

STRUCTURING THE NEW PRODUCT DEVELOPMENT PROCESSES

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1. Introduction

In this paper we attempt to describe several approaches used for standardization and formalization of the new product development process with special emphasis on its early stages. First, we introduce the classification of the process models and their generations. We focus on the and briefly describe the traditional stage-gate model of Cooper et al. In following sections we bring a survey of two models recommended for the use in the initial stages: New Concept Development and Technology Stage-Gate models.

2. New Product Development process models

Innovation success of the company significantly depends on its ability to formalize and properly structure the innovation process: In the literature, we can find descriptions of various models that split the process models into phases. In [Verworn, Herstatt 2002] the process models are classified according to their objectives and target groups as follows:

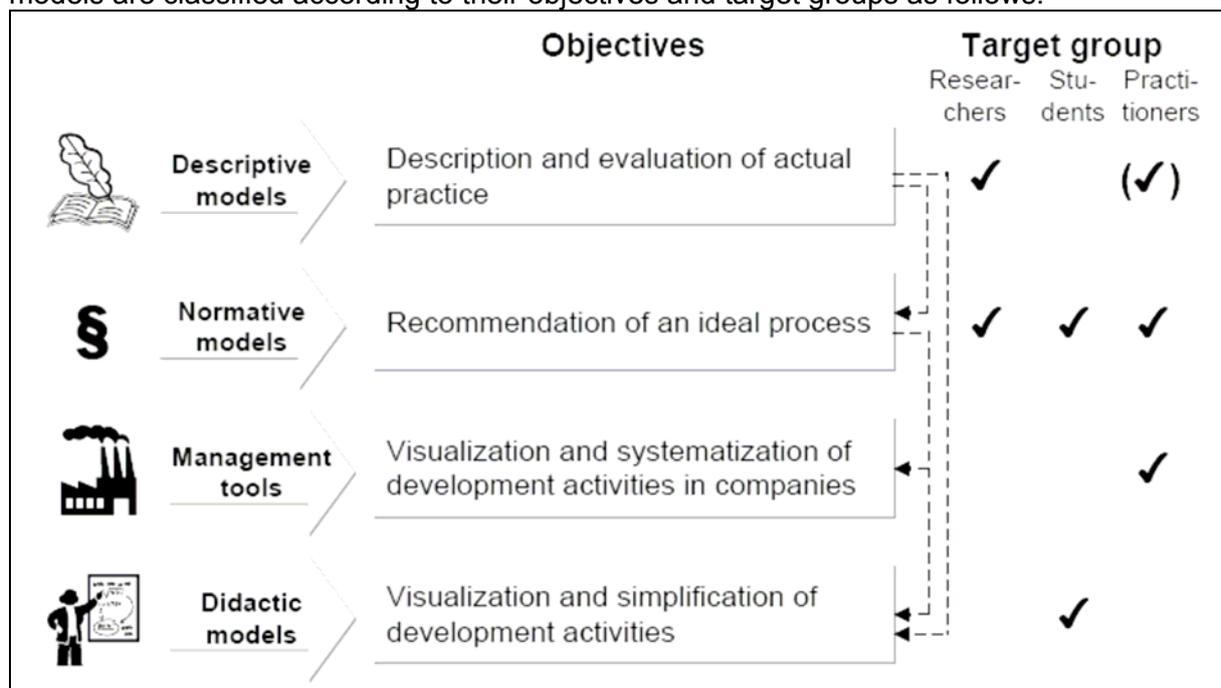


Figure 1. The objectives of process models [Verworn, Herstatt 2002]

The descriptive models describe, evaluate and classify the existing practice. Normative models are often based on practical experience and case studies and generalize successful approaches. The resulting process models then can provide the basis for the systemization of company processes and play the role of management tools. The last group of models, the didactic ones, are used in education and training.

