

Műszaki Tudományos Közlemények vol. 13. (2020) 40–44. DOI: Hungarian: https://doi.org/10.33895/mtk-2020.13.04 English: https://doi.org/10.33894/mtk-2020.13.04



INNOVATION DESIGN FOR SAFE PRODUCTS

Roland CSONGVAI,¹ Zoltán TORKOS²

Erdélyi Múzeum-Egyesület, Cluj-Napoca, Romania ¹ csongvai.roland@gmail.com ² z.torkos@upcmail.hu

Abstract

Innovation & product safety in the case of the EC & Hungarian SMEs is a top priority, where product safety is also a legal obligation. Despite this, innovation design is dealt with inadequately by the majority of companies, and this is due to lack of knowledge or competency, especially considering the processes related to the design of safe products. Improper behaviour in the design stages results in losses for the companies - losses due to the inadequacy of otherwise innovative products. Inadequate or poorly applied directives/policies, especially when coded into processes influence not only the safety of the products but can result in delays to market access, significantly increasing costs & development time, as well jeopardising the product's acceptance on the future market.

Keywords: innovation, product design, product safety, design, regulation.

1. Innovation design for safe products

Nowadays, one of the most important strategic challenges facing both the European Union and our country is that of accelerating innovation, so that we can bridge the gap in particular areas with other economic players in the world. An essential part of this is improving and expanding the innovative capacity of SMEs. Unfortunately, experience shows that SMEs do not have the appropriate knowledge in the field of innovation and product safety, and thus are at a disadvantage compared to most major international companies. As a result, most of the companies, either due to a lack of knowledge or lack of competence, fail to properly manage innovation design, especially in those processes associated with the development of safe products. This results in enormous damage to the companies due to deficiencies in their otherwise innovative products. Inadequate or poorly applied directives/policies, especially when coded into processes influence not only the safety of the products but result in delays in market access, significantly increasing costs & development time,

as well as undermining the product's eventual acceptance in the market. Nowadays, innovation and product development processes have accelerated. As a result, traditional business processes are complemented by various acceleration phases such as the pre-innovation preparation phase, and the idea-discovery/solution delivery, pre-development phases that Peter Koen was the first among others to recognize and formulate (Figure 1.).



Figure 1. Full process of innovation. [1]

2. The efficient synthesis of the innovation and product development, processes and phase

Nowadays, the whole process of innovation is divided into three main groups, all equally important to each other. The first phase, the socalled Pre-Innovation Phase (PIP), has become very important, especially for companies with a non-continuous development cycle. Important, because its well functioning nature makes the initialization of the innovation process effective & successful, which is utilized successfully, for example, by Start-Ups as well, due to their flexibility. Of course, without an effective second (product development) and third (market launch) phase, a product will not be successfully marketable. In this study, we would like to look at the PIP and Product Development phases in the context of product safety, but firstly, we should look at how these two phases are structured in a generalized way.

2.1. FEI (Front End Innovation) What is it?

According to Peter Koen [1] mentioned earlier, FEI is considered by most to be the precursor to gate 3 of Stage Gate TM, which corresponds to gate 1 according to PACE [2] and which today would have been ranked one gate earlier due to accelerated development and new idea validation solutions. (Figure 2.) PIP covers all processes that can potentially generate new marketable ideas, which can be produced by various idea-generating software, creative individuals, (dedicated) R&D teams, incubation/acceleration phases of start-ups, specialist teams, different techniques,



Figure 2. The first two phases of Innovation.

professional groups, user assessments, so-called converters, Universities and Research institutes, Clusters, etc. PIP might incorporate any creative opportunity that encourages people to create something new; its essence is to seize the moment and materialize the idea. Nowadays, there are several techniques that help to solve a problem, such as traditional group brainstorming or the employment of the newer Design Sprints, the Design Thinking [3], Lean Start-Up [4], Biomimicry, Platform Design, Business Innovation Design Framework etc. Applying the various techniques mentioned above helps to identify new innovative ideas and to find and implement solutions.

