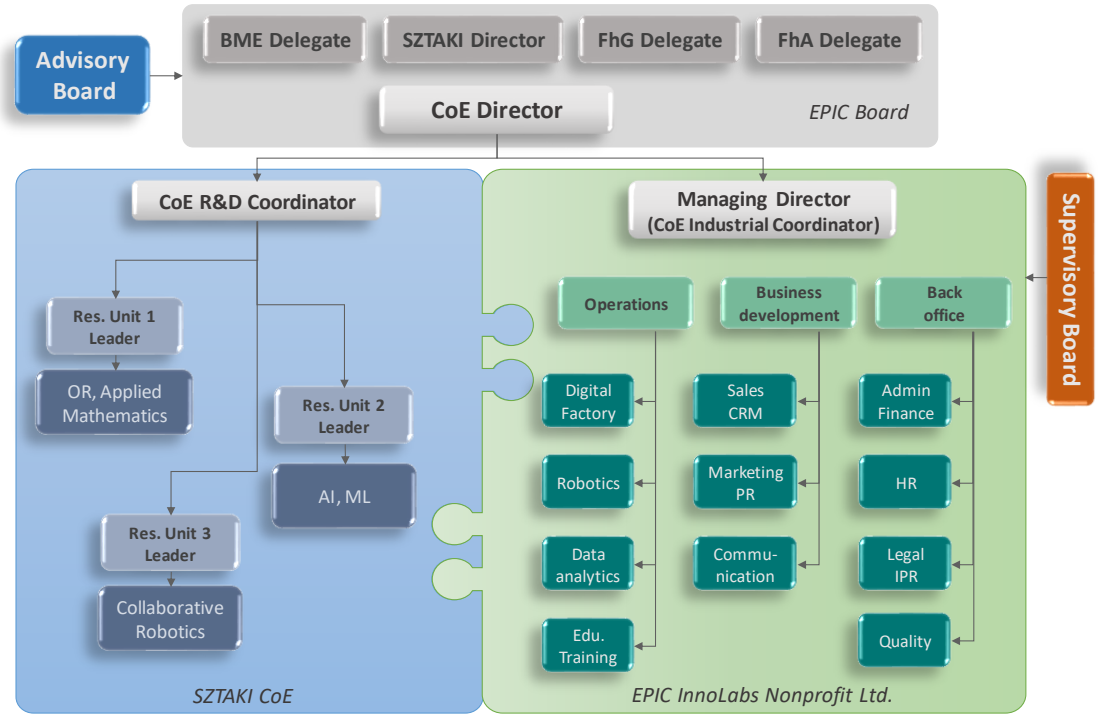

Figure 5: The EPIC CoE's organizational structure

The Management structure of the EPIC CoE

Table 2: Glossary of EPIC managerial positions

CoE Director	The person in designated from the project's beginning to head the EPIC CoE organization. With its role it is inherently part of the EPIC Board and manages both pillars of the Centre. The role of CoE Directorship can be taken both by SZTAKI Director or a separate person.
CoE R&D Coordinator	The *CoE R&D Coordinator* is the leader on the R&D part of the EPIC CoE, engaged as a SZTAKI CoE employee responsible for keeping the research themes and knowledge base of the CoE up-to-date, monitoring the R&D activities and providing the support for a successful transfer.
Managing Director of EPIC InnoLabs Nonprofit Ltd. (Industrial Coordinator)	The *CoE Industrial Coordinator* who at the same time is the *Managing Director of EPIC InnoLabs Nonprofit Ltd.* is the counterpart of the CoE R&D Coordinator on the industrial transfer side employed by the newly created company. He or she is responsible for the operation of EPIC InnoLabs Nonprofit Ltd. including the acquisition and completion of technical industrial projects, planning and completing the marketing activities and controlling the operation of supportive units.

Figure highlights the two basic functional and legally independent pillars of EPIC CoE. Their smooth and coherent cooperation is coordinated and headed by the *CoE Director*. On strategic level EPIC CoE is controlled by the EPIC Board, which is the highest decision making body of the Centre. The EPIC Board coordinates and monitors but *does not manage* the research and industrial projects. The structure of the two pillars are as follows:

- *SZTAKI CoE* is and remains part of the entire SZTAKI organization. At the SZTAKI CoE the research units are the equivalents of the laboratories and/or groups which can be with traditional basic research dominance and/or labs and groups where the applied research and innovation activities are also carried out. The research units are led by Leading Researchers while the *CoE R&D Coordinator* is the professional who coordinates these research activities as whole. According to the new trends or new research needs, new research units can be established, existing ones re-thought or even eliminated if its main topic is not any more relevant.

- *EPIC InnoLabs Nonprofit Ltd.* follows a more conventional organization with the main standard functional units that support the innovation management, acquisition, management and monitoring of new industrial projects as well as taking care of outer, mainly industrial stakeholders of EPIC CoE and finally yet importantly channeling the industrial needs back into SZTAKI CoE, the research pillar of the centre. It is headed by a *Managing Director* who is also taking the role of *CoE's Industrial Coordinator* being responsible for the overall operation of the company.