Stage-gate process and its modifications

One of the most successful models used in the new product development is so called stage-gate process, based on the processes implemented in the NASA in 1960's. They divide the whole process into phases with inputs and outputs specified beforehand. At the end of each there is the gate, in which the gatekeepers decide about the continuation of the process. Activities, performed ad hoc before the stage-gate process implementation, were standardized and the indicators of the process performance (process lead time, costs, etc.) significantly improved. This process was later adopted by the U.S. Army, Hewlett Packard and the others and today it is broadly supported by the PDMA and used in many companies. However, the first generation of models focused only on the development and did not treat the complete process from the idea conception to the product market launch.

The following research, mainly within the framework of the Canadian NewProd project lead by R. Cooper, resulted in the second generation models; their typical representation can be found in Figure 2:

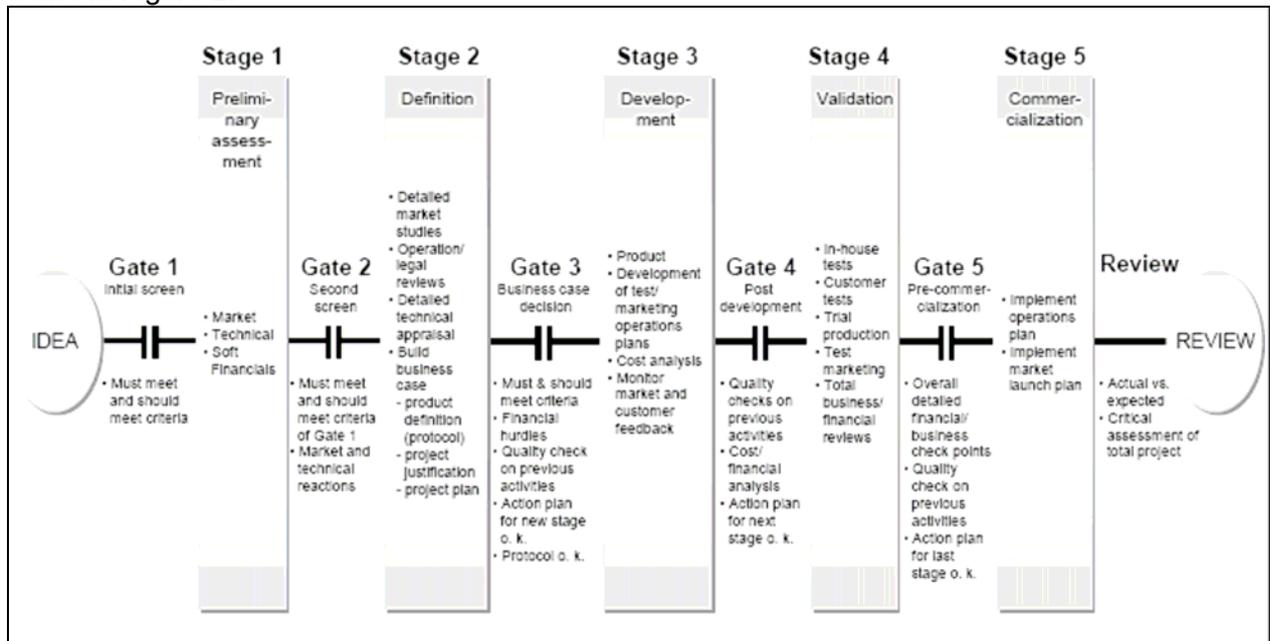


Figure 2. Typical second generation stage-gate process [Cooper 1990]

This model divides the innovation process into five phases with gates, in which interdisciplinary team decide if to continue or kill the project. The model integrates both technological and market perspectives. Its advantage is the systemization facilitating communication both between teams and with the top management.

The new product development process starts with the idea or concept that can be originated in the R&D, idea bank, customer's feedback and many other resources, which are in more detail described e.g. in [Vacek 2000].

