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Innovation of a Technological Product with Utilizing the Target Costing Methodology

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ABSTRACT

The modern business environment is characterized by high competitiveness. If an enterprise wishes to maintain a competitive edge and hang on to clients, it is very important to engage in innovative activities, even if there is no real justification for doing so. Such innovation in the business environment and cost structure is additionally a catalyst for change in cost management. Gradually, costs begin to be seen from a strategic perspective and planning is undertaken in the preproduction phase, as a consequence of this stage creating the greatest impact on any future success of a product. Varying perceptions of costs and the behavior pertaining to them also necessitates that adequate tools are developed for their strategic management, e.g., target costing. The aim of this paper is to present the upgrade of an electronic item - a sports light-emitting diode display, adapting it to be compatible with external devices running the Android operating system, in accordance with cost projection applied via the target costing methodology. Doing a target costing calculation through the procedure proposed allows for functional differentiation of the given product, specifically to satisfy the requirements of potential customers at an acceptable market price.

Keywords: Cost Projection, Calculation, Target Costing, Innovation
JEL Classifications: M21, M41, O31

1. INTRODUCTION

In a competitive business environment, firms are faced with making numerous decisions in connection with their products and services, thereby ensuring survival on the market and, hence, their long-term prosperity. The key to achieving prosperity and success is gaining a competitive advantage. This is also crucial for the capacity to innovate so as to enhance supply chain performance (Storer and Hyland, 2011). For instance also advanced cost management techniques can improve the information quality for decision-making (Fialová and Popesko, 2014). Petřík (2009) concludes that the three main strategies for gaining a competitive edge comprise the following: Cost leadership, discovering new market opportunities, and differentiating products and services.

The latter of these permits the possibility of utilizing target costing. This represents a special management approach with the aim of integrating cost management orientated towards the marketplace and clients. Such management informed by target costing provides for timely and comprehensive formulation of market-oriented products and services, while also developing and provisioning a cost structure for new projects (Dirnberger, 2009). Doing a target costing calculation through the procedure proposed allows for functional differentiation of the given product, specifically to satisfy the requirements of potential customers.

2. LITERATURE REVIEW

At present, there is a huge need to engender orientation towards the marketplace and the client, a task which can be handled by target costing. Indeed, it is possible to discern a growing trend to be so orientated. The primary function of calculations is not to determine how much a product costs, but what its cost should be for acceptance in the marketplace and to make it salable. In the past, costing was understood as the practice of assigning consumed costs to an individual output. As the free-market economy

develops, his form of calculation system diminishes in importance, simply because it no longer adequately reflects changes affecting the structure of business costs. Under the influence of current commercial conditions (reduction in demand, heightened competitive pressure, shortening the life cycles of products, reducing production costs), businesses are forced to apply new calculation techniques, ones primarily geared towards the market and customer. These new techniques are linked with specific approaches to pricing, target costing being the most often applied in practice. Kato et al. (1995) offers a definition for calculation via target costing, stating it as: "…an activity whose aim is to examine all possibilities to reduce costs within phases of research, development and prototyping. The result of this activity should be a product design that meets all the requirements and expectations of its customers, and its cost of production and the price of the company provide the required profit…" Vedder (2008) writes that the origin of such a calculation technique dates back to the 1970s, when the income of the private sector in Japan experienced rapid rise and people started to explore greater diversity in their needs. Subsequently, changes were made in the products offered for sale. As a result from study of Vedder (2008), Japanese companies were under pressure to develop and produce a huge variety of products with different characteristics. Furthermore, it was necessary to advance mass production procedures in order to meet these new societal demands. Immense progress in automation and robotics facilitated the manufacture of numerous low-cost products. Such automation in manufacture involved the combination of computer-generated design, a flexible manufacturing system, and the oversight of management. The conveniences they afforded created ideal conditions for applying target costing for each product variation. A long recession in Japan also furthered the use of target costing, the crisis in the financial sector forcing many Japanese companies to reduce costs to reach their desired profit levels. These also represented reasons to modernize costing system mechanisms and increase the amount of data needed to estimate costs (Clifton et al., 2003). This was confirmed by authors such as Dudin et al. (2015), who argued that the most important managerial function is effective cost management (or management of expenses) so as to provide appropriate and necessary support for furthering the profitability of industrial enterprise operations. These conclusions on the greater significance of cost management, cost behavior analyses, and appropriate cost projection to adequate cost systems have also been backed up by authors such as Novak and Popesko (2014), Potkány et al. (2012), Olsovska et al. (2016) and Dejnega (2010).

