R&D Process Management in Academic Environment

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Abstract: The mission of the Knowledge Center is to collect and provide information for partners belonging to the corporate body as well as to create new knowledge in the area of vehicle electronics and mechatronics. Consortium partners cover the whole chain of innovation from basic research to product development and marketing. The Knowledge Center positions itself as an interim body between the academic world and the market economy, bringing market and product centric issues into the system of higher education, moreover, promoting the utilization of the most recent vehicle technology in industry. Its goal is to become one of the most appreciable development and service centers in Europe in the area of vehicle electronics and mechatronics.

1 Introduction

The *Advanced Vehicles and Vehicle Control Knowledge Center* (AVVC) was established in 2005 with the intention of organizing, documenting and developing the knowledge that is available at the consortium partners in the fields of vehicle electronics and mechatronics. The result of this consolidation procedure is a marketable product of 'knowledge-type' that is promoted through the Knowledge Center owned by the Budapest University of Technology and Economics (BME).

In order to understand the motivations of the Knowledge Center, the preliminary activities with respect to this field in Hungary will be described which logically led to the idea of funding a more formal organization which structures, develops further and makes available this knowledge for others. The importance of the field, namely the vehicle control, will be explained both from global as well as from domestic perspectives. The mission and strategic targets of the Center will be derived giving the technical as well as the economical and political necessities of the programs.

2 Importance of Advanced Vehicle Control Systems

The *mobility* and the *transport* were and always will be one of the most important *social needs*. This necessity can be explained by several factors from communication, work, through pleasure to industrial production. The *road mobility*, especially in Europe, is getting more and more an issue due to the limited infrastructure. The forecasts predict 55–95% increase on roads throughout Europe, especially in West–East direction. Although the importance of the combined transport increases as well, the roads will remain overloaded.

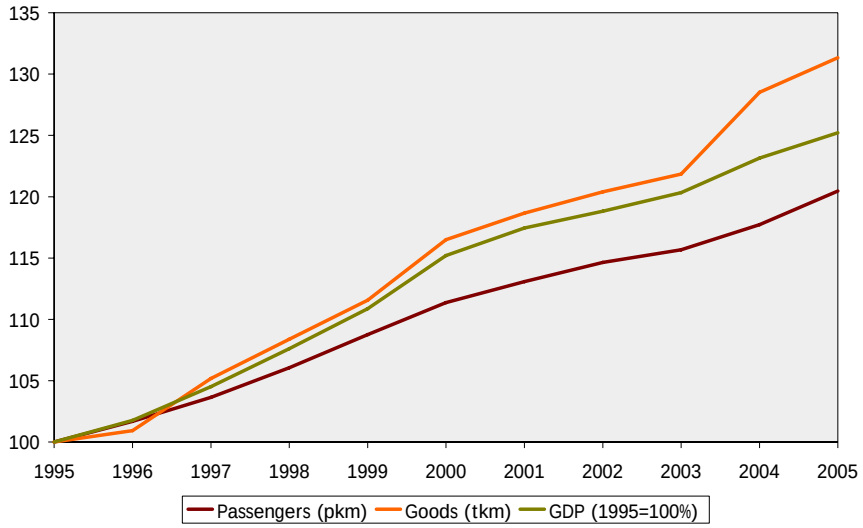

Figure 1
Growth of transport in the European Union (Source: Eurostat Yearbook)

The consequences mentioned earlier will become into *conflict* with the expectations of the society, and since the infrastructure will not follow this increase, the only option is to relief this situation through appropriate *vehicle design*. To reduce air pollution, noise emission, increase vehicle stability, driveability, reduce stopping distance and dynamic wheel load, avoid roll-over, increase vehicle security, reduce driver's work load, avoid unintentional lane leaving and rear-end collisions the mechanical systems are not enough, the artificial *intelligence* of the vehicle and infrastructure systems have to be increased. With developments in microelectronics, electric sensor and actuator technologies, the vehicle industry became one of the primary fields of their application, not much later following the aeronautics and the airplane industry. A contemporary vehicle has several electronically controlled systems, basically in all vehicle sub-systems: engine and transmission control systems, steering and suspension, brakes and communication. The development process is at the beginning that the engineering society faces within the next

decades. The developments in the above mentioned fields will cause a *fundamental change* in the whole vehicle industry. Significant changes are expected in the following fields:

- *Qualification* of human resources from engineering through sales down to line-workers;
- In the production structure of the companies, these systems require other *technologies*;
- In the *supply industry*, from top-to-down.

These changes are going to touch all segments of the Hungarian automotive industry as well, and the major target of this Knowledge Center is to start the *preparation* in order to preserve and develop our competencies in all the mentioned segments.