Figure 3 presents the model of Ulrich [Ulrich et al., 1995], stressing out the interdisciplinary view – participation of functions in all process phases.

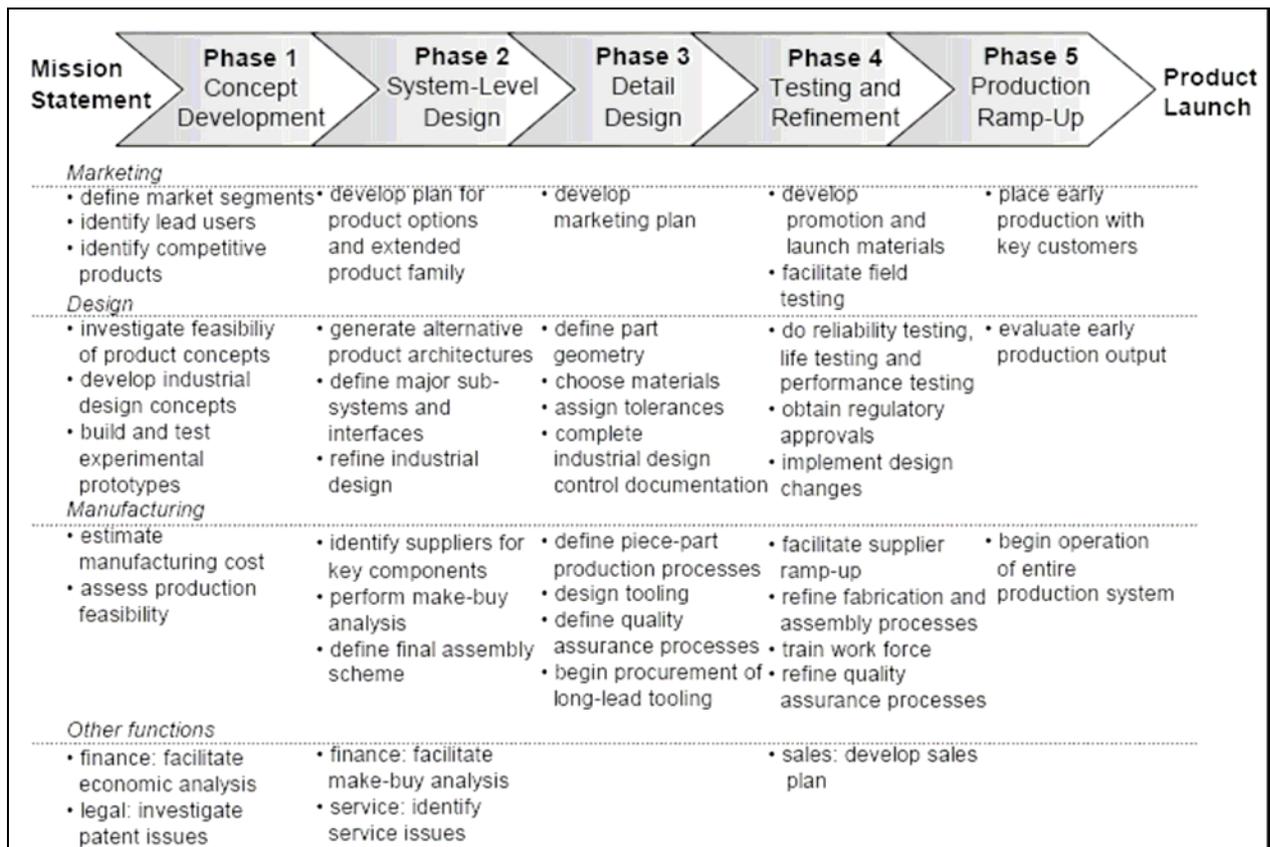


Figure 3. Process model of Ulrich [Ulrich et al., 1995]

The disadvantage of above mentioned second generation models is their sequential character and low flexibility. Moreover, the process phases in many cases overlap, as this can significantly shorten the lead time from the idea to the market launch and, moreover, overlapping supports the sharing of feedbacks among various project phases.