In summary, EPIC InnoLabs Ltd. enables the acquisition, organization and accomplishment of CoE's industrial projects, by which the overall technology transfer is much more professionally and successfully undertaken. As such, the right pillar of EPIC CoE depicted in Figure includes the main operational fields that were identified by the EPIC partners for the starting phase of the Centre and additionally, the supporting functions grouped as Business Development and Back Office type activities which are needed in a very professional way.

The main starting themes of the Research Units in SZTAKI CoE as well as the initial main operation fields of EPIC InnoLabs Nonprofit Ltd. were defined as focussing on the technology definition methodology and strategy.

3.4. Key business processes

The operation of EPIC CoE including the research, development and innovation core activities, as well as the management and support functions will carried out according a formalized set of processes which were designed in the EPIC Teaming project. A brief summary of the results is described as following. It should be noted that the elements of the process map clearly matched to the EPIC organiational structure.

The activities are planned with the main focus on efficiency, reliability, clear accountability and high-quality services to EPIC CoE's clients and partners. Being service oriented is specifically a key issue, therefore the processes are grouped in three different levels. The Core processes group embodies the main daily businesses focusing on the core competencies of the Centre identified in the previous section. Management processes govern the functioning of the organization's system of operation and ensure the effective flow of all processes. Supporting processes are put in place to support the core processes.

To get the organization more efficient, processes of these three levels have to be regularly analyzed, the employees sensitized for changes and the processes optimized step by step. The determination and application of such processes are particularly necessary for a newly created organization like EPIC InnoLabs Nonprofit Ltd. The fact that new employees have to be hired and efficiency in working is required from the very first day, standardized processes are needed.

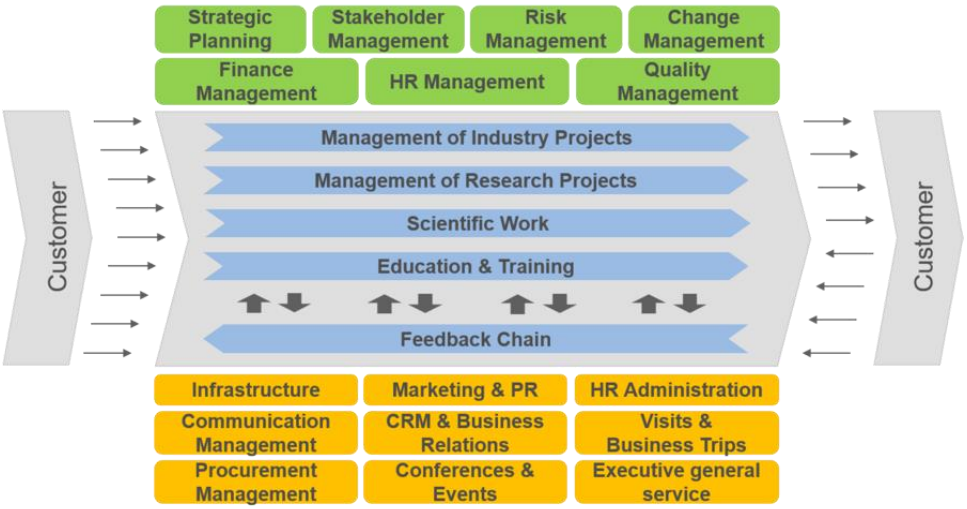

Figure 1: The overall process map of EPIC CoE

Following multiple workshops with consortium partners and taking into consideration the solid experience of several FhG institutes in Germany and Austria, for EPIC CoE a process landscape map (Figure 1) was adopted with the following processes and areas of activities:

- *Management processes*: Strategic Planning, Stakeholder Management, Risk Management, Change Management, Finance Management, HR Management and Quality Management;
- *Core processes*: Management of Industry Projects, Management of Research Projects, Scientific Work and Education & Training;
- *Supporting processes*: Infrastructure (Facility Management), Procurement Management, Communication Management, Marketing & PR, CRM & Business relations, Conferences & events, HR Administration, Business Trips &Visits abroad and Executive general service.

Obviously, there is a high degree of interdependence between the organisational and the processes' structures. Indeed, the processes may also be matched to the individual elements of the organisational chart.

It is worth to note that a comprehensive Balanced Scorecard based (Kaplan, Norton 1996) framework of the Key Success Factors and Key Performance Indicators for the entire EPIC lifecycle has also been developed. The former ones are derived from the EPIC mission and major goals while the latter ones are integrated in this structure. Ensuring the full compliance of this framework with the process and organisation structure is subject of further research work.

4. Conclusion

In this paper, the path leading to and the organisational development and transformation process of an Industry 4.0 oriented state-of-the-art organisation is presented. The special aspects of the EPIC CoE comprising the two independent, however integrated entities have been highlighted. This fact was a key factor when designing the governance and management structure of the organisation. In addition to this, the focus of this approach was to enable the continuous evaluation and adaptation of the organisation, thus ensuring the flexible operation in a world that is most adequately characterised by the VUCA model. The schemes outlined will guarantee to become and remain successful both from the scientific and the economic perspectives.

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