Nowadays, successful development can only be rapid and successfully breakthrough if the problem, the Persona till the first gate, can be successfully identified and the solution can be outlined to the extent that after the first gate, the PACE product development process can start with a project team based on a true concept and a complete implementation plan. It is advisable to consider the product safety feasibility of the product being developed and its opportunity for implementation even at this early stage.

2.2. Product development

Most successful companies integrate the classic PACE [5] or Stage Gate TM product development into their company structure and use it to perform incremental and innovative product development. Briefly, the essence of the PACE system is to see more clearly its possible interfaces with product safety at an early stage of development.

The PACE Report (Product And Cycle-time Excellence) breaks down all product development into phased development processes, validating each phase with a single gate assessment, as shown in **Figure 3**. By using PACE, companies can save themselves a lot of unnecessary time and expense, thus speeding up development efficiency and cost-effectiveness. The effective operation of the system must include effective and committed involvement of senior management in gate reviews to ensure immediate decision-making.



Figure 3. Process of full PACE system.

3. An early merger of innovation and product safety

Strange though it seems, at the beginning of the innovation process, at Gate 0, a decision has to be made; the product needs to be categorised so that, it is, e.g. consumer goods such as cars, cell phones, etc.

This activity does not contradict any cleverly applied methodology, on the contrary it's a clear example for the higher expectations towards integrity which those methodologies are known for; The fact that a product must be safe, among other attributes, is also related to integrity, and the product categorisation contributes information regarding this.

Staying with our example, a two-pronged approach to safety is a daily practice, as in addition to protecting the health, safety and economic interests of product users, environmental protection of the product is required. [6], [7]

For the users, this does not necessarily mean that the use of the product poses any risk to users. Instead, the risks associated with the product are known, and the users are informed of this. However, this expectation can only be fully met if there is an ongoing documented risk analysis from the first steps of innovation. Obviously, that means answering the simple question of whether the desired innovation/development poses any risk in terms of health, safety, economic interests or environmental protection. This can be answered with a simple yes or no. The "cannot be known" answer is also "yes" because it means that the severity of a hazard or the degree of exposure to it is unknown, which makes risk analysis inevitable. However, risk analysis needs to be systematic, so it is inevitable to develop a socalled preliminary risk-oriented robust system design concept metamodel. (Figure 4.)

3.1. Systematic approach

Any of the agile methodologies and frameworks have a metamodel that describes the relationship of the information and steps, as well as the structure of cause and causalities that appear in it. However, in most cases, this information is publicly not available but might be partially accessed through training because of the related business model.

This aforementioned fact is a serious challenge when it comes to making the first steps as one has to deal with a situation characterized by both lack of information/knowledge and a high level of complexity.

Additionally there will be many initial assumptions about the product; assumptions which might be confirmed later (if at all), and which are in some way – either directly or in a roundabout way – related to the aforementioned issues.

In addition to all of this, a secure product is nothing but a well-performed system engineering job that handles all aspects of a product's context in a dynamic way, so it doesn't just focus on technical content. A simple conclusion is that, despite the lack of knowledge and complexity, it



Figure 4. A possible metamodel of a preliminary risk-oriented robotic system design concept.

is necessary to map relationships in simple, clear language across attributes that are both informative in technical and non-technical terms. Such a method is described in ISO / PAS 19450: 2015. [8]

The lack of this, even when viewed through a safety lens, gives rise to strong doubts about the requirements of minimum relative safety, and being well-constructed, e.g. assuming PACE's product development process, the lack of contextual embeddedness of new information, without contradiction analysis, results in the project coming to a stop.

4. Product Safety

This kind of sophisticated approach (Figure 5, 6.) is not exaggerated but can be expected as a minimum, let's look at the example in Figure 7 to prove it. An SME dealing with the development of an electric vehicle needs to take into consideration the following requirements due to the corresponding legal framework.