Due to changes in consumer behavior, the life cycles of products have rapidly diminished. For example the authors Ax et al. (2008) state that the basic notion of target costing is that the quality, functionality and cost of products are determined in the greatest detail during the first (design) phase of such a life cycle. This is why the phase of planning, research and design of products has taken on such relevance to cost management. Therefore, returning to the Japanese case study, target costing appeared to be an applicable tool for planning the elements and features of products at an acceptable cost level and desired profit level for the Japanese companies. The foremost initiator for change and application of target costing was the Japanese automaker Toyota. As a consequence of pressure from its competitors, and in an effort to maintain a certain level of profit, its managers defined the maximally allowed costs of their products, triggering a fall in overall costs and boosting the competitive position of Toyota. Since the 1980s, target costing has spread to the United States and subsequently across the world. The main motivation for implementing this method was a sharp increase in Japanese market share prices, primarily in the automotive and electronics industries (Vedder, 2008). It is worth nothing that this method is now widely used across the globe, not only in Japan and the US, due to the pressures of high competition. Analysis in the literature on target costing versus other methods has been conducted, an example being a paper by Ryzhova et al. (2015). Below is given sum (1). The primary view of this mathematical sum is to focus on the market (the individual wishes of customers) and the development of products with reasonable cost levels, with respect to specific market potential, acceptable price, estimated volume and desired profit. Suntrup (2008) concludes that the demands of the customer can be defined as an expectation of quality, at a standard in accordance with their requirements. The entire process of target costing for products and services can by characterized by the following sum:

$$\text{Target costing} = \text{Estimated price of sale} - \text{Target profit} \quad (1)$$

Teplická et al. (2012) writes that his is very clear and simple, however, target costing involves a complex of activities and requires great endeavor on the part of the company. This is primarily due to the estimated selling price, which is derived from the conditions of the market and pertains to the requirements of customers and offers of competitors (Kampf et al., 2012). Frequently, the final selling price is less than the figure estimated by management. In order to proceed successfully with target costing, it is necessary to observe six key principles (Monden et al., 2007).

1. Budget informed by price – the price is dictated by the market and leads to targeted costs (principle of formula below)
2. Focus on the customer – the price is fair if the customer is satisfied with the quality of the product
3. Focus on design – cost management in the target costing process demands that considerable savings be made of the product and its design; cost reduction proves very challenging without it
4. Functional teams – target costing teams are fully responsible for developing new and renewed products from an early stage; ideally, this should be true for all departments involved in development
5. Involvement of value chain – target costing activities require the participation of external members of the value chain, e.g., suppliers, dealers, distributors; otherwise, the effect of target costing is affected
6. Life cycle costing – target costing has to reduce costs throughout the life cycle of the product, starting with development.

Target costing relies on product design in line with reduction in costs, these adhering to the set requirements of the company. Typically, target costing comprises two stages, approximately corresponding with the first and second stages of product development. The first is that of establishment, which pertains to

targeted costs arising during planning and development processes, while the other represents achievement of a desired goal. During management of a product cycle under target costing, firms are faced with carrying out seven activities (Swamidass, 2002):

1. Conducting market research on information such as the needs and requirements of customers, thereby discovering gaps in the market
2. Doing analysis on competitors, how consumers perceive their products, and predictions of any possible reactions after launching the new product
3. Discerning a gap in the market, especially addressing new segments of clients; how the particular properties of the proposed products target them
4. Encompassing the needs of customers within the concept, examining their attitudes and reactions. The product should be engineered to satisfy specific needs
5. Defining features of the given item according to specific requirements and determining the level of these features
6. Pricing the product at a market-led price point acceptable to customers, in disregard of the competitive position of the company
7. Deciding what the desired profit level is from the sale of the product.

