

System analysis applied for controlling the quality of metallurgical rollers

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Abstract

In the work, the system analysis in the foundry where the quality management system has been implemented was described. The generalized model of the foundry's production system was presented taking the company's surrounding and process attitude into account.

Key words: Casting quality management, System analysis, Entity, Production system, Control, Metallurgical rollers

1. Introduction

Taking the market economy realities into account, The Foundry's efficiency is closely connected with the production system quality what has an influence on the financial result. The production system is a static and dynamic combination of human, physical and financial resources which transform input (work, subject matters, operation means and information) into output represented materially (products and services) or in the form of information. Therefore, the production system is each organizational unit which manufacture the material goods and provide material services. The example of the production system is also The Foundry. The Foundry's course of action is determined by its targets which are precise and which should be included in The Quality Book. The Foundry Quality Politics is a strategic point for the foundry's activity, which is casting in accordance with the clients' requirements and needs. What have changed are the methods and actions which give rise to attaining goals adapted to market conditions that are dynamic micro and macrosurrounding and competitiveness. The Foundry's surrounding has a double influence on it: it requires as well as fits it with the resources thanks to which the these requirements may be met what is depicted in the figure 1. The impossibility to quantify all the factors which are the elements of the process of transforming input into output shows how complicated is the

process of managing The Foundry. This impossibility is intensified by the fact that The Foundry as the coherent system, relatively isolated, consists of many subsystems of different types which are also systems for minor objects (subsystems). In most cases generating profits is the result of the fact that the company provides and focuses on executing quality requirements. The high quality of the casts is one of The Foundry's basic aims and condition for its development. The process of creating casts' quality consists of technical actions (identifying the client's requirements) and projection actions of the product, planing indispensable technological processes, implementation of the production processes as well as economic, organizational and steering actions (creating the common quality politics and efficient information systems, control techniques, the set of devices used for analysing and estimating the results of the casts quality).

By analysing the production system with respect to its functioning the following subsystems can be identified:

- technical – which is the collection of the interrelated production means,
- technological – which covers spatial structures and the processes of transforming production factors occurred in them,
- organizational – which determine and identify the structures of all subsystems and the processes proceeded in them,

- economic – which is the collection of the processes which create valuable and financial aspects of the production system
- management – which covers the processes realized by people and which concerns the operational, tactical and strategic functions of the production system.

Each subsystem performs certain functions which finally aim at executing the production. Production, which traditionally is the main task of the company, becomes equivalent with the sale. The clients' requirements increase: lower prices, higher quality, wider range of products, shorter life cycles of the products what forces The Foundries to execute new tasks.

It is impossible for the production system to function without the factors which supply it and ensure the continuity of the production process. The generalized model of The Foundry's production system is depicted in the figure 2.

In order to provide the high quality of the casts, the individual departments of The Foundry should analyse the system and synchronize the results of this analysis.

System analysis is the collection of analytic, evaluation, decision-making methods and techniques which rationally solve decision-making system situations and the research which supports the activities of people responsible for the decisions or the strategies how to act in case of uncertainty and risk. In The Foundry which has an implemented quality management system and which aims at TQM it enables registering control procedures and the control of operations and actions in the production system and reengineering, as well as applying other improvement methods and techniques [1,2]. Its main aim is to define the desired activity or the strategy how to proceed by identification and consideration of the available options and comparing its expected less or more direct results. If there is a system, its structure and reactions are known, such parameters and sought for at the input for which the system is the most profitable taking a certain criterion into account (optimisation) The probable reactions are defined on the basis of the structure. If the system is to be constructed, its structure should be designed in such a way so that it would point the desired reactions with the definite probability (optimum functioning)

In the system analysis, the generalized model of the system is divided into the functional parts, these are the individual processes in The Foundry. For the individual parts, the data models are created, so called entity. Entity is the logically separated set of data elements which describe the external object playing a definite part in the company. Subsequently, the contextual diagrams of the data flow in the entity or in the entity set are created [2].