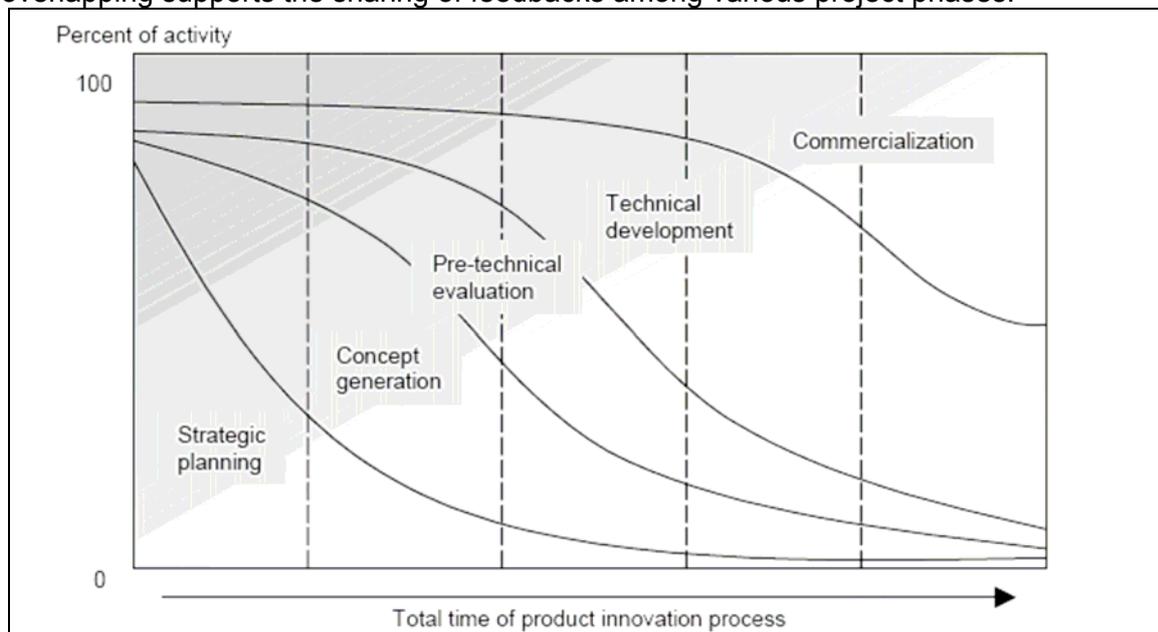


Figure 4. : Concurrent process phases [Crawford 1994]

The third generation models therefore use the partial concurrency of project phases.

FUZZY FRONT END AS THE INITIAL PHASE OF THE INNOVATION PROCESS

Empirical studies, as e.g. [Cooper, Kleinschmidt 1994], show, that the quality of pre-development phases before the proper product and project development starts significantly influence the product success. These early phases to a large extent influence, which projects will be realized, why, what will be final costs, time, and – in the end – the final success in the market. This phase is in the English literature usually called the “fuzzy front end” (FFE) or “front end of innovation” (FEI).

This phase is usually highly dynamic, not strictly documented and creativity competes with systemization. It is therefore difficult to make generalizations. Let’s try to place the FFE into the general framework of innovations, which are in the current innovation management treated as projects and processes. One of the possibilities – the model of Khurana and Rosenthal, is presented in Figure 5.

