Chapter XX
Performance Measurement in Innovation Processes

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ABSTRACT

This chapter introduces a new approach for performance measurement in product development and innovation processes. It shows that there is a great need in practice to increase the efficiency of product development processes because existing approaches are not sufficient to give enough information about a running project. These approaches both from science and industry are analysed and a new attempt is introduced that aims at the integration of concrete project data with information about the product by using Semantic Web technologies. Furthermore, the authors want to show that there is an emerging gap between productivity increase and the complexity of product development processes. This will be a challenge in the future and has high potential for research that has to be done in close cooperation with industry.

INTRODUCTION

"To measure is to know." This quote by Sir William Thomson (1824-1907, doyen of thermodynamics, better known as Lord Kelvin) describes a fundamental paradigm of science: the generation of knowledge by describing the properties of an object with impartial, physical measures. He went on saying that "If you cannot measure it, you can-

not improve it," thus describing a primary goal of management: guiding an economic endeavour to success. Ultimately, success in the business context means a profitable market performance. But how is this performance rated? As a physicist, Lord Kelvin would have said that the best performance measure is power. It is defined as the rate at which work is performed and is measured in Watts (W, see Figure 1).

But this physical measure falls short of assessing the economic performance of a company, a project or a business process. Here other means of performance measurement such as shareholder value, time to market or customers served per hour have been devised as indicators of economic success.

Performance measurement techniques are an integral part of the management toolbox. The literature of economics describes a vast amount of performance measurement methods for almost all branches of business. While classical fields of business sciences such as manufacturing (Maskell, 1991), human resources (Fitz-Ens, 2001), marketing or finance, and accounting (Neely, 2002) are well understood and have generally accepted performance indicators, the understanding and management of R&D and innovation processes are a source of ongoing research and dispute. The reasons for this deficit can be found in the very special nature of innovation and R&D. Firstly, innovation activities can cover a wide range of activities from "applied projects to competency-building programs to basic research explorations" (Hauser & Zettelmayer, 1997). This calls for distinct, goal-oriented measures. Secondly, innovations are no longer the result of a single ingenious inventor who single-handedly creates ground-breaking new products—if they ever were. New products and innovations brought to the market today are the result of many experts working together in a somewhat structured, however complex, dynamic, and sometimes chaotic course of action: a development process often carried out in a global engineering network (Gausemeier, Hahn, Kespohl, & Seifert, 2006). The third common trait of R&D and innovation processes is their intangibility caused more and more virtual development methods (CAx-technology, Crabb, 1997) or completely invisible products such as software, nowadays the driving force behind many innovations (e.g., in mechatronics (Cetinkunt, 2006) or consumer electronics) (Rooijmans, Aerts, & van Genuchten, 1996). Product development or engineering consists of conceptualization, construction, and computation, thus it is characterized as an information processing process even though it covers material processes such as prototyping and testing.

Despite all of these specific traits, performance measurement in innovation and product development is a challenging research area since its creativity, complexity and its intricate management demands call for new, integrated solutions. At the same time, it is of vital and growing importance to any company's success in today's fast paced and global markets. A fresh range of products and high R&D investments are prerequisites for market success (see Little, 2004). Despite their high priority and the immense governmental and industrial research investments, many innovative endeavours and product development programs are subject to uncertainty, risk, and ultimate failure. Depending on the sector and degree of innovation, many studies (GPM, 2004; Harmuth, 2003; Mandl & Stiegnitz/Lichter, 1999; Standish Group, 1994) show that a significant percentage of innovation projects fail or exceed economic limits. The reasons for this high failure rate can be found in the aforementioned traits of innovation processes that are conducted in a multidi-

Figure 1. Physical definition of power

$$P(W) = \frac{\partial E}{\partial t} = \frac{\partial W}{\partial t}$$