

QUALITY SCHEDULING INDEX WITHIN PRODUCT'S LIFECYCLE AND THE MODERN SOCIETY

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Abstract

The purpose of this article is to provide a starting point for application of Quality Scheduling Index within the production process with an emphasis on the product lifecycle and a comparison with our society where due to demand there is an offer which should be in time, at the required level of quality and at the corresponding place of selling. The scope of the article is the expansion of the application of newly developed Quality Scheduling Index within several other branches of industry and an initial evaluation of its implementation. The article presents outputs of the author's yet not published research and work in the field of management and economics of the industrial enterprise and wants to become a starting point of the implementation of Quality Scheduling Index in enterprises which want to innovate their production process and reduce costs and dead time of the products / services within their lifecycle.

Keywords: *innovation, quality, management, production, lifecycle, Quality Scheduling Index.*

1. Introduction

The Management of Product Lifecycle is aimed in driving all the particular areas, which have a direct influence on some of the life cycle stages such as maintenance, quality, information systems and costs - research, development, production management, etc. Among the life cycle management there are a number of methods and techniques with different approaches regarding the necessary data input and as well as the results we get from them. The common element is the valuable information supporting the management, which helps us make the right decision and choose the optimal way of solving the economic problem. Among the aforementioned methods belongs the design cost, LCA - Life Cycle Assessment, LCE - Life Cycle Engineering, LCC - Life Cycle Costing, WLCC - Whole Life Cycle Costs, PDM - Product Data Management, etc. Until now were created many tools, methods and techniques for managing the life cycle, but these tools are limited to the evaluation of certain selected specific tasks. The models have a number of assumptions and initial conditions, in order to allow universal applicability for a wide range of users.

We consider the following approach of using the product lifecycle stages for delimiting and showing the applicability where newly developed Quality Scheduling Index can be used and/or these product lifecycle to be used as starting point for computing the necessary variables which are being used in the computation of Quality Scheduling Index.

This research is part of a greater project where based on the philosophy that all the necessary resources should be in place at the right processing table where at the specific, requested time should be processed

without any or minimizing the delays (dead time) also the society should be organized so that our daily activities to be most efficient and to get the maximum output without overworking the worker / processing machine. An analysis is being made from a social - economic point of view where first the government should be working Just-In-Time, to be efficient and to become a model for other private companies from different domains, because after all, the processes can be divided in time and according to a manufacturing production line. However in this article only an initial overview of this idea is being presented.

2. Quality Scheduling Index and Product's lifecycle

The current article is based on the author's previous work, where Quality Scheduling Index (QSI) was developed¹ as an answer to the below Research Questions, which can be continuously updated to answer the actual market conditions:

- How can we achieve the desired level of quality of our services / products by using the available resources with the condition of minimizing the costs?
- Where should we consider the quality within the product lifecycle and with what costs?
- How can we optimize the production process from the quality, time consumption and indirect costs point of view?

These Research Questions are part of the author's yet not published work and due to article constrains we consider only some part of them in the present article. We will consider further the implication of Quality Scheduling Index within the production process and how can we use it within the product's lifecycle.

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¹ Gruia George Cristian and Kavan Mihal „A New Managerial Tool For Scenarios In Scheduling”, *Global Economic Observer*, Institute for World Economy of the Romanian Academy, vol. 2(2), (2014): 4-13

The Quality Scheduling Index was developed for small and middle size enterprises as a management tool which can be used in finding the optimum function of costs, time consumption and quality from different scenarios due to the request from several managers from different European companies. A survey was carried out in this sense and the result was the need from the market of such a tool which can show managers how to basically optimize and innovate the production process. I consider that managers should come together and decide about the next step in the company's future on the market and to do so they need scenarios:

- Optimistic;
- Most probably;
- Pesimistic

Scenarios are part of the selecting process of the right strategy for the required segment of the market.

In my opinion, managers in manufacturing companies can use the newly developed index, which can be implemented in different scenarios to help them decide which strategy to adopt on the desired market, according to their initial goals and budgets.

Innovation is part of the company's business model and each company should decide which innovation portfolio to adopt according to the competitive environment. As Davila (2012) considers in his book², I too consider that the right amount of innovation at the right time, can differentiate winners from the losers of the customers. Thus we will further consider that there are two types of strategies (Play To Win Strategy and Play Not To Lose Strategy), which companies must consider on a long term to achieve their goals. In the same sense in different studies it was considered that the innovation and development of the public sector³ are also important in the good development of the state⁴, and thus the area of applicability of my quality scheduling index can be broaden in the private as well as in the public sector.