Despite the benefits associated with target costing, there are some less positive aspects that have to be considered. Friedl (2012) surmised this aspects. It is a highly complex process, one strongly influenced by uncertain market data. Any targeted costs are static in nature, almost no cost optimization is conducted within the company. Issues arise concerning short-term decisions – target costing is a fully cost-oriented procedure and the dominant tendency is to forge ahead with a technical approach to the product.

3. PROBLEM STATEMENT AND RESEARCH OBJECTIVE

The primary aim of this study concerns the upgrade of an electronic product - a sports light-emitting diode (LED) display. The intention was to adapt it for compatibility with external devices running the Android operating system (OS). From an analysis perspective, the authors endeavored to define costs and cost groups according to their behavior, and project these costs adequately for calculation, using the target costing method. The sample product was one selected for the purpose from an unspecified company. The product is introduced in this section, while core groups of costs are defined that are associated with said product. The methodology of simple absorption costing is applied. The following chapter presents innovative solutions for this product, and costs are identified according to their behavior as pertain to the defined parameters of the product and the innovation of the same. The subsequent sections detail the procedures of the target costing method the authors utilized to discover the required target price. The product chosen was an LED display entitled the Smart 90, which was designed for sports activities such as running, cycling or motor sport. The price calculation for this product was arrived at via the well-known methodology of absorbing costing, which results in the following simple calculation:

Direct material	195.66 €
Direct wages	105.37 €
DC	301.03 €
General expenses (60% of DC)	180.62 €
Total output costs	481.65 €
Profit (15%)	72.25 €
Resultant price ex VAT	553.90 €

DC: Direct costs

The average price in the Slovak Republic for the Smart 90 LED display is 550 € ex VAT. The final price obviously depends on whether it is intended for a consumer or distributor, and does not include any deductions in the form of rebates or discounts. Presently, the constant need for innovation is evident. This product is no exception, as it is necessary to maintain a certain degree of modernization and adaptation to contemporary trends. In sports, stipulations and requirements relating to information are often amended for aesthetic reasons. Thus, alteration has occurred in the manner in which information is presented and the design of displays. Even though LED displays remain essentially the same, the past few years have witnessed great modification in the materials used. Production demands ever simpler and more durable parts, thereby also making weight savings. However, the greatest innovation has taken place in electronics and firmware, these consequently becoming simpler and more reliable. It is when operating a product that interaction happens between the consumer and the product. Initially, LED scoreboards were distributed as standard with cable controls. Later, they were supplied with a remote control unit of relatively long range, while the cable control was solely reserved for emergency situations. Of course, this advancement in Smart LED boards caught on quickly, and their popularity rapidly increased. The remote control is powered by a 9 V battery, and thanks to its long range is a practical solution for all outdoor sports grounds. The unit is of simple, clear and robust construction. However, robust design and construction can eventually end up outdated and impractical. In addition, this basic solution provides no support for any additional features of such LED scoreboards. Although the majority of customers prefer this method of control, extended functionality is expected in the near term. Smartphones and tablets look set to take such operational functions, as a result of the appropriateness of their OSs. This kind of innovation naturally requires alterations to the circuitry of the scoreboard.

4. RESEARCH RESULTS

The fundamental issue that arises when enhancing the scoreboard for control via smartphone or tablet is that of software support. When determining which OS is the most suitable choice, it is necessary to make bear in mind the market share of each option, this data being available at www.businessinsider.com. Consequently, it would be advisable for the hardware upgrade to the scoreboard to be fully compatible with the most widely used OS in the world, which is Android (accounting for up to 81.5% of market share). A direct benefit to users is the sheer breadth of Android cell phones and tablets at their disposal.