2.1 Importance of this Field for Hungary

The machine industry, in particularly the *automotive industry* is one of the most prospering industry branches in Hungary, its weight and importance has been increasing since the mid of 90ies. After the collapse of the former automotive industry at the end of the eighties many *foreign companies relocated* their production (or part of the production) to Hungary because of the available, in some regions well trained and relative to the West-European prices cheap work forces and last but not least the that time already available infrastructure and political stability and security. Regardless of the company, this process always had the following typical phases:

Phase 1: relocate simpler products, establish processes, most of the purchased material comes from the original suppliers in Western-Europe;

Phase 2: more complex products and technologies come over, consequent search for local supplier, not only for the local production but also for other European factories. The development of the supply base has been started;

Phase 3: relocate own R&D activities, starting with product support and new development is growing out of it, and develop suppliers toward the R&D partnership (not all R&D activities will be done in-house). In this phase increase the cooperation with other R&D suppliers (like universities and research institutes). As a result of Phases 1 and 2 the Hungarian machine industry reached a stable and economically deterministic position: 17% of the total production, and 59% of the total export is generated here, and 25% of the total export in machine industry is produced by the 10 largest automotive companies. 13% of the total employed work force is working in the machine industry.

2.2 Definition of the Knowledge Center – Mission and Targets

The definition of the Knowledge Center can be derived from the needs described in the previous parts of this paper. It intends to fulfill the following targets:

- *Collect* and *structure knowledge* that is available at diverse organizations in different forms.
- Based on the requirements defined by the industry, the scientific community in this field, this knowledge base should be *further developed* during the program through the defined projects.
- This know-how is *documented* during the project and added to the Center's database serving as the most important asset of the Knowledge Center.
- The *investment* strategy was determined so that the purchased tools and system will serve the established Knowledge Center during the program and also in the first phases of the "market like" operation.
- The established, implemented, documented, measured and continuously improved *processes*, methods and tools are being developed during the first phase of the project so that after turning the program into normal market operation they will be used as the management system of the newly established ventures describing their business processes.

The *mission* of the Knowledge Center is – based on the above described structure – to offer this know-how to companies who are working in the field of the automotive, but also in broader sense, in vehicle industry both in Hungary and also abroad, and willing to buy that. The product that will be sold is the *R&D service* in a first step, but it is not excluded to develop and sell *niche-market products*. In a later phase of operation, the Knowledge Center will broaden its activities and enters into other fields besides vehicle industry in order to profit from the expertise collected here. The Knowledge Center positions itself as an *interim body between the academic world and the market economy*, transfers the market requirements through its marketing and sales venture to the university, and provides the requested product through this venture to the customers.

2.3 Participants

The participants of the Center cover the *total innovation chain*: starting with basic research through application oriented activities followed by the product development and its commercialization including not only the large volume production but also the niche and small products. The process will, however not be ended by the production start, cover the legislative aspects of the field as well. Parallel to the product development, the related structured product development and knowledge management process development capabilities are also available. The project participants cover a very significant portion of the domestic activities (over 90%) in this field, and acknowledged members of the international scientific society.

3 Business Model of the Knowledge Center

In order to be able to formulate the business model of the knowledge center, we have to have a clear understanding of its definition. The evolution process of the Center is shown in Figure 2. As seen, the existing diverse know-how in this field is brought into the four years program by the participating and supporting companies, where it is *consolidated, structured* and *enhanced*, and after the program this knowledge will be transferred to the Regional University Knowledge Center.

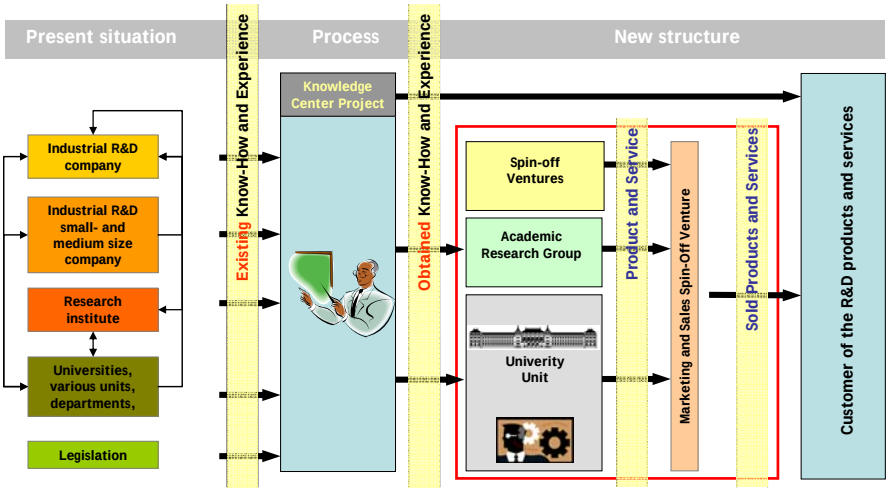

Figure 2
Definition of the Knowledge Center

3.1 Start-up Assets of the Center

The Center possessed the following start-up in-kind contribution from the four years governmentally founded project:

- The *knowledge*, collected during the 4 years from the cooperation with industry partners, research institutes and other ventures available
  - in documented form in the Research Data Management System (RDM) in a form of research reports, concept studies, software and hardware specifications, test specifications, FMEA, development methods, tools, etc.
  - in the project management system through the communications, reviews, which are archived in the Project Management system
  - in form of experience at the different university departments
  - products and experience at the other partners

- The *business processes*, describing and controlling the activities of the Center, which is an absolutely necessary key of business-like operation.
- The central equipment *laboratory*, with the invested tools and instruments
- Management structure and knowledge that is generated from the *management system* of the project.
- *Acknowledgement* and *acceptance* of the industry environment generated during the project, which is absolutely necessary for the successful market operation.

3.2 Other Ventures

In addition to the Center described above, several other units and ventures might be established, as a result of the project (c.f. Figure 2):

- A *sales and marketing* venture, which will be established by the university and potentially by the AHAI, but totally outside of the university organization in order to act freely in the marketplace. This company is going act as an interface to the Center in the direction of the customers, makes a consequent marketing activity, and sells the products created by the Center.
- *Spin-off* ventures, depending on the results of the research and development activities. If a product idea will be generated by the consortium, a spin-off venture will be established, which must function as an independent company.
- In order to provide the further development of the knowledge base, it is planned to establish an *academy research group*, whose activities will be ordered by the Center.

3.3 Suppliers and Customers

Since the Center does not have a direct R&D capacity (at least at the beginning), it has to buy it from external sources. The biggest R&D suppliers are *departments* of the university. Depending on the task given, the appropriate persons or departments are selected and subcontracted by the Center for the given task. In case the necessary knowledge or capacity is not available at the university, external companies are subcontracted.

The *customers* of the Center (via the sales and marketing company) are industrial companies, who might be:

- Larger companies with R&D units, but missing either capacity or know-how in certain fields;
- Larger companies having no R&D competence, but in certain fields requiring development;
- Smaller ventures, who do not have neither R&D capabilities nor know-how, but want develop or their customers requires that.

Especially this last group must be the number one target, since they normally *lack the R&D capability*, but this would be extremely important for their business development.

The know-how transfer between these companies and the Center is going to be done strictly on a business platform. The advantages of the university based Center is that both *government* as well as *EU funds* can be easily obtained for such activities. The general timeline of realizing the structure is shown in Figure 3.

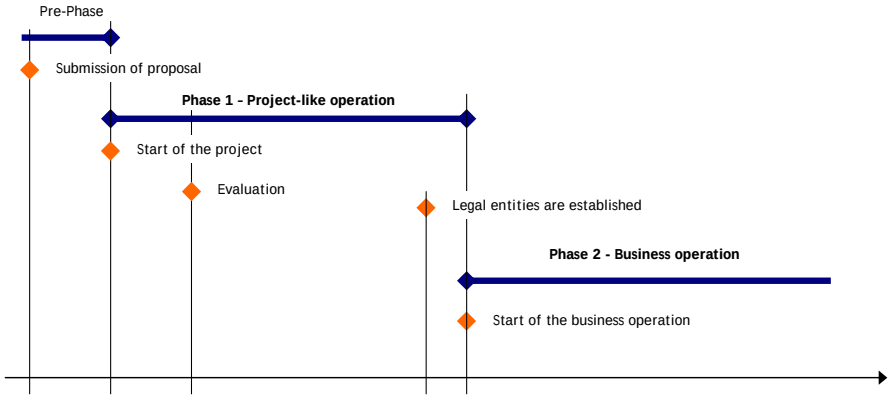

Figure 3
Project plan overview – definition of the phases

Phase 1: project like operation, covers the first four years. These years serve for the knowledge base establishment, definition, implementation and measurement of their implementation level, improvements.

Phase 2: both the processes as well as the knowledge base turn into the productive phase, and operate in the business environment.

4 Project and Program Management System

Due to the specific nature of the program, the large number of participants with different project management cultures (a well defined and strictly followed at the larger industrial companies, and non-existing at small ventures, very much research oriented at the universities) requires a well defined, traceable project management system with clearly defined roles and responsibilities, and measurable *performance indicators* in order to be able make a quantitative project/program controlling (Jain and Triandis 1996).