The red boxed sections tell us two things:

(I) "Article 5" reverses the burden of proving conformity of a vehicle as a whole so that any doubt on the part of the approval authority may result in the refusal of type-approval. [9].

(II) "Article 8. Objective requirements for conformity



Figure 5. A possible model for risk management.



Figure 6. A possible model for risk management.



Figure 7. Requirements stemming from the legal framework.

1. In addition to complying with any subjective requirement for conformity, the digital content or digital service shall:

(a) be fit for the purposes for which digital content or digital services of the same type would normally be used, taking into account, where applicable, any existing Union and national law, technical standards or, in the absence of such technical standards, applicable sector-specific industry codes of conduct;" [10].

This means that the manufacturer, during the product innovation cycle, must apply all according to the current state of science and technology available innovative solutions, know-how as well as document them to guarantee, among other things, safety and justify these efforts even in the event of a remedial procedure later.

This expectation has such complexity, that even the most prominent car brands have a hard time coping with it if it is not part of their systematic innovation process from the start, so it is easy to see that for the SMEs the only way is that from the beginning they manage their innovation processes in a easy but systematic way, e.g. outlined in this article.

5. Conclusions

It can be concluded that an SME can only succeed in operating an efficient and innovative product development if it has or is willing to build up the following strategic knowledge within the company:

- Knowledge about and the regulation of product development and product safety within the company;
- Knowledge about the environment in which the product is used;
- Developing a common language and knowledge base within the company;
- Employee commitment to innovation and the ability to manage complexity.

References

- P. Koen P., A. Ajamian, G., Boyce, S., Clamen, A., Fisher, E., Fountoulakis, S., Johnson A., Puri. P., Seibert, R.: *Fuzzy-Front End: Effective Methods, Tools and Techniques*, PDMA Toolbook for New Product Development, P. Belliveau, A Griffen, S. Sorermeyer, John Wiley and Sons. 2002, 2–35.
- [2] McGrath E. M., Anthony T. M., Saphiro R. A.: Product Development: Sucesss Through Product And Cycle-Time Excellence, Butterworth-Heinemann, Newton, 1992, 1–260.
- [3] Luchs G. M., Swan K. S., Griffin A.: Design Thinking: new product development essentials from the PDMA, John Wiley & Sons, Hoboken, New Jersey, 2016, 1–431.
- [4] Eric Ries: *The Lean Statup*, Crown Publishing Group, USA, 2011, ISBN 0307887898
- [5] McGrath E. M., (revised edition), Setting the PACE in product development: a guide to product and cycle-time excellence, Butterworth-Heinemann, Newton, 1996, 1–184.
- [6] Consolidated version of the Treaty on the Functioning of the European Union PART THREE - UN-ION POLICIES AND INTERNAL ACTIONS TITLE XV - CONSUMER PROTECTION Article 169 http://data.europa.eu/eli/treaty/tfeu_2016/ art_169/oj
- [7] Consolidated version of the Treaty on the Functioning of the European Union PART THREE - UN-ION POLICIES AND INTERNAL ACTIONS TITLE XX – ENVIRONMENT Article 191 http://data.europa.eu/eli/treaty/tfeu_2016/ art_191/oj
- [8] ISO/PAS 19450:2015 Automation systems and integration — Object-Process Methodology.
- [9] Regulation (EU) 2018/858 of the European Parliament and of the Council of 30 May 2018 on the approval and market surveillance of motor vehicles and their trailers, and of systems, components and separate technical units intended for such vehicles, amending Regulations (EC) No 715/2007 and (EC) No 595/2009 and repealing Directive 2007/46/EC.

http://data.europa.eu/eli/reg/2018/858/oj

[10] Directive (EU) 2019/770 of the European Parliament and of the Council of 20 May 2019 on certain aspects concerning contracts for the supply of digital content and digital services. http://data.europa.eu/eli/dir/2019/770/oj