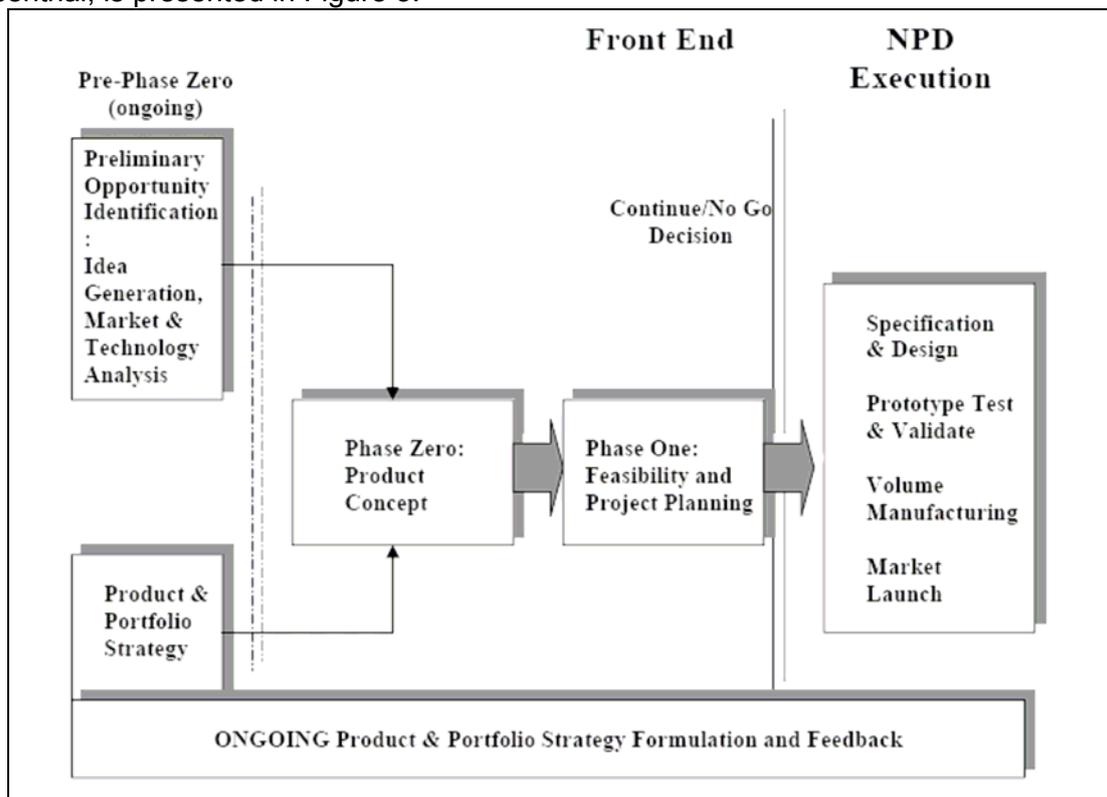


Figure 5. Fuzzy Front End Model [Khurana, Rosenthal 1998]

In this model, FFE is defined as a phase including product strategy formulation and communication, opportunity identification and assessment, idea generation, product specification, and project planning.

Project starts by preliminary phase 0, which should include market opportunity assessment. However, the idea or concept is often generated in technical department; close cooperation within the inter-functional team is therefore necessary.

The phase 0 results in product concept, including preliminary identification of customer requirements, market segments, competitive position, business opportunity and compliance with strategy. The first phase then includes the business and technical feasibility evaluation, development of product definition and project plan. After the continuation is agreed on, the proper new product development starts.

This model of FFE has similar advantages and deficiencies as the sequential models described above. It allows visualising and structuring of activities, supports systemization and facilitates communication. However, it is not very flexible. As especially in the initial phases of the product development we face the greatest uncertainty, the flexibility is an important

issue. According to [1], systematic approaches using process models can be successful in the case of incremental innovations, where both business and technical uncertainty is rather low. Whenever at least one of those uncertainties is high, we need more flexible approaches with iterations and parallelization of activities. E.g., successful radical innovations often use rapid or virtual prototyping even in the zero-th or the first phase, as it allows better visualization and communication of the product concept.