Another important aspect is that a great number of programmers are familiar with Android. In actual fact, Google – the originator

of Android - even provides internet courses for those new to their OS. Ideally, for the task in question, it would be best to secure the services of a professional company engaged in developing software solutions. Several such companies exist that are capable of handling the functional and graphical upgrade. One such firm was Touch4IT from the Slovak Republic, which is engaged in developing Android apps as well as software solutions for iOS, Windows Phone and BlackBerry, whose quotation for the job equaled 1500 €. A visual presentation of the draft app is presented in Figure 1, as alaborated by Kováč (2015). Enhancing control of the LED display in this manner brings about the potential for additional features and benefits. The first is that the user does not need to carry around the usual remote control unit, as it is sufficient to place a phone or tablet in a pocket. Currently, the only limitation is the range of the Bluetooth module, which is utilized for data transmission to the board. The plan in the future is to switch from Bluetooth to communication via the Wi-Fi module, which boasts a range of 50 m. The connection between the LED scoreboard and the Android device is secured through a password, thereby preventing unauthorized access. In terms of additional functionality, it is envisaged that there will be data storage in case of power failure, the possibility to save pre-programmed times, a more responsive and intuitive timer control mechanism.

The intention is that as software functionality expands, users would be informed about updates through the website of the company, with the latest version being available on the Google Play Store (the official on-line app repository). A subsequently name change could be see it rebranded as the Smart 90 RC/Android (Figure 2), as alaborated by Kováč (2015).

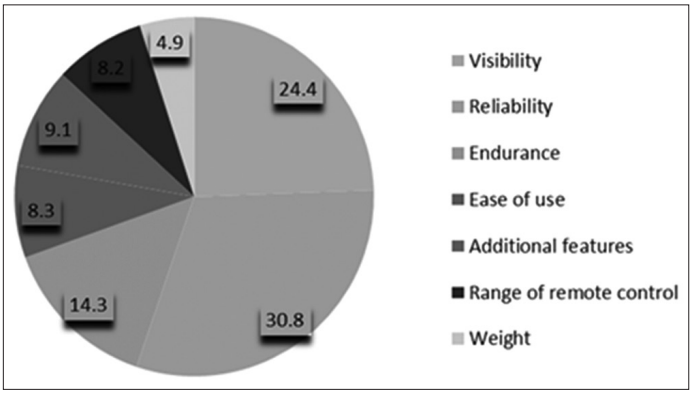
It was necessary to conduct market research in order to correctly discern the preferences of potential users. This was undertaken in the form of a questionnaire, as well as by carrying out personal interviews with a selected group of customers of the company. The questionnaire was published on-line at www.survio.com/sk. It specifically addressed forty importance clients of the company. The result of the survey showed that the customers of this product consider the most important criteria (Figure 3) to be reliability (30.8%). Another focused on the visibility of the display (24.4%, i.e., good visibility from a wide viewing angle) and endurance of the product (14.3%, i.e., the possibility outdoor installation). Other responses included the addition of extra features (9.1%), ease of use (8.3%), the functional range of the remote control device (8.2%), as well as similar feedback. The smallest figure related to the weight of the board (4.9%).

Following the survey and analysis of material requirements for upgrading the item, the eventual price for it was calculated to increase by a maximum of 30 €-580 € ex VAT. Allowing for a predetermined level of profit, set at a level of cost efficiency of 15%, the total cost for the Smart 90 product would increase by 25 €; structured as 20 € to cover material costs for the new broadcast communication module, and 5 € for labor costs to construct the communication and broadcast module and to test its functionality). General costs pertaining to the charge for all overhead costs amount to 506.65 €. These overheads remain largely unchanged in their total amount due to the minimal impact made when adding the upgraded

Figure 1: Primary user interface for smartphones and tablets running the application

Figure 2: Smart 90 RC/Android

Figure 3: Customer preferences



product to the product portfolio. An overview of permitted costs relating to each part of the product is given in Table 1.