2. Controlling the production process in The Foundry

The production process in The Foundry where metallurgical rollers are produced is complicated. The production plan for The Foundry Department together with the schedule of work and numbering the next roller is drawn up. According to the directions, the heat is being prepared and the casting form is being made in advance. The heat is selected from the marked

Pods, weighed and transported to the induction furnace. The correct preparation of the heat is confirmed in the certificate of rollers' smelting where any the essential information of the melting process is registered. The taken heat is directed to the induction furnace and then the cast is being made according to the technological instruction. The casting form is prepared according to the definite requirements and in advance. Inpouring the liquid metal to the vat is supervised. The previously prepared casting forms are filled with it according to the directions. After certain time of getting cool, the rollers are taken out by lifting devices and are cleaned mechanically or manually. Afterwards, the raw roller is controlled and the conformity status is given. Such a roller is transferred to the dispatch or to the machining treatment according to the drawing and the operations specified in the certificate of rollers' smelting and the production cycle control card.

3. The technology of producing two-ply rollers

The material rollers are made of alloy cast iron of diverse contents of coal and alloy supplements: Mn, Cr, Ni, Mo, Cu. The chemistry of materials is well-known but the final quality result depends on the technological details worked out and applied in The Foundry such as the manner of casting, solidifying rate, the method of transferring heat, heat treatment. The technology of casting two-ply rollers differs from the general technology about the manner of preparing liquid cast iron (two types of cast iron) and about the manner of casting alloy cast iron and the phase of rinsing the form with grey cast iron. Rollers are casted in the metal forms. At first the roller blanket is casted by filling the form with the alloy cast iron to about 100 mm above the roller barrel's brim, what is informed by 'pushing out' the wooden signalling device. Then, filling the form is aborted. As a result of intensive heat transfer by the metal ingot mould the layer of alloy cast iron solidifies. Its thickness depends on the size of the roller and the time before starting the spillage. Three-melting pot induction furnace with acid silica lining of the average frequency of 250 Hz is used to smelt the liquid metal. Heat materials that is the scrap metals are segregated on the dump. The chemistry of scrap materials coming from the proper production (the scrapped rollers, chips from the roller treatment, waste from the casting workshop, heads) is known. The contents of pig-iron and other materials coming from the outside (ferroalloys, metallic supplements, modifiers, spheroidizatory) is certificated by the supplier. The conformity of the chemistry analysis is systematically checked with the order requirements. All the heat materials loaded to the basket in the heat room are weighed by the electronic balance. The heat is heated up and dried in the basket before loading it in the furnace. The chemistry of metal bath is also checked. The technological process of smelting the cast iron is supported with the computer system which collates the heat and estimates indispensable supplements taking the technical-economic criteria into account. The computer system enables calculating the production costs as well [3].