The management system should have two levels: a *project level* control as a responsibility of the project leader, and a *program* (and program group) *level* control

done by the Program Manager. A clear interface has to be defined between the development process (defined and described in the first year of the Phase 1) and the project management system. The development process describes *what to do*, in order to generate the requested product, while the project management process describes *how to do* that. The interface between them are the deliverables at the different milestones of the structured development process, whereas the project management system has to control, whether the planned targets are achieved, how they are achieved and what to do in order to proceed. This structure is shown in Figure 4. The progress in the projects and programs is measured during the reviews, which are described below:

- **Project review:** organized by the project manager in a minimum of a monthly rhythm (its frequency can be increased), with the participation of the sub-project team leaders and other necessary invitees. Optionally the Program Manager and the Scientific Director can be invited; in case of capacity conflict the Program Director should also participate. During the meeting the project status should be discussed, the project documents should be updated, and actions should be defined with deadlines and responsible.
- **Program review:** organized by the Program Manager in a minimum of bimonthly rhythm, with the participation of the project managers, the Scientific Director and Program Director. The complete project portfolio (programs) should be reviewed.
- **Strategy review:** organized by the Program Director with the participation of the Scientific Director, Program Manager, and the Steering Committee, in a yearly rhythm. The status of the complete program should be reviewed; the deviation from the released strategy portfolio should be discussed and released.
- **Management review:** organized by the Program Director with the participation of the Scientific Director, the Program Manager and the representatives of the participating organizations in a monthly rhythm. Mostly organizational, financial topics should be discussed.
- **Quality review:** on a project level, initiated by the Program Manager, supported by the project manager and conducted by the experts of Informin.hu (as process responsible in the consortium). The target of these reviews is twofold: to check the implementation level of the defined processes and review the project documentation status.

The above described project management system is supported by an appropriate *software tool* (the so-called Redempt™), which was specified and developed during the first year of Phase 1.

Both the structured development process as well as the project management system can be offered to the other departments at the university with the necessary implementation and training support, as a product of the Center.

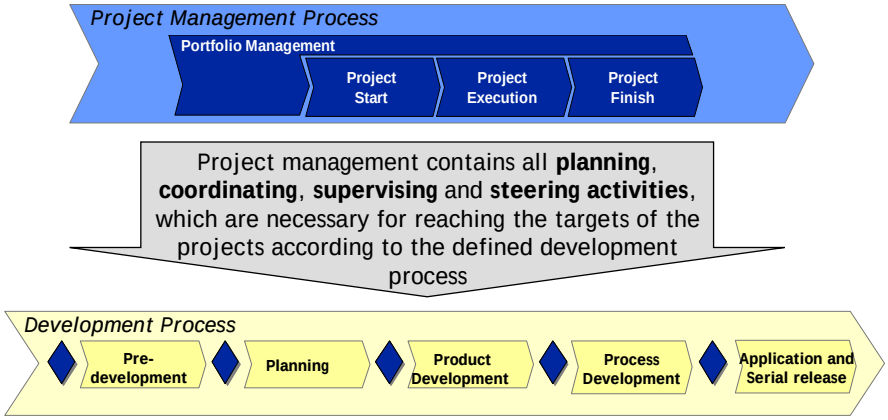

Figure 4
Definition of the interface between the project management system and processes

4.1 Performance Indicators

In order to be able to measure the performance of the processes, the projects, and also the individuals, a set of so called *key performance indicators* (KPI) have been defined. By the definition of the indicators, the following important factors should be considered:

- The indicator must be *easily measurable*, most optimally should come automatically out of a system, if possible;
- Indicators have to be defined not only for *monitoring* the actual process, but also to *control* it (by means of the error between the actually measured and target indicator).

The performance indicators for all the four groups (processes, projects, programs and individuals) were described in detail in the four year strategic plan of the Knowledge Center. In order to measure the progress of the project *target values* for these indicators were set, based on academic and industrial benchmarks (Niven, 2003).

5 Intellectual Property

The objective results of the project appear as *patents* (or similarly protected intellectual properties) by one or more of the participants. The patent is belonging to that participating organization, which created that particular property with the inclusion of other partners from the consortium (this is usually the leader of the pro-

ject which resulted in the patent). The end-users have the right of preemption, which is restated and detailed in the *Consortium Contract*. Problems arising in the fields of patenting and intellectual property law are coordinated by the management of the Knowledge Center.

During the whole period of the project all participants are obligated not to take over or not to brain-drain any workforces from other participants without the direct permission of the interested party. Anyone breaking this engagement is disclosed from cooperation.

Acknowledgements

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