

INDUSTRIAL PROCESS SIMULATION AND OPTIMIZATION

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Abstract — *The topic of this paper deals with problems of simulation processes in the environment of an industrial company. In introduction a method simulation of business processes and software tools are described which support mentioned activities. Next part of the paper describes current business processes and mapping their current data to situations in the area section repairs and maintenance. Further fit carving instrument and suitably selected business processes (from areas repairs and maintenance) are chosen and described by the help of selected model tools in the ARIS Web Designer.*

Index Terms — *industrial processes, process control, simulation, maintenance*

INTRODUCTION

The correct application and functionality of system in a concrete company conditions use to be secured by consistent fulfilment of all periods of customization Enterprise Resource Planning (ERP) system. However the length of ERP system life cycle is not given only by a correct selection of system and its careful customization, but substantially it depends just on concrete company conditions that the system is applied on. Correct formulation of business aims, policy and optimization of intradepartmental processes belongs to the most important from these conditions. The aim of use of information system and information technologies (IS/IT) is not only to automate the current structure and processes, but to create new quality of processes.

System integrators sufficiently worked out processing methodologies of each period of business informative system life cycle. It is not a common practise to these suppliers to fulfil appreciation and optimization of intradepartmental processes before application of their system. This task rests with companies themselves or they can rent an external firm that deals with these problems. In principle it should to find out, what is really happening in the firm, what processes there are under way, pass a judgment on their maintenance ability and effectiveness (costs, time and usage of each sources etc.) and on the basis of effected analyses to suggest some effective methods. Rut and often for ages unchanged work style in firms can lead to the fact that some processes do not suit to current or ingoing conditions existing in the present firm conditions. It is shaping up that something must be changed but how can we do it? It is evident that it is not possible to try different settings of business processes in practice because possible mistakes can have fatal consequence for the firm. It could bring more advantages if these firm processes could be modelled and checked up simultaneously (to accomplish BPM – Business Process Modelling) before implementation of definite changes into processes (BPR – Business Process Reengineering).

The models and simulation are the aids how to investigate some future phenomenon or situations, how to search out the inner rightfulness of real processes of which the direct observation could be unreasonably expensive, risky or even impossible. The simulation is a sort of intellectual imitation or reproduction of real going system by the help of specially designed analogues – models, in which the principles of organization and purpose of this system are reproduced.

Generally speaking, it always fits to approach of modelling and simulation of the processes when company management starts to study these kinds of questions:

- How do the firm processes support the firm's aims?
- Which alternatives are needed and which are unnecessary?
- What parts of processes are the most expensive?
- Where is formed the biggest profit for customer?
- How many sources (workers, tool grinder and sharpener, lines) are needed for achievement of the aims?
- Where are the limiting points (constraints) of the processes?
- How to accelerate respond on the customers' needs?

INDUSTRIAL PROCESSES IN LG. PHILIPS DISPLAYS CZECH REPUBLIC, PLC.

Manufacturing company LG. Philips Displays Czech Republic, Plc. was located in Hranice na Moravě region. It was founded by the join of two firms dealing with the manufacturing of electronic equipment and instruments, LG and

Philips. The company deals with the manufacturing of the TV screens in two production lines, so-called JUMBO line and LARGE line. The scheme of the manufacturing process is represented in Figure 1.