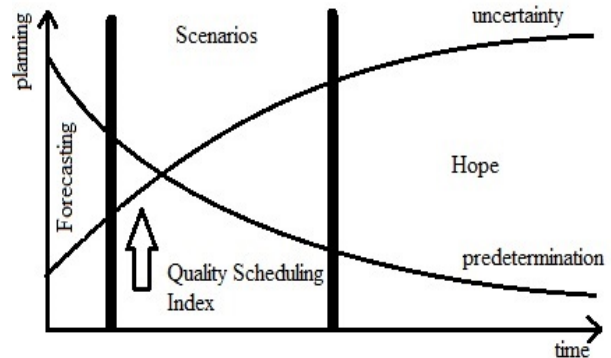
Based on my research, I can consider different scenarios based on different values of the index QSI. The main goal of the index is, based on the input data, to find the best value for obtaining maximum value for the requested quality level by the customers, with minimum production costs and time usage.

The level of quality is settled according to the utility level, different customers consider for the desired products. In collaboration with the marketing and CRM/CI departments, companies should find the needs and the problems of the customers and develop strategies based on different scenarios, which in turn are based on the computational values of the Quality Scheduling Index, for different levels of quality desired by different customer segments from different markets.

With the help of the Quality Scheduling Index, based on the operational output, different scenarios can be stated and some strategic decisions can be taken accordingly. The usage of the index is for the area in time when the level of uncertainty is bigger and the level of predictability is lower than in the area of planning based on forecasting, i.e. the area of planning based on scenarios for the development of new business strategies. This can be better seen from the figure 1 below.

Companies should use time and quality of time consumption in planning and deciding next steps for maintaining the same or better level on the market. With the help of the Quality Scheduling Index, one can improve the productivity of work within company and thus can produce better and faster outputs with the same inputs (resources, financial and non-financial).

Fig. 1 – Position of QSI in planning using scenarios



Source: Own contribution

We all know that productivity is the ratio between output and input,

$$productivity = \frac{output}{input}$$

and if we know that the input is according to the standards (for e.g. the raw material is delivered in time, at the required quality standard imposed by us, the company, the people are trained and chosen by the HR department to work within our company according to our needs and financial resources and our equipment is advanced enough to perform well our manufacturing operations), the only way to improve the productivity of the company and our work is to increase the our output to the market. By output I understand either a bigger number of products (but which must comply with quality standards and not to overburden the machines and / or workers) or the same amount of products, but with better quality, thus to lower the rebute and the faulty products which will be refused by the quality audit. In the second case, the quality of the products is improved, thus the company reduces its

² Davila, T., Epstein, M., Shelton, R.: *Making Innovation Work: How to Manage It, Measure It, and Profit from It*, Updated Edition, FT Press, 2012.

³ Gruia George and Gruia George Cristian: „The role of state powers in the development of business environment”, *Perspectives of Business Law Journal*, [online], vol.2, no.1: 105-112.

⁴ Gruia, George. *Politici Publice*. (Craiova: Sitech: 2014), 130-156.

time (and accordingly its costs) dealing with service, rework or maintenance of our products, when they broke. Also customers will recommend our qualitative products to their acquaintances and relatives and our market share will raise, qualitative products being one of our competitive advantages.

If we consider either two cases, we can increase the output of the company by organizing the resources on the production line to produce faster and better products, without any additional costs. That is why I have developed the Quality Scheduling Index which can improve the output of the company and in this way the management can use it as managerial tool to improve the productivity within the company and plan on larger time interval, than the one, where forecasting is used, in order to expand on other markets, destroy the actual competition and faster innovate the products in radical way, rather than semi-radical one.

A manufacturing company can thus better implement a radical innovation in either the technology or in the business model, or in both actually, by reducing the risk involved with this kind of innovation, because, now, after implementing the QSI on the production line, the time usage of the workers is without any "dead" time, the company doesn't lose money from this, nor uses additional resources than the one which are absolutely needed for the production process and can relocate these resources in the R&D department for next generation products.

However, without strong leadership and vision from the top management, the innovation is not likely to be achieved and implemented in the company's culture. The difference between the two possible types of strategy is given by internal as well as external factors of the company. Between the internal factors, we can recall:

- Technical possibilities
- Organizational abilities
- Success of the actual business model
- Finances
- Vision of the company

I can add to the internal factors, which drive innovation through the company, also:

- Innovation culture and willingness to improve the process within the product lifecycle, without any financial drive incentives---and this factor can be easily solved with the help of the QSI.

