INDICATING THE CAST PROCESSES ON THE MAP

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Abstract
Nowadays all aspects of a company functioning, regarding the executed processes as well as all connections between them, should be analyzed to improve the company’s activity. Processes achieved in the cast iron foundry were presented in the article. It has been discovered that indicating processes on the map is an effective tool simplifying the control cast quality, an exemplary map of processes generalized for a whole company as well as a detailed map of the cast form preparation process were presented. Information achieved in the map formation enables: to reach reliable data of production course, to identify places of discrepancy creation, to use the quality management tools and techniques that are helpful to improve the quality of processes and products.

1. Introduction

All enterprises perform a number of complicated actions. As far as small businesses are concerned, and their products are comparatively simple, the production supervising as well as solving all the problems related to the product quality is not difficult. A quantity of factors, that influence the process of a product forming, increases as the processes become more and more complicated. Such factors have varied characters, sometimes they affect the processes simultaneously. Incompatibilities and a dissatisfied customer, and finally – losses appear as a result of an unskilled management. A process description skills, their mutual dynamic influence in creation of final effects, gives a possibility of implementation of an effective control system as well as process steering. The more extended productive system the wider such process description must be. There is necessity of process characterizing in particular units of a cast iron foundry as well as analysis of all possible connections related to information/record/material flow as a co-operation of a customer – supplier chain. A general description of a process is called the process architecture or a map of process connections. Maps of processes can show a whole of production or particular parts of production. A process mapping is comparatively compiled and complex action, it is also a basis of management in a company working in a new system of the ISO 9000{2000 standards.

2. A process mapping

2.1. A process map definition

A main key to transformation and change implementation in companies is a complete understanding of processes [7, s.8]. If we define a process as a group of mutually connected and mutually interdependent actions, which transform inputs into outputs
than the map shows, in the most modest way, which of the actions are related to the process and how such actions are connected with each other. More extended processes may include [1, 2]:

- action performers (e.g. positions or organizational sections),
- mechanisms of their realization (e.g. Used computer systems),
- information necessary to perform the actions (entrance information),
- information that result from the action performance (exit information),
- interprocess connections and refers to other processes.

Mapping means creating of process diagrams, which is necessary to know what exactly is happening now in the company and what is going to happen later in the future. A map of the process creates a model of a certain area or a whole company. A definition, which defines a process mapping as a special recognition and identification of all processes that leads to a process map creation [10].

There are a lot of factors that improve the company and its processes, of which a description and characteristics is helpful in a process mapping. The factors are as follows [3, p.26]:

- management – oriented onto the process improvement, rebuilt not to be oriented onto the functions of particular persons, units or departments, but to be oriented onto the processes,
- record – that enables an exact description of the existing state, based on a simple architecture of the connections between the units,
- analysis – of a correct definition of the challenges needed to a process improvement,
- designing – creating a new system of a process management,
- implementation – implementation of certain solutions that can be useful in the future or oriented onto potential changes,
- management – a company management as well as its organizational processes in aim of a continuous improvement.

Maps of processes serve the better visualization of possible productive and managing action course, they facilitate an insight in varied aspects of the process [7, p.9]. Mapping, as a management tool, has been introduced and originally implemented by General Electric, as a part of an integrated strategy system as well as a part of the best management trainings and a process marking for a decisive improvement “from the bottom” of the organizational structure activity. Idea of the process mapping is based on possibilities of description, related to diagrams and comments of each important stage of production, every assignment and process [4, p.23].

