ECONOMIC EFFECTIVITY OF HIGH-TECH ENTERPRISE -LIFE CYCLE COSTING IN NANOTECHNOLOGY PRODUCTS PLANNING AND CONTROLLING

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Abstract

High-tech enterprises, such as the nanotechnology enterprises are highly expensive in pre-production phase (R+B expenses). Both in terms of dynamic progress their shortened cycle is continuous. Decisions on the implementation of such projects should take into account other criteria also and economic efficiency. Basis of this assessment should not only be incurred expenditures for research and development. Valid evaluation should address the market life cycle and phase out. If there is a comprehensive evaluation of the effectiveness of the project, which could result in another image effectivity than where base accepts only the volume of expenditure on research and development. This requires the adoption of appropriate assessment instruments effectiveness projects in the planning phase and the phase control. To develop a comprehensive assessment tools on the usefulness of high-efficiency technology in the planning phase, and monitor their implementation.

Keywords: economic effectiveness, life cycle costing, controlling

1. DETERMINANTS OF THE IMPLEMENTATION OF LIFE CYCLE COSTING

Dynamic technological developments which we have been recently witnessing need to harmonise with the entire economic activity of a given business consistent with its major objective, i.e. sustainable development (corporate sustainability). The Brundland Report, also known as “Our Common Future”, defines sustainable development as “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”\textsuperscript{1}. According to the Agenda 21 Action Programme\textsuperscript{2}, this development should be implemented in three major dimensions: economic, ecological and social, known together as the Triple Bottom Line – TBL\textsuperscript{3}. Based on this foundation, long-term corporate development is understood as a principle of combining economic, ecological and social objectives of a business with the need to preserve resources for future generations\textsuperscript{4}. Such an approach to business in the international “fight for capital”, however, does not undermine the role of the economic dimension as the most significant one. Raising the value of companies is still the major financial objective. Unlike in the past, however, the present approach incorporates to a larger extent the social and ecological factors. The value of a company, and the wealth of its shareholders as a consequence, may be maximised through raising customer satisfaction and initiation of internal processes in cooperation with both suppliers (who aim to achieve their own objectives) and employees. Those processes may generate satisfaction and benefits for creditors, government and other stakeholders involved. It follows that the essence of sustainable development is to meet the expectations of all the stakeholders. The limited resources make it impossible, however, to meet all those expectations.

\textsuperscript{1} World Commission on Environment and Development (WCED), Our Common Future, Oxford 1987, p. 43, quoted by: T.M. Fischer, R. Huber, A. Sawczyn: Nachhaltige Unternehmensführung als Herausforderung für das Controlling, Controlling 2010 No. 4/5
\textsuperscript{2} http://pl.wikipedia.org/wiki/Agenda_21
simultaneously thus requiring their careful selection. Those choices, however, need to be approved of by all the stakeholders in the processes of planning, managing and controlling.

Turbulent changes in business environment and the enterprise as such, with dynamic technological (and nanotechnological in particular) progress being one of its major aspects, combined with more complexity may lead to wrong choices from the point of view of corporate sustainability. As a result a need arises for appropriate instruments supporting correct decision making. Cost accounting is one of such instruments. The decisions concerning the manufacturing of products using the latest technologies belong undoubtedly to the most strategic ones which the organisations need to reach. Therefore traditional cost accounting systems fail in the processes of planning, controlling and decision making in this area. The achievement of long-term financial objectives is determined by the decisions generating and affecting not only future revenues but also future costs. Life cycle costing is one of the most popular methods of strategic cost management.

2. THE ESSENCE AND COGNITIVE VALUE OF LIFE CYCLE COSTING

The concept of the product life cycle has been known to marketers for a long time. It is defined as gradual acquisition and loss of the product’s potential to satisfy customer needs, and the process of incurring costs related to product innovations: their development, introduction to the market, support while in the market and finally withdrawal from the market. The product life cycle may have various phases dependent on the type of the product, its alternative uses, types of consumer needs it satisfies, the current technological progress or the structure of the present market players (Fig. 1)\(^5\).

Fig. 1 Phases of Product Life Cycle
Source: S. Riezler, Projektcontrolling bei Entwicklung und Einführung neuer Produkte der Großserienfertigung (Lebenszyklusrechnung), ZfBt 1999 No. 42.
It follows that life cycle costing is a cost accounting system which encompasses the planning and controlling of all the costs and revenues generated in the entire product life cycle. Unlike investment appraisal, it lays ground for decision making, active influence on the decision making process and a continuous control in relation to a given product. The two cost accounting systems share, however, a similar approach to expenses and use cash basis instead of the accrual basis underlying the traditional cost accounting systems. It is cash inflows and outflows related to a given product in its entire life cycle that are in the centre of attention here, which allows the estimation of the expected return on sales in the whole product life cycle. A product is considered profitable when the accumulated sales exceed the accumulated costs generated over the whole product life cycle. It is noteworthy that while calculating the profit, R&D expenditure and other expenses usually neglected by traditional cost accounting systems are taken into account. As a result the information is more complete and provides a better reflection of the product's overall profitability since whereas the sales of a given product may be profitable in individual phases of its life cycle (and this information is provided by short-term cost accounting systems), the sales of the same product may be unprofitable in the long run if R&D expenditure and withdrawal expenses are taken into account next to the traditional production and sales-related cash inflows and outflows. The expenses incurred in those phases may be compared and contrasted to the expenses related directly to the manufacturing and marketing of a given product, and their share may be estimated easily. It is important in particular for short product life cycles, complex customer service and utilisation (essential from the viewpoint of environment), as it enables a constant pressure on the reduction of expenses in those phases. Therefore, regardless of the basis (cash or accrual) adopted, life cycle costing is an instrument of cost management as it serves two purposes:

- it is a basis for appraisal of the production programme in the entire product life cycle, i.e. the pre-production (development, construction, investment in machinery and equipment), production and post-production phases,
- it delivers information in advance, which lays ground for decision making.

PLC-based approach to product planning and controlling remains within the optimisation of inflows and outflows. A global approach to all the phases provides a better basis for decision making. As a result the increase in expenses in the pre-production phase may lead to significantly lower expenses in the post-production phase thus contributing substantially to raising the general profitability of introducing the product to the market.

The costs of the product life cycle and their breakdown may be approached from the perspective of:

- manufacturer,
- customer, who incurs those costs while using the product.

In the first case, i.e. the perspective of manufacturer, the sum of net discounted cash flows is a basis for decision making, and it is understood as a difference between cash inflows and cash outflows related to product development, manufacturing, management, sales and waste utilisation in the entire life cycle, i.e. the pre-production, production and post-production phase. Moreover, the use of sensitivity analysis allows the identification of the impact of the change in the assumptions concerning the product in individual phases of its life cycle or individual expenses.

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6 P. Horvath: Controlling, München 2009, p. 473
The adoption of the customer's perspective may become a key to the company’s success. This success is possible under global competition only provided that the company develops a product profitable to the customer, offering high quality and usefulness, and efficient customer service. Life cycle costing incorporates all the costs incurred by the customer from the moment of purchase to the moment when the product is no longer in use. The starting point is to define customer expectations and the ability to meet them at the lowest cost. Those expectations underlie the predictions concerning all the technical requirements, production costs and the estimation of all the inflows and expenses generated by alternative options.

The following categories of expenses may be distinguished from the customer’s perspective:

- expenses related to initial investments, i.e. purchase, readiness to use, training and preparation to use,
- expenses related to the use of the product, such as salaries, raw materials, equipment,
- expenses related to maintenance, i.e. salaries and spare parts,
- expenses related to utilisation.

The combination of the two forms of life cycle costing (manufacturer’s and customer’s perspective) may be a significant contributor to the decision whether to purchase the product. Low expenses incurred in the entire product life cycle complementing other intangible factors such as quality or safety are the major determinants of the potential purchase. The producer may optimise not only the internal costs but also customer-related costs thus becoming more competitive.

3. REQUIREMENTS AND PERSPECTIVE OF THE IMPLEMENTATION OF LIFE CYCLE COSTING

Life cycle costing supports both planning and control. It is prepared after a new product has been defined, and incorporates all estimates of selling prices for various markets, various models of the product and the venues of their future manufacturing. This cost accounting system is adjusted on a regular basis as more and more details in the development phase are known and the information on the product’s construction, functionalities, as well as production requirements and its impact on employees and the environment is more complete. It provides more transparency to the determinants of performance and its variation, which is one of the system’s greatest advantages. The estimation of the product’s overall profitability enables benchmarking with other similar products.

Life cycle costing has two major limits. They are related to the processes of calculating and forecasting. Those problems result generally from the unavailability of data concerning the damages caused by nanoparticles and their impact on health and natural environment. Perception risk and real risk are important factors to be distinguished here. The preceding is related to consumers’ scepticism concerning the safety of nanotechnologies. The real risk, on the other hand, concerns free particles which may have a harmful effect on the environment and human beings through technological processes. The reduction of nano-risks and the great potential of nanotechnologies are arguments in favour of extensive research which may both facilitate the calculations and partially eliminate the problem of forecasting cash inflows ad outflows for the entire product life cycle.

Life cycle costing is a powerful tool to estimate the real long-term profitability of a product. It allows the management of costs before they are actually incurred. The knowledge of the estimated expenses

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8 Ibidem, pp. 32-33.
allows their minimisation, especially if this tool is used by engineers employed in planning departments rather than economists from financial and accounting departments. Good communication between the two major departments, however, may contribute to development of a high-quality product generating low costs to be incurred by all the stakeholders. This communication requires a common language, i.e. certain amount of knowledge of economics among engineers on the one hand, and engineering knowledge among economists on the other.

LITERATURE

a) Article in professional journal