However, account must be made of the costs associated with developing and completing the software, estimated at 1500 €. According to the information available, the company sells about 40 Smart 90 RC units monthly, and it looks set to continue to dominate sales of classic LED scoreboards in the future. In the first ½ year the authors suppose that the company could sell about 15 upgraded Smart 90 RC/Android units per month. Therefore, financial resources for developing the innovated product should come from reducing the profit margin to 13%, thus ensuring a 2% contribution from each to set off the charge for software development. Hence, the price would be maintained at an acceptable level for the customer, and each LED scoreboard would also contribute the sum of 10 € towards covering development costs. At estimated development costs of 1500 € and predicted sales of approximately 15 upgraded units monthly, full return of investment would expect take 10 months. Should the new timer be readied in a shorter time frame, this period could end up considerably shortened.

Target costing methodology demands quantitative/functional analysis as an input factor, which details connections between demands placed by users on the performance of products and the individual components of said product (Table 2). Each component shown in Table 2 contributes to the overall functionality of the product. However, they correspond to features required by customers differently. For example, the LED panels are largely utilized to a timer. The actual LED diodes used in production determine the light intensity of the scoreboard. At a lower level, these components affect its reliability, endurance, and weight. Nevertheless, the LEDs do not contribute towards ease of operation, or facilitate additional functions or alter operability over the range of the remote control. There are also other components that ensure it functions fully, e.g., its wiring.

Having gathered data from the quantitative/functional analysis performed, as well as on the allowable costs of each component, it is possible to proceed by analyzing functional costs. The task therein is to compare costs relating to provision of features of the product and the preferences of customers. Table 3 shows data that the foremost allowable costs which provide for preferential functionality pertain to features such as good visibility (26.13%), reliability (24.29%), low weight (17.11%), and endurance (14.10%).

Figure 4 reveals differences between preferences as given by users and the necessary costs to meet them. Hence, in terms of visibility of the display, the product actually exceeds the requirements of its customers. This is due to the company using the same LED diodes as applied in the automotive industry. One anomaly that arises relates to reliability, as the level of costs incurred to ensure this quality is 6.5% lower than the figure for the preference of users. Therefore, it is suggested that improvements be made in the quality of components utilized, especially in the electronics of the LED timer, which is a key factor in reliability. One approach to solving this could involve consulting suppliers about obtaining better quality electronic components, with the option for a longer warranty period for such parts. Any rise in costs could by partially offset by reducing the predetermined profit margin (e.g., reducing it to 10%), so as to maintain the intended price of the product. Criteria such as resistance to weather conditions, ease of use, additional features and the range of remote control should be deemed such that the costs incurred approximately equal the levels of interest from users.

Table 1: Permitted (allowed) costs for Smart 90 RC

Component	Material (€)	Labor (€)	Overhead (€)	Sum (€)	Allowed cost (%)
LED panels	57.36	25.8	49.9	133.06	26.26
Main panel	47.24	16.7	38.36	102.3	20.19
Electronics	40.87	20.67	36.92	98.46	19.43
Transceiver	18.19	8.9	16.25	43.34	8.55
Controller	29.54*	9.4**	8.37	47.31	9.35
Cabling and power supply	22.46	28.9	30.82	82.18	16.22
Sum	215.66	110.37	180.62	506.65	100.00

*Original cost level+20 €, **Original cost level+5 €. LED: Light-emitting diode

Table 2: Quantitative/functional analysis for the upgraded Smart 90 RC

Functions	Components of Smart 90 RC LED display					
	LED panels (%)	Main panel (%)	Electronics (%)	Transceiver (%)	Controller (%)	Cabling and power supply (%)
Visibility of display	85	10	5	-	-	5
Reliability	5	10	65	35	5	30
Endurance	5	15	10	10	5	40
Ease of use	-	-	-	-	40	10
Additional features	-	-	15	-	45	10
Range of remote control	-	-	-	50	-	-
Weight	5	65	5	5	5	5
Sum	100	100	100	100	100	100