THE FOUNDRY'S SURROUNDING

MACROSURROUNDING

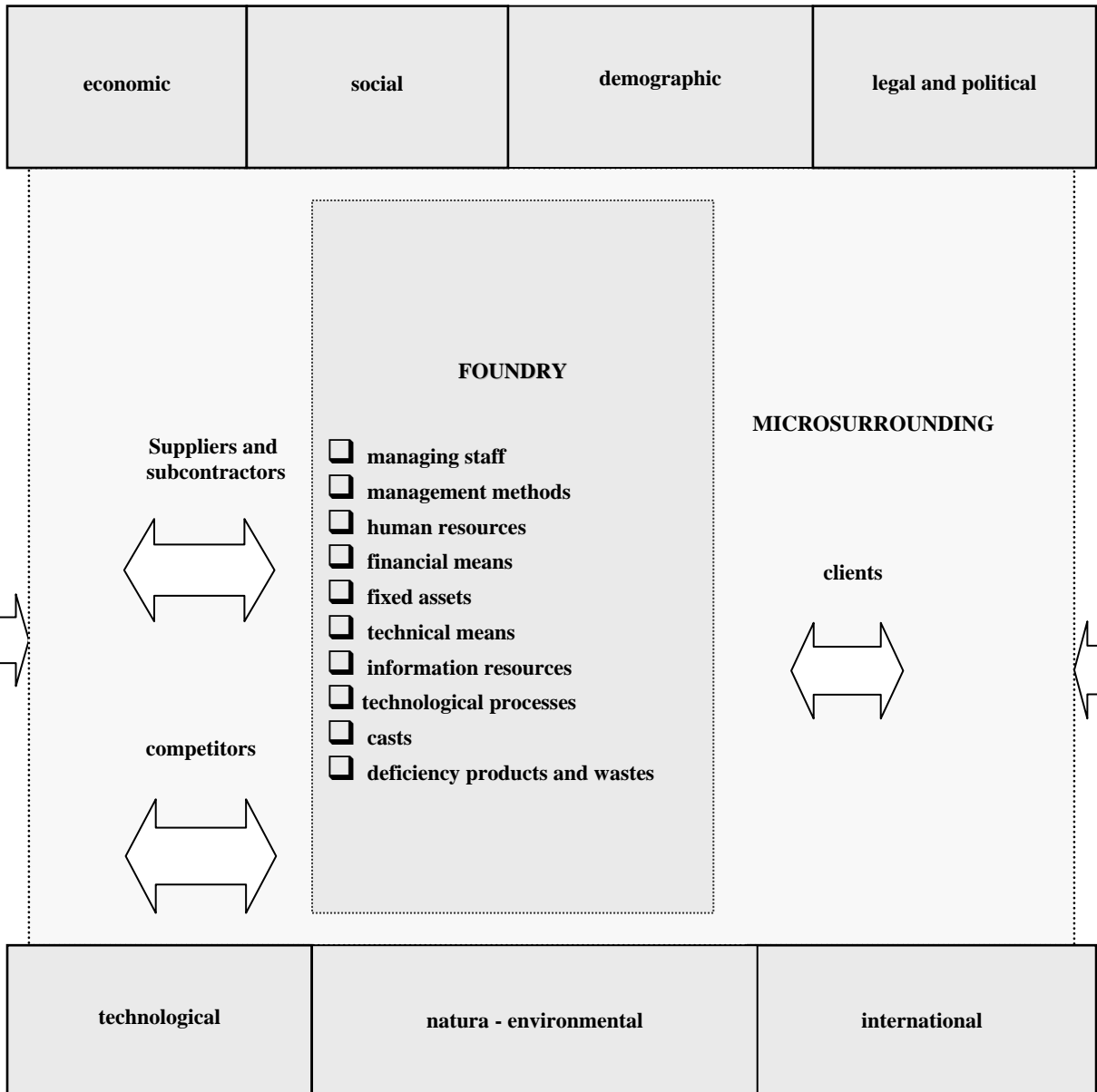


Fig.1. The Foundry's surrounding