The index can be also used as part of the top management's vision of innovation the business model, by adding value to the produced final products, by increasing the quality and reducing the time spent with their production. Here by "reducing time", I consider reducing of the unnecessary time spent of the product on the production lines, reducing or even elimination of the waiting / dead time of the products from their technological processes and manipulation.

2.1. Scenarios and QSI

Whatever part of the innovation process we want to improve (business model or the technology), we

should also increase productivity of the processes, by reducing the time spent with them and correspondingly the costs, and increasing the quality of the processes and of the products.

The success of the actual business model, as one of the internal factors which influence the choosing of the right innovation strategy, can be analysed from the productivity point of view. Managers must look at the processes and based on different scenarios, made from the data from the customers and suppliers, i.e. data from CRM and CI, they should improve the time spent in the factory with the production of their goods, but without reconsidering the quality level required by the standards on one hand (ISO 9001, 14 000, 18 000, etc.) but also by the customers, on the other hand.

I consider that a manufacturing small or middle size company can develop its innovation strategy based on scheduling the internal processes in a productive way. In other words the following main scenario mainframe should be maintained when dealing with a new scenario, as part of the future strategy:

1. Arrange the working areas with the corresponding tools in a greedy manner so that each worker can be accounted responsible for his work, if any fault will appear.
2. Prioritize the work according to the available resources and the main skills of the workers so that the time and quality can be maintained within standards.
3. Consider and arrange the machines in a parallel way in order to increase productivity and schedule the manufacturing operations with a focus on quality, time and their corresponding costs.
4. Deliver goods to the market and receive feedback from both the customers and workers in order to improve the process.
5. Adjust the short term and long term strategy of the company, based on the feedback and obtain approval from the stakeholders, with regard to the fulfilment of their needs.

Scenarios are very difficult to create and implement in a company, i.e. because when we talk about scenarios we should consider different points of view of the same problem in order for managers to come to a single generally accepted idea.

The scenario should take in consideration the companies outside environment as well as the internal one, which is responsible for production and shipment of the goods.

2.2. Product's lifecycle stages and QSI

We focus on improving the strategy, by managing the internal processes of the company in a productive time manner from the early stages of the product's lifecycle.

When talking about product's lifecycle we should consider the following stages:

- Introduction to the market – where after a R&D stage the new product is introduced based on customers' feedback and requirements;

- Growth – where our product is already known by some customers and due to its qualities and marketing campaigns, it acquires more visibility and more and more customers are willing to buy it;
- Maturity and Saturation of the market from our product – here all of the market targeted segment know our product and there is only a matter of time to buy it;
- Decline – where due to product's end of life or end of sale we or due to competition take out the product which became obsolete and replace it with a newly developed one.

A company can apply the QSI in the first stage by arranging the machines and working stations into a parallel way so that the required level of quality from the customer's feedback to be attained. Actually this first stage is connected to the last stage of our product's lifecycle if we choose to Decline our product to make room for the new one, which in most of the cases is done due to legal or ecological regulations or due to another competitor who developed a better product than ours and the only way to Win is to completely innovate and launch anew product.

In the second stage, where our product gets momentum and is being seen by more and more potential customers, QSI can be used to adjust the production costs and time used in production (even if our goal is to have them at minimum, due to some technical constraints some parts of our product might spend a higher time on a machine that others and this is due to the requirements of the desired quality level). However there levels of quality even if they are according to the norms can be lowered in order to minimize costs and thus get the product to more customers than before and this also can be done by adjusting the Quality Scheduling Index.

The Quality Scheduling Index is to be implemented into the production process as stated before, however this is in direct relation with the product's lifecycle because the desired level of quality should be at least the same with the initial requirements from the market, in all of the sales stages within time from introduction to the market until the decline, where we can take feedback from customer and adjust our index levels so that it answers the new requirements of quality.

As we all know, manufacturers are not willing to invest into a product to be more qualitative than the requirements from the market, because for an example a market is not mature enough and there is not enough money to cover the costs related with the 100% quality level ideally required by our market segment and that is why we can adjust our QSI if our strategy requires so based on an optimistic scenario. The management of a company can decide that in certain circumstances to prolongue the Maturity stage of the product's lifecycle by changing level of the quality up so some specific point, based on the research and feedback from the market. And this can be easily attained in the automated and semi – automated production stages, where a change of operation and machine processing can be

done relatively fast in comparison with human operated working stations where we cannot do anything without a proper training and investment in long term positions. An example can be seen into the automotive industry where after a new model is launched and it acquires momentum from the market, the producers decide to innovate the product by changing the design of the headlights, which gives another boost in the sales, even if the technical functionality of the car didn't change and the previous and the new headlight give the passengers the same light on the road.