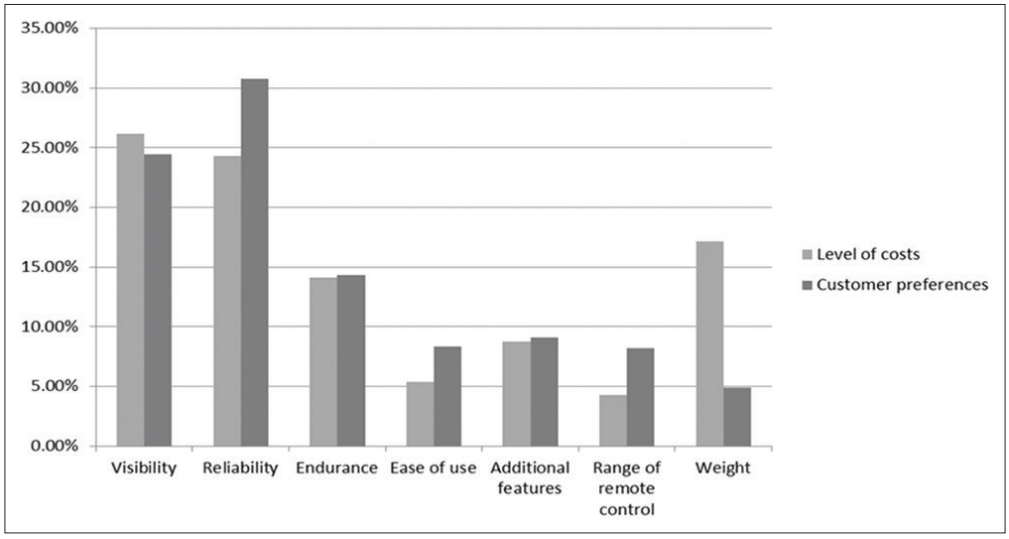
LED: Light-emitting diode

Table 3: Analysis of functional costs Smart 90 RC

Functions	Components LED display Smart 90						Sum (%)
	LED panels (%)	Main panel (%)	Electronics (%)	Transceiver (%)	Controller (%)	Cabling and power supply (%)	
Visibility of display	22.32	2.02	0.97	-	-	0.81	26.13
Reliability	1.31	2.02	12.63	2.99	0.47	4.87	24.29
Endurance	1.31	3.03	1.94	0.86	0.47	6.49	14.10
Ease of use	-	-	-	-	3.74	1.62	5.36
Additional features	-	-	2.92	-	4.20	1.62	8.74
Range of remote control	-	-	-	4.28	-	-	4.28
Weight	1.31	13.12	0.97	0.43	0.47	0.81	17.11

LED: Light-emitting diode

Figure 4: Comparison of preferences of users and allowable costs



However, a large discrepancy in figures concerns the weight of the product, with the costs to the company exceeding customer preference by more than 12%. If users consider this an unimportant parameter, it lends the producer a competitive edge as other features of the product are strengthened as a result. Taking account into the fact that the greatest impact on weight is made by the main panel, which is also the second most expensive part of the Smart 90 RC, is this difference a significant factor in raising the price of the unit? Research reveals that the base of the timer is produced from special polycarbonate panels, which are reinforced with aluminum profile sections. The special structure of the panel contributes towards keeping the weight down, as well as to benefiting the space necessary for the wiring of the timer board. In addition, it is resistant to ultraviolet radiation. This means the panel maintains its original shape and appearance even after several years of use in outdoor sports venues. Other advantages of its overall low weight relate to costs incurred during transportation, and the indisputable fact that the item can be easily and quickly placed into storage after each use. If any potential reductions were to be found in light of the preferences given by users, a solution would be to focus on untapped reserves permissible in overhead costs. The estimated quotation shows that overheads actually comprise approximately 40% of total costs. The entire process for applying the target costing method can be generalized, hence the description given in the following schematic diagram, as alaborated by Hematfar et al. (2013). Figure 5 visualizes the standard utilization procedures of target costing as borne out by theory, and it represents a graphical simulation of the procedure followed in the study detailed herein.