2.2. A process recording

Each process is described by attributes that are part of an identification card of a process. There is a possibility to add some - required for a given process – informations. Technological instructions, procedures of control and examination as well as procedures of the equipment exploitation proclaim the basis of the monitoring and supervising of the suitably settled characteristics of a process or a product. Such documents, included in the company system record, are described, checked and confirmed according to the procedures of the quality management system. Some essential parameters of a production process, related to quality, are registered and recorded and, where it is necessary, reported. Table 1 shows the possible ways of connections between the records and the process.
<table>
<thead>
<tr>
<th>PROCESS</th>
<th>RESPONSIBLE PERSONS/DIVISIONS</th>
<th>CONNECTED DOCUMENTS AND INSTRUCTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>designing and project steering</td>
<td>Trade Unit of the Productive Department (PD), Department of Technology and Quality Assurance, Tool-room</td>
<td>„Shift production plan”, „technological card of the cast” “Monthly report statement” - Production material purchase (a basis of a production process for responsible supervisors)</td>
</tr>
<tr>
<td>metal melting</td>
<td>PO 09.07 Shift production plan”, „technological card of the cast” PO 09.09 „Shift report”. General report matching - „Book of production reports”. „Book of production reports in fettling shop”.</td>
<td>- Preparation of batch and furnace - Cast iron melting, - Cast iron modification - Pouring of moulds - Exploitation of devices used to in pouring temperature measurement - Knocking out of casting - Cast cleaning - Exploitation of cleaning devices - Cast classification</td>
</tr>
<tr>
<td>Pouring moulds</td>
<td>PO 09.10 Shift production plan”; „technological card of the cast” PO 09.04 i 05 „Daily report of quality control”, PO 09.16 „Pw”</td>
<td>- Thermal treatment of cast malleable - Exploitation of furnace and thermal treatment devices - Mechanical treatment - Cast repair - Cast packaging. - Sheet „Foundry production checking”</td>
</tr>
<tr>
<td>Knocking out, cast cleaning and clasifications</td>
<td>Supervisors of every production departments</td>
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<tr>
<td>Thermal and mechanical treatment of castings</td>
<td>Supervisors of every production departments</td>
<td></td>
</tr>
<tr>
<td>Final treatment</td>
<td>Technology Department, Quality Protection Department</td>
<td></td>
</tr>
<tr>
<td>Process transforming and checking</td>
<td>PO 09.16 reports</td>
<td></td>
</tr>
</tbody>
</table>

Source: Own research based on a book of quality of a chosen cast foundry

The classification shown in table 1 also contains of dismissals to the parts of casting procedures (CP), which are directly related to the process. Some other procedures that are recorded in a company records are significant to make the processes be lead properly.

Such composition enables to precisely account all possible production assortments in a chosen day as well as it defines such elements as: amount of a good production, quantity of the casting lacks (taking kinds of incompatibilities into consideration), broken forms, technological diminutions, production in process. An actual production account for a chosen cast product is used in a production plan correction.
3. A process map creation for key processes of the cast iron foundry

There are few stages of the cast iron production. Three main technological processes were chosen as the most important ones. The processes are:
1) production process of casting forms,
2) and a process of a liquid metal receiving – concurrent processes,
3) process of the liquid metal pouring into the form.

A process of the cast form preparation will be considered in the other part of the paper. Outputs of the forming and melting processes are the inputs of the pouring process, it is an element which joins all the results of the previous processes. The first of the mentioned processes should be analysed regarding the materials used in the production process and the parameters that are investigated and kept in a finished casting form. The characteristic of the mass parameters is more essential as far a description of a map of a form creation process is regarded. Technological properties of the moulding mass can be divided into the two groups [8, p. 180-181]:

A – The mass properties while forming
   A1 – plasticity – ability of a shape changing maintaining the continuity of a mass,
   A2 – fluency – a proper fluency allows to reproduce the shape of the model and the core box,
   A3 – stickiness – the lower it is the better the models can be removed and separated from the finished form,
   A4 – brittleness – a form sensibility onto dynamic actions e.g. Stream of liquid metal,
   A5 – apparent thickness – a relation of the mass to the volume (endurance, permeability and phisical properties of the form depend on such thickness).

B – the mass properties that influence the quality of a mass and a cast in a pouring process:
   B1 – thermophisical properties (specific heat $c$, thermal conductivity $\lambda$, temperature level $a$ and accumulation $b$ factor),
   B2 – moisture – (test of the moisture, including the fast tests),
   B3 – resistance – grip, bending, cutting and expansion,
   B4 – penetrability – the larger it is the larger cast mass and the metal temperature while pouring,
   B5 – degassing – the mass susceptibility to a gas emanation resulting from the contact with the liquid metal,
   B6 – susceptibility – too low susceptibility causes cracks of the cast and its tension,
   B7 – dislocation – larger for core mass (it depends on such elements as: the sand composition, kind of a binding material, temperature of the warmed mass, metal and the temperature distribution).