New concept development model

Initial phases of the innovation process were analyzed by P.Koen and his team in [Koen 2001]. They conclude that in those phases it is not suitable to use the same approaches as in the later, more structured process phases. On the basis of the analysis of a number of works and their own research they developed two models suited for the initial, less structured phases of the innovation process: New Concept Development (NCD) and Technology Stage-Gate (TSG) processes.

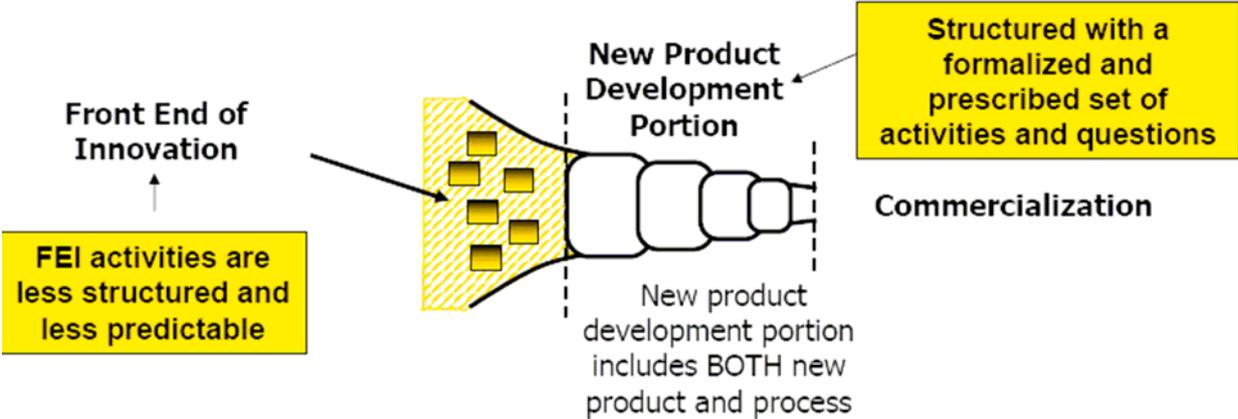


Figure 6.

In their models, the entire innovation process may be divided into three parts: Front End of Innovation (FEI), new product development (NPD), and commercialization. “Front End of Innovation” is defined by activities that come before the “formal and well structured” New Product Development (NPD) portion and it is synonymous to the FFE.

The division between the FFE and the NPD is often less than sharp, since technology development activities may need to be pursued at the intersection.

The differences between the FFE and the NPD) processes are summarized in Table 1.

	Fuzzy Front End (FFE)	New Product Development (NPD)
Nature of Work	Experimental, often chaotic. “Eureka” moments. Can schedule work—but not invention.	Disciplined and goal-oriented with a project plan.
Commercialization Date	Unpredictable or uncertain.	High degree of certainty.
Funding	Variable—in the beginning phases many projects may be “bootlegged,” while others will need funding to proceed.	Budgeted.
Revenue Expectations	Often uncertain, with a great deal of speculation.	Predictable, with increasing certainty, analysis, and documentation as the product release date gets closer.
Activity	Individuals and team conducting research to minimize risk and optimize potential	Multifunction product and/or process development team

Measures of Progress	Strengthened concepts.	Milestone achievement.
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TABLE 1-1. Difference Between the Fuzzy Front End (FFE) and the New Product Development (NPD) Process

To emphasize the nonlinear structure of the New Concept Development (NCD) process, the authors represent it by the circular model (see Figure 7). The circular shape suggests that ideas and concepts are expected to iterate across the five elements.

The arrows pointing into the model represent starting points and indicate that projects begin at either opportunity identification or idea generation and enrichment. The exiting arrow represents how concepts leave the model and enter the new product development (NPD) or technology stage gate (TSG) process.