My QSI was developed as a management tool which can be applied and used to innovate the production line, which in terms, as shown above, influences the stages of the product's lifecycle.

2.3. What is Quality and EFQM?

Quality is always evaluated and determined by an entity, which can be: a person, a buyer, a customer. This evaluation process has a strong distinctive and personal character! For example the same "qualitative" product for a buyer, where costs are crucial, is different seen by a person who wants to buy that product no matter what the cost is, due to its features and because is an innovation / new thing on the market.

Quality is assessed primarily by the buyer - customer (agent)! He is paying the requested cost and therefore his opinion is authoritative and always right! There is an old saying that "Our customer is always right", which translates in different cultures in slightly similar ways, but the idea is the same.

Quality can be assessed by non-target agents - not just customers, but

- Manufacturers;
- Competitors;
- Creators;
- Service providers;
- Experts, valuers;
- Bureaucrats and clerks.

One can attribute the value of quality to things he does create or does not create:

- Quality of casting;
- Quality of service;
- Quality of process;
- Quality of environment;
- Quality of life;
- Quality of people, etc.

based on their observations, utility, use or consumption.

One can also evaluate and rate quality based on:

- Selection;
- Sorting;
- Classification;
- And predictions of corresponding use.

If there is no quality definition, then the quality cannot be measured! If something cannot be measured, it cannot be on purpose and efficiently improved.

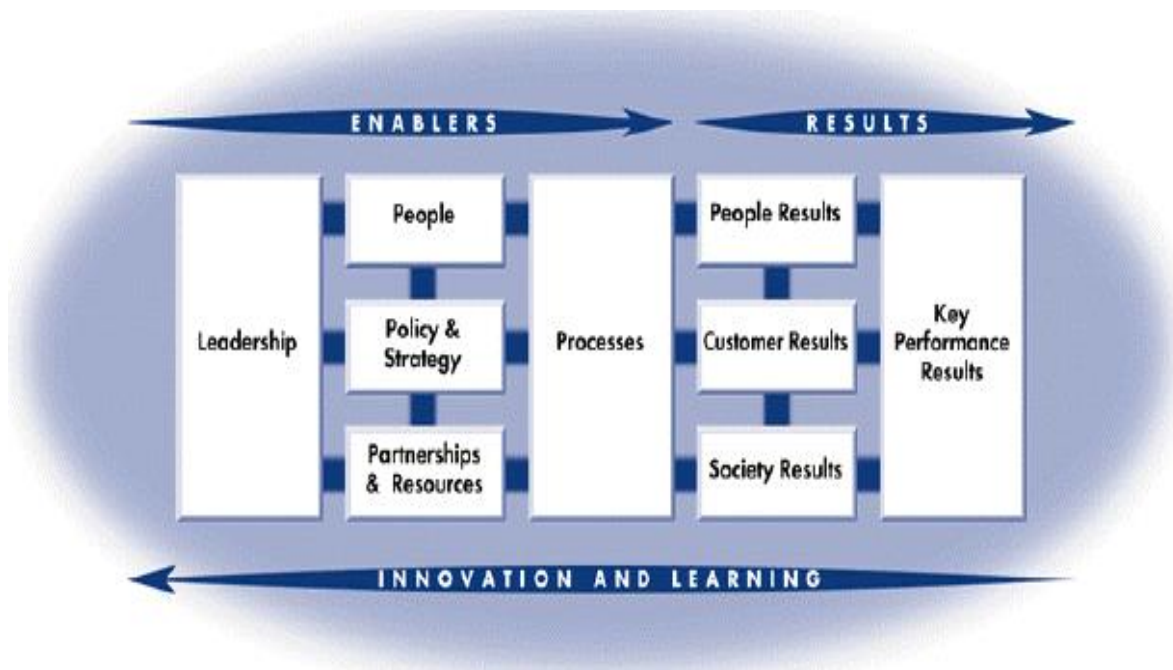
In this sense we consider the newly developed index, i.e. Quality Scheduling Index, which evaluates

the time consumption of each operation with regard to the quality of the work and associated with indirect costs. In order to apply this index in any manufacturing small or middle size company, a new methodology (standard) for its implementation was also developed with its evaluation scale, however this is part of the author's other published work⁵.