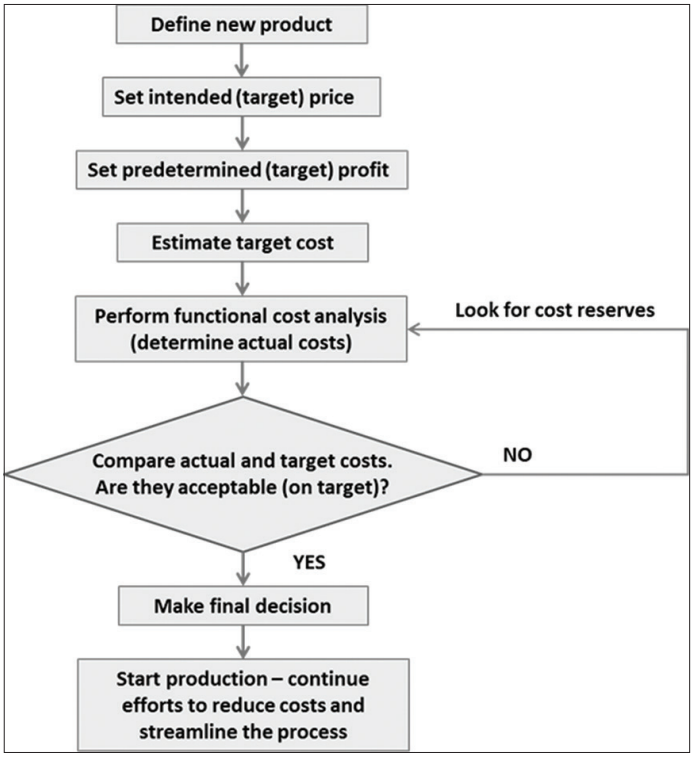
Measures for efficiently managing costs require that such expenditure is viewed differently by management. Attention should be primarily paid to finding means to improve systems for monitoring, record-keeping, and budgeting, in relation to costs. Doing this would bring about greater efficiency in the inputs necessary for manufacture and utilization. The scientific literature has for many years been proposing calculation models for estimating the productivity of a machine. One of the most famous, and still used, is overall equipment effectiveness (De Carlo et al., 2014). Therefore, the authors recommend more detailed monitoring of costs items, from the phase of acquisition until the stage that items represent the essence of the intended produced output. This step could significantly contribute to furthering the efficiency of the entire company, and could reveal opportunities for reducing the prices of products. Furthermore, there is the potential to boost profits, as well as to improve products by paying attention to selected preferences expressed by customers. Such actions do not require complex software solutions, as used by large organizations in the form of complex reports. Greater efficiency can be achieved primarily through appropriate planning and control mechanisms in the short and long term. This is also confirm by Tuček et al. (2009).

5. SUMMARY AND CONCLUSIONS

Target costing applies principles of value analysis. Utilizing tools to analyse functional costs and conduct quantitative/functional research can indicate if functional differentiation in the product exists. This approach means it is possible to pick up on any defects early on in the R and D stage. Indeed, 85-90% of costs related to products arise as a consequence of decisions taken during pre-production phases. The risks associated with such an approach primarily relate to the accuracy of the market research conducted and to correctly determining the levels of relative costs for individual components. This paper presents research carried out by the authors on applying the methodology of target costing in the electronics engineering sector, the sample case concerning production of an upgraded LED timer display.

Results show that the given innovation, i.e., introducing Android software support, would trigger a slight increase in the sales price, bringing it up to 580 € ex VAT. Nevertheless, the functionality of the product would still remain intact, in line with the requirements of customers and requiring a minimal return of investment. From a strategic point of view, the company could accept that certain features of the product would be enhanced due to funds gained through rationalizing overhead costs. The main recommendations of the authors comprise increasing the reliability and endurance of the LED scoreboard to a standard that exceeds customer

Figure 5: Process diagram for target costing



expectations, while still maintaining its quality of visibility, ease of use and low weight.

Within the framework of the proposed innovation as detailed via the target costing methodology, it would prove necessary to expect greater demands in the monitoring of overhead groups when projecting costs. A satisfactory solution is to introduce planning and control mechanisms, thereby raising efficiency and subsequently adjusting the optimum price for the product. This is also confirmed by authors such as Belás et al. (2015), Hajduová et al. (2014), Hassan et al. (2015), Kampf et al. (2016) and Tokarčíková and Kucharčíková (2015).

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