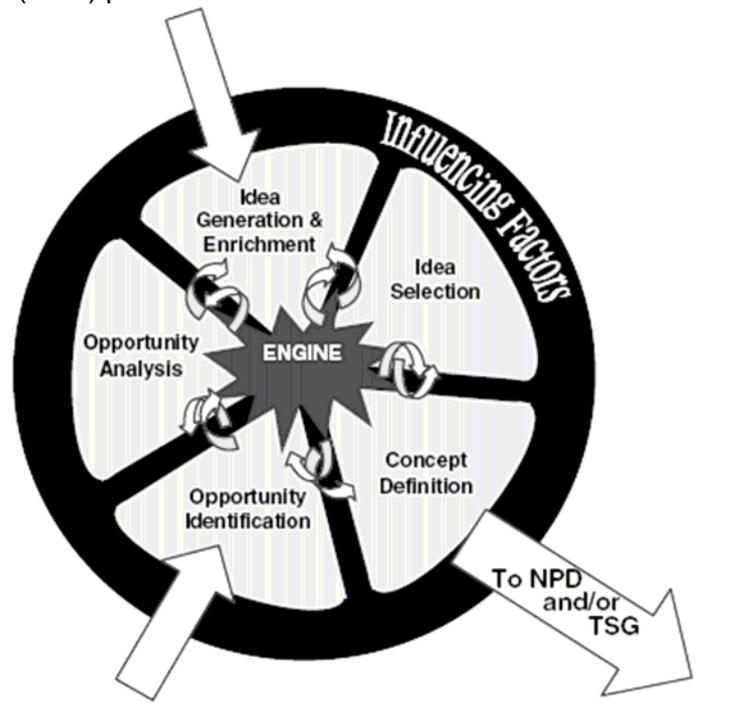


FIGURE 7. The new concept development (NCD) model

The engine in the centre represents management support, which powers the five elements of the NCD model. The engine and the five elements of the NCD model are placed on top of the influencing factors.

The most effective methods, tools, and techniques in each part of the process are in detail analyzed and described in [Koen 2001],

Technology stage-gate process

As mentioned earlier, the overall innovation process may be divided into three parts: the fuzzy front end, new product development, and commercialization.

Traditional stage-gate processes are utilized to manage new product development projects. TechSG is used to manage high-risk projects within and at the transition between the fuzzy front end and new product development (see Figure 8).

In traditional SG, shown on the left, the gates are transparent. The product development team can "see" all the deliverables at the gates. In contrast, in TechSG, shown on the right, the gates are opaque. The technology development team can only "see" to the next gate and understands that the deliverable may change as the technology is developed. The traditional SG Process is compared with the TechSG Process in Table 2.