For the sake of this study I will only mention the mathematical formula of the index, my purpose being to focus more on the managerial point of view and how we can extrapolate the philosophy behind the need of its creation to the modern society where time usage is critical and we should improve our daily activities, especially the quality of the time usage and the indirect costs associated with them.

$$QSI = \frac{\sum_{i=1}^h \sum_{k=1}^f (ew_{ki}E_{ki}y_{ik} + tw_{ki}T_{ki}z_{ik} + w_{ki}C_i)}{\sum_{i=1}^h \sum_{k=1}^f \frac{q_i}{tc_i * (E_{ki} + T_{ki} + C_i)}}$$

Figure 1 – Enablers of EFQM model



The European Quality Award Model is based on the above enables from Figure 1 and on the below fundamental concepts:

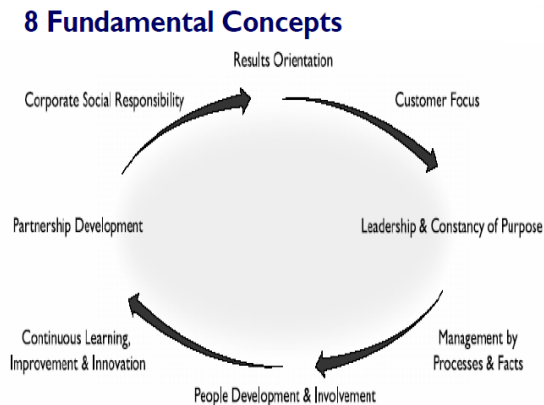
From the production point of view the improvement of quality of time usage and the indirect costs associated with it, we can use the index as showed above to improve the product's lifecycle stages, because every manager wants to develop its products with the minimum production costs, at the highest quality and in the fastest way possible, so that he can take the lead in the market with the innovation of the product.

For better visual aid we can use the European Quality Award Model, which was created as a reward for companies from public and private sector where the resources are scarce and according to their website⁶ : "The EFQM Excellence Model provides a framework that encourages the cooperation, collaboration and innovation that we will need to ensure this goal is achieved."

⁵ Gruia George Cristian and Gruia George "Sustainable growth with the help of Quality Scheduling Index", *Procedia of Economics and Business Administration* (2014)

⁶ The EFQM Leading Excellence Model www.efqm.org

Figure 2



The scope of the article is not to explain nor to present the EFQM model and how it appeared, however I consider that the above figures are suggestive in my approach to integrate the QSI within the requirements and needs of the modern society. If we consider only partly Figure 1 we can state that the enablers (leadership, people, policy & strategy, partnership & resources, processes) give results which in turn help companies to learn from their outputs and further innovate. However the innovation cannot come without the 8 fundamental concepts from Figure 2.

3. Conclusions

In the above article I have presented a short result of the initial outputs of my work, where newly developed Quality Scheduling Index was implemented in the production phases of the product and its versatility was prolonged to the product's lifecycle by the empirical analysis and evaluation of the each of the phases of product's lifecycle.

There is still room for further research in this field and I consider that the product's lifecycle and the newly developed QSI can further be applied in other disciplines where product or service can be divided in several production phases as well as lifecycle steps. The connection with the modern society is that due to the ever changing conditions on the market due to diversity

and the multitude of choices a customer is bombarded from different marketing channels, including without doubt the social media, the time is "precious" as the old saying where "time is money". In this modern society where the amount of smartphones are almost the same as the number of people in the world, the time consumption and overhead costs associated with our daily activities must be lowered in order to remain productive and to answer the daily demand from the society to the individual.

One can read this study and check and evaluate if he/she can become better by using the same monetary and non-monetary resources, because this is the fundamental stone in my research: how can we improve the processes and products by using the available resources, because additional resources are scarce in today's market and investors are difficult to find and convince of our "innovated product" on the paper in order for them to invest and get the ROI as fast as possible.

If we look back at the 2008 economic crisis and check the social and economic status in several European countries, one can predict that the next cycle of the crisis will soon come, thus the option of using resources (money) as commercial or governmental loans is not a good idea as the next crisis might come sooner than expected and instead of Play to Win strategy we might Play Not to Get bankrupted strategy from different changes in exchange rates and interests or even governmental decisions due to social instabilities.

I consider thus that one individual should become better in everything what he/she does as long as they maintain a moral, ethic and legal code according to the country / region they live it and in this scope one can analyse their daily activities and improve the quality of time consumption, indirect costs in order to achieve and innovate its processes. Starting from the individual level in time the modern society will evolve and we can even state that the human race can achieve intellectual and scientific progress faster than usual because we solve our daily requirements faster and better and we have more time for innovation and developing new ideas and concepts.

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