Another essential point in a mapping process is to define the centres that are responsible for execution of particular examination as well as for connection qualification. It is not possible to locate all possible complex connections in a simple diagram, which is presented in figure 1. A different kind of a map record can be used. It is one of the accessible computer tools – e.g. ARIS – Aris Simulation. There is many more application like this. They simplify to reach a great number of connections between the records and the actions related to all processes of the company. When the number of mapping processes (starting from architecture of the process and finishing at the particular processes performed by particular units of a company) exceeds the number of 10-15 processes, mapping without any computer tools seems to be too complicated. For the forming process the mentioned factors and records were collected in one schema, on which the connections between them can be seen. Except for the
connections that are presented below, some interprocess relations, according to the general architectural conception of the cast iron foundry processes, would be presented in a final map

![Diagram](image-url)

Fig. 1. A map created for a forming process.
Source: own research

It is profitable when a company, presenting all the processes that have been identified, groups them, showing basic relations between all processes in the company. Introduction of more detailed relations and actions should be accomplished in the appropriate records, in which relations between actions, persons or records should be specified. In a foundry one should accept the map functioning based on a relation of simple connections and mechanisms, which, co-operating with each other, are enable to fulfil the policy of quality and its aims. A
map presented in figure 1 can appear in a certain company unit as a graphical presentation of responsibility, material flow and records and also as a supplement of general procedures. A detailed analysis of a forming process, which is shown above, is a part of a general architecture of the quality management system. In practice such map would be less extended, concentrating itself on basic actions as well as checking its influence onto realization of the policy of quality in the company. The map presented in figure 1 can be applied in the analysis of relations between the product parameters, records and executed actions.

The basic of process mapping concept of all architecture of casting processes can be summarized by the following key points [4. s.23]:

− understand a process or system by creating a „process map“ that graphically shows things (objects or information) and activities (performed by men or machines). The process map is designed to properly relate both things and activities,
− distinguish what functions a system should perform from how the system built to accomplish those functions. The distinction must be clearly evident in the process map,
− Structure the process map as a hierarchy with major functions at the top and successive process map levels revealing wellbounded details. Each process map should be internally consistent,
− Establish an informal process map review cycle to „proofread“ the developing map and record all decision in writing. This ensures that the process map reflects the best efforts of committed team.

Productive processes appear in the centre of architecture and they are mapped separately, it is related to possibilities of a company and requirements of the quality system. The map of the forming process (fig.1) can serve as an example. The process measurement and analysis
determine the next step after mapping and process visualization. A properly created description of processes simplifies the system investigation as well as it bounds the number of mistakes. The system of measurers is a tool, which diagnoses the whole production, and the quality management effectiveness as well as it prevents cast incompatibility formation. A map itself is also a perfect communication tool of different company areas and responsibility centres. A cast iron foundry maps of processes concentrate on a course of the management and technological processes. They allow identifying and supervising inputs and outputs of the processes. The advanced maps define the responsible persons as well as they simplify a record management in a company.

4. RECAPITULATION

Nowadays companies in the whole world are keen on implementing the minimal requirements related to their systems that mean agreement with the latest world standards. But not many of them wonder how the basic processes, performed by them, mutually depend on each other, react on external factors and how they depend on the system of supply and information flow. What the process map is in fact? It is a certain way of presenting how people do their job. Such map is a graphical presentation of a process, which shows assignments with the use of modified version of standard symbols, flow diagrams and procedures. A map is to present, step by step, a process course together with all possible alternative paths and methods. It was affirmed, that a good map is a basis of a continuous improvement as well as it allows to choose most profitable solutions in conditions of appearing disturbances and the influences of varied factors. It was shown, that:

- there is a strong relation between the process management and an atmosphere of cooperation and engagement,
- there is a strong relation between the process management and the company results,
- the process management makes the internal conflict diminution,
- the process management makes the internal communication growth.

We can use maps to show how work currently gets done or how we want work to be done. We can also use process maps to:

- orient new employees,
- evaluate or establish alternative ways to organize your people to get the work done,
- quickly get up to speed on what your group, team or department provides the rest of the organization and vice versa,
- Identify improvement opportunities,
- Evaluate, establish, or strengthen performance measures.

BIBLIOGRAPHY