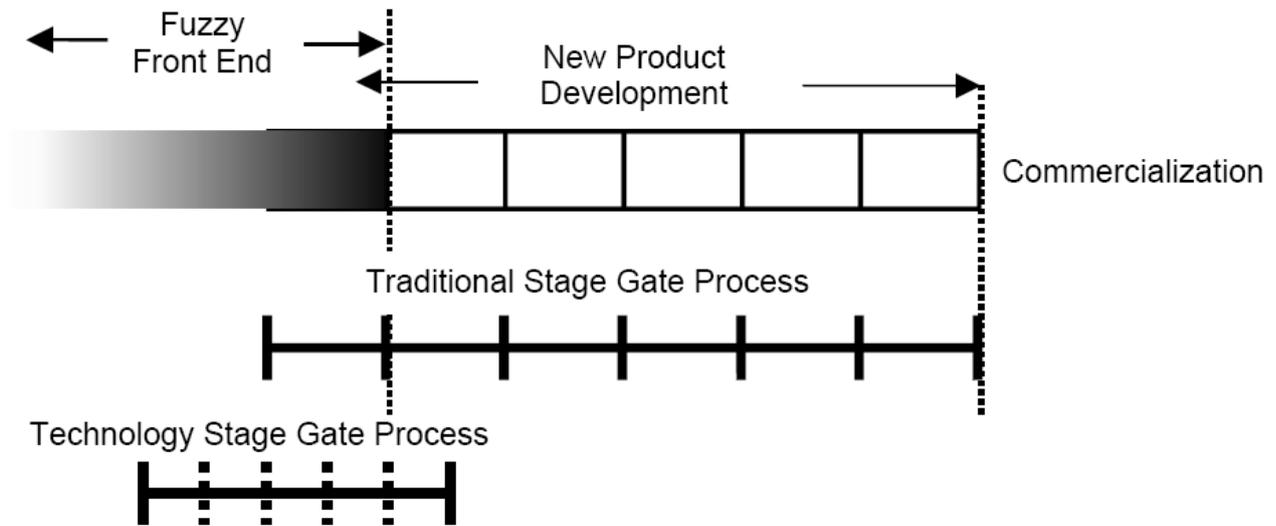


FIGURE 8. Traditional and technology stage-gate processes

	TechSG	Traditional SG
Project Charter	Formal pre-agreement with upper management on the technologies to be investigated and the high-level approach.	Formal pre-agreement with upper management on the entire project, including the timing expected for project completion.
Review Process	Emphasizes the technology portion of the project and focuses almost entirely on the technology work and timing to the next gate. The gates are relatively opaque, with the deliverables known only to the next gate. The number of gates is unknown and varies significantly between projects.	Discusses the entire project, deliverables, and timing expected for the entire project. The gates are relatively transparent, with well-accepted deliverables known for all gates from the start of the project. Number of gates is usually the same for all projects.
Review Committee	Representation focused on technology. The chairman typically is the technology leader, with business representatives and scientific peers.	Broad representation of key functions of the business: R&D, marketing, regulatory, and manufacturing. The chairman is usually the division business leader.
Structured Planning	Detailed project plan exists only to the next gate and is very specific to each project.	Detailed plan throughout all of the gates. Same general plan for all projects; fairly detailed and known from the start of every project.
Development Team	Primarily consists of R&D or R&E.	Multifunctional. Typically made up of representatives of R&D, marketing, regulatory, and manufacturing.
Process Owner	Responsible for making sure that the TechSG process is adhered to.	Responsible for making sure that the traditional SG process is adhered to.

TABLE 2. Comparison of the Traditional SG Process with the TechSG Process

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References

- [Ajamian, Koen 2002] Ajamian G.M, Koen P.J., „Technology Stage-Gate: A structured Process for Managing High-Risk New Technology Projects“, in P.Belliveau, A Griffin, S.Sommermeier, eds., *The PDMA ToolBook for New Product Development*, John Wiley et Sons, New York, 2002
- [Cooper 1999] Cooper R.G., „From Experience: The invisible Success Factors in Product Innovation, *J.Prod.Innov.Manag.*, Vol. 16, 1999, pp. 115-133
- [Koen 2001] Koen P.J. et al., „New Concept Development Model: Providing Clarity and a Common Language to the ‘Fuzzy Front End’ of Innovation“, *Research Technology Management*, Vol. 44, No.2, 2001, pp. 46-55
- [Koen 2002] Koen P.J. et al., „Fuzzy Front End: Effective Methods, Tools, and Techniques“, in P.Belliveau, A Griffin, S.Sommermeier, eds., *The PDMA ToolBook for New Product Development*, John Wiley et Sons, New York, 2002
- [Vacek 2001] Vacek J., „Innovation Impulses, in Vacek J., ed, *Seeking and Implementation of Innovation Opportunities*, pp. 42-55, <http://www.kip.zcu.cz/USME/seeking.doc>, 2001
- [Vacek 2005] Vacek J. „Innovation Management in Design Process“, *Proceedings MOPP 2005*, pp. 286-293
- [Verworn, Herstatt 2002] Verworn B., Herstatt C., „The innovation process: an introduction to process models“, Working Paper No. 12, Technical University of Hamburg, 2002

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