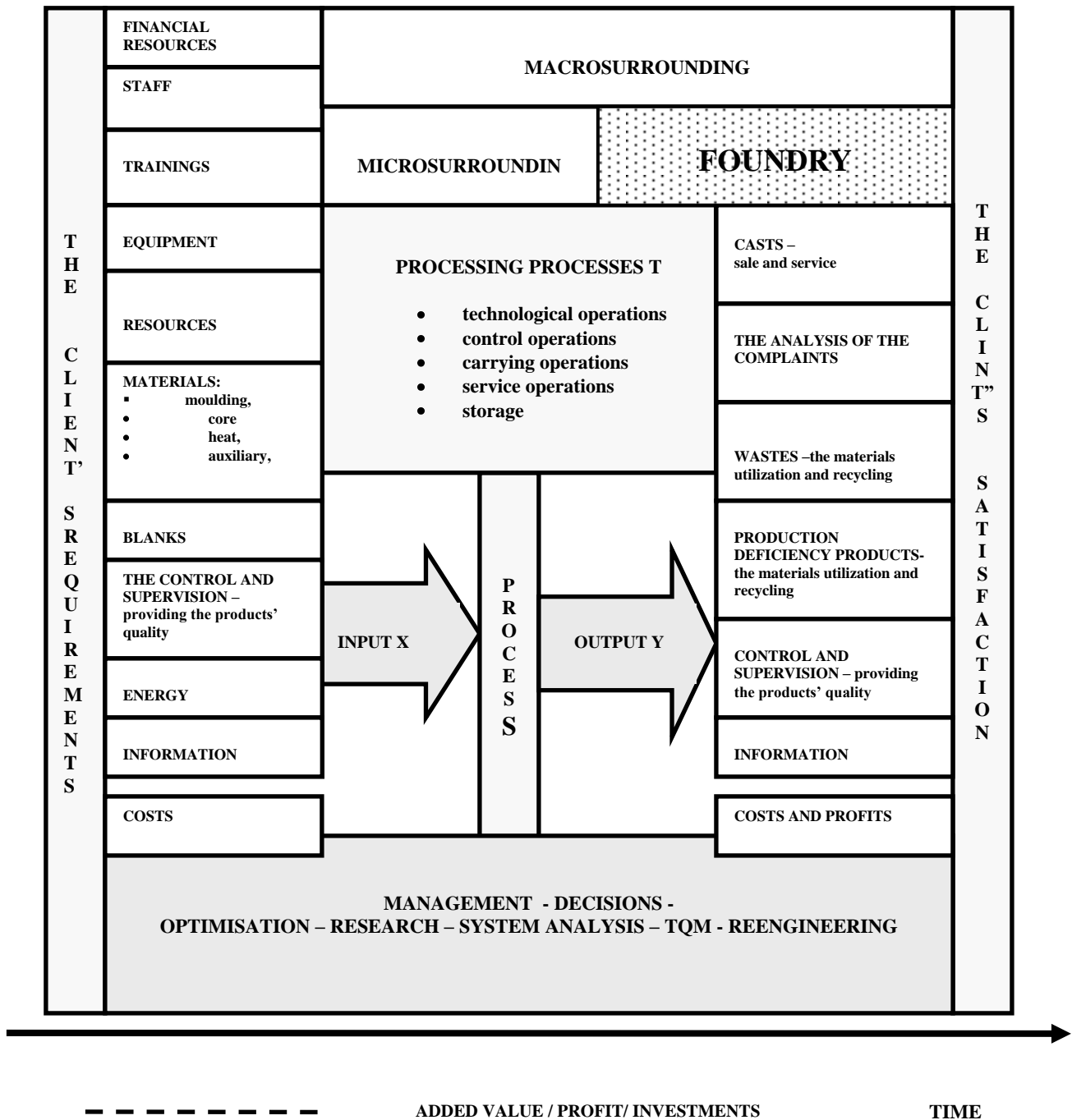


Fig. 2. The model of the foundry's production system [1,2]

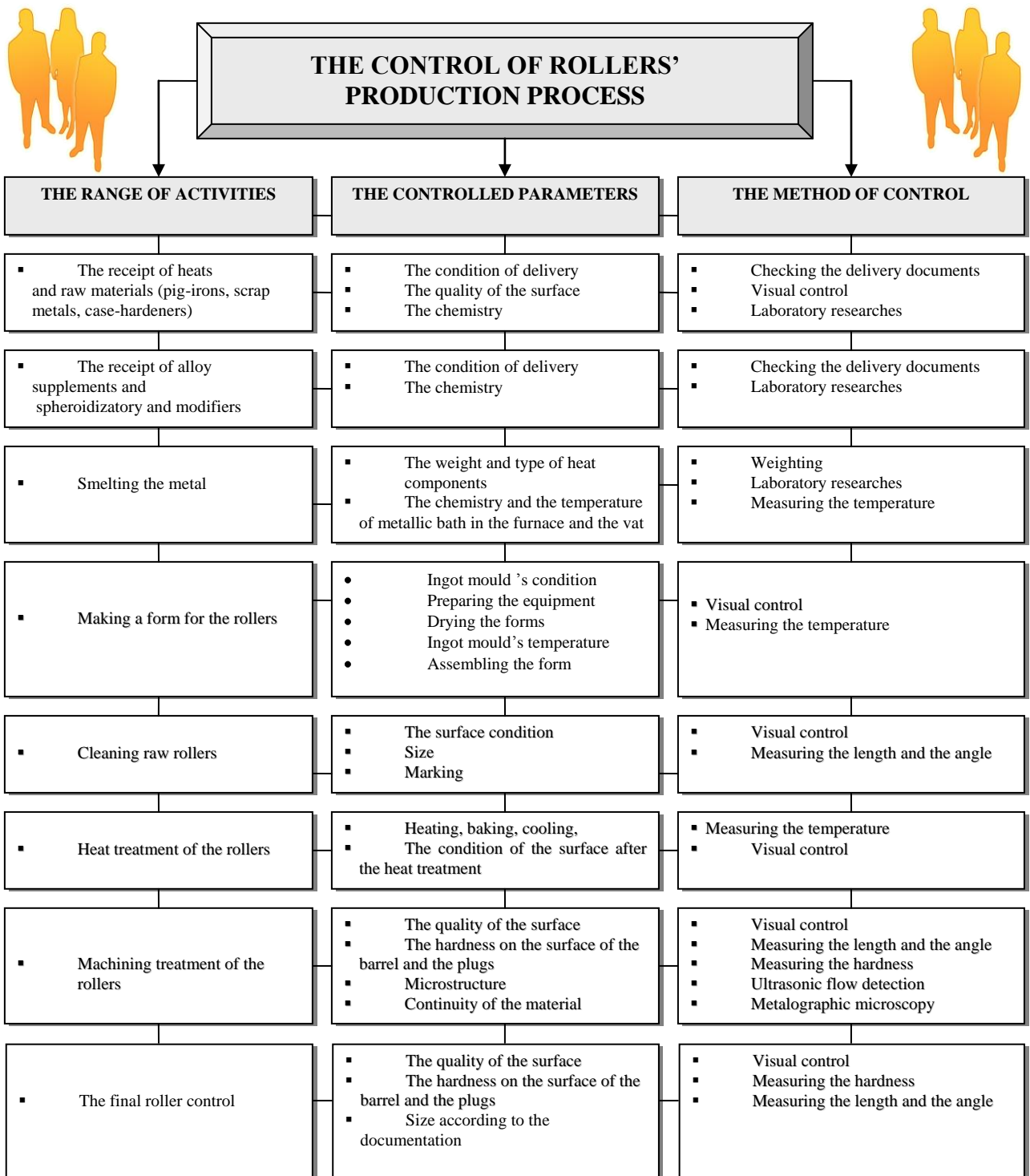


Fig. 3. The cycle of rollers' production control

4. Metallurgical rollers' quality control

Rollers are inspected at all the production stages. The production control process is depicted in the picture 3. It may be adopted also for other castings. Each of the depicted elements, these are 'the activity range', 'the controlled parameters' and 'the method of control' may be particularized by the additional system analysis which conditions the casts of high quality and defines the reasons of defective products. Particularizing the system analysis should lie in drawing up entities for each of presented control process elements.

The roller may be a useful defective product, that is such which may be corrected, processed or reclassified or a final defective product, destined for the scrap. There may be a lot of reasons of rejecting the roller for example breakes on the surface and thoroughly (caused by stress), breach of toughness on the surface what often results from the lack of alloy cast iron layer or too thin layer of alloy cast iron, not proper chemistry and other rare reasons such as short run castings, folds, sand holes , cold shuts.

5. Conclusions

In the work the issue of system analysis in The Foundry was described. The generalized model of The Foundry's production system was presented. Applying the system analysis in the control of metallurgical rollers' quality was indicated. The system analysis makes it possible to write out the particular processes which take place in The Foundry and make them more precise as well as provides the cooperation of The Foundry's Departments thanks to which the reason of defective products is detected instantly.

References

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