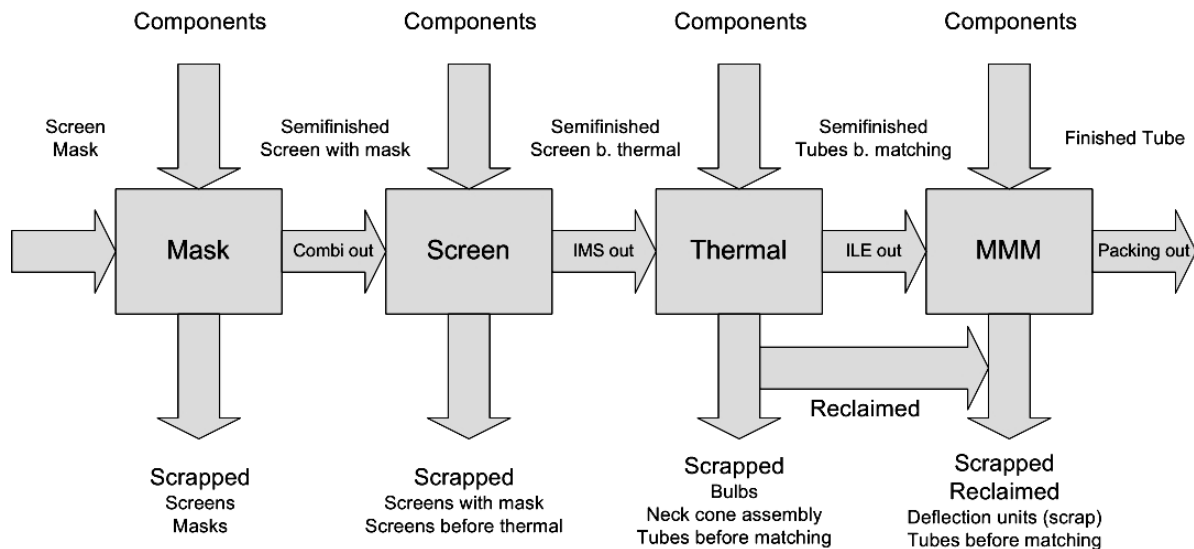


FIGURE 1
INDUSTRIAL PROCESS IN LG. PHILIPS DISPLAYS – JUMBO AND LARGE LINES

Industrial processes

Manufacturing concern uses ERP system for the control of the business processes. For documentation a software Microsoft VISIO is used. Company also derives benefit from so-called ISO Pack which is built on norm ISO 9000 quality control. ISO Pack includes information about all processes in company e.g. production, purchase, sale, logistics, communication with consumers etc. Described processes are divided into the branches, where they are worked out then.

Process of manufacturing consists of these periods:

1. First the process *Mask* is done where the screen masks are hung on the conveyor (the front screens are made from glass). The mask is cleaned and prepared for the next process.
2. In process *Screen* the parts so-called Screen are put in, these are parts from the metal, consists from three parts, in which there are three openings for imagery points of colours. In construction of each part the layer of phosphorus is laid, the washing follows and then the next montage of *Screen* is done, next the shade is added. This part of industrial process needs a very pure environment.
3. The third process is called *Thermal* process, there are front and back parts of screen put together due to a special silicic adhesive and high temperature in the furnace.
4. Process *MMM* consist of three parts:
 - Measuring - where are measured screen parameters and the quality of the screen is evaluated.
 - Matching - in this process deflecting coil and electron-beam gun are placed.
 - Magnetization - the gunray electron ordnance is magnetized and set.
5. In the last process the side of screen is painted and the control is made, if the front side of the screen is not scrapped. If not, it is polished again and the finished product is dispatched to process of logistics. If the screen is defective, it is sent to the Reclaim Process where the stage of the fault is evaluated and the screen is taken apart. It goes into washing, cleaning and then it goes back into the manufacturing process again.

The present situation in Repair and maintenance section

The present situation in area of company processes on the repair and maintenance section are divided according to this structure:

- JUMBO line: Mask – Screen – Thermal – MMM,
- LARGE line: Mask – Screen – Thermal – MMM,
- RECLAIM a CHEMPREP: Reclaim and Chemprep are manufacturing sections which are corporated for the JUMBO and LARGE, their activities are not reliant on the concrete manufacturing line. The reclaim processes reject production from the all lines and tries maximally to recycle the used components and take them back to the manufacturing. Chmprep goes about the preparation of chemicals (e.g. phosphorus) for all these products and manufacturing lines.

In each section another system of maintenance and reparation is innovated. Different kinds of managing and documentation forms are used, e.g. written documentation or programmes such as Excel, Lotus and Access. That is why the company LG. Philips Displays Czech Republic, Plc. decided to unite all these systems into one. The System SAP R/3 is used for this purpose.

Repair and maintenance system is divided into:

1. **Working maintenance (solving of disorders on the spot).** It refers to unplanned, upkeep tool grinder and sharpener that the machine fault or his arrangement caused. Mostly it is concerned on exchange of the crank arrangement, correction of the arrangement on the spot (constriction of definite unstrung parts of the machine) and so on.
2. **Planned maintenance (regular yearly dead plate).** The planned maintenance defines, which work will be done, on which equipment it will be accomplished and how often it will be repeated and what rules of the repetition will be used. In the system these rules can be combine together:
 - Repeated maintenance – the work will repeat always after a period of engaged time interval. It is used for planning of the checking, regular work on equipment, especially with usage recipes producer, plans skill and so on.
 - Seasonal maintenance – the work is done every year in given date. This way it is possible to plan line work on chosen group of arrangement.
 - Maintenance after abrasion – the work is done after over-fulfilment of a limit, given for tracked period of the abrasion (mileage, number of working cycle...). The abrasion is secured by the inspection, for work accomplishment the attrition is counted from zero.
3. **Preventive maintenance (following critical values, delete plan and so on).** Preventive maintenance is done partly according to the given maintenance programmes and partly on the basis of plotting diagnostic signals (in the event of using of diagnosticians at maintenance). E.g. maintenance and cleaning tool grinder and sharpener, small corrections, cleaning of filters and traps impurities and so on.

THE STRUCTURE OF A MAINTENANCE AND REPARATION PROCESS

Requirements for texture creation

First we need to create a structure and according to this structure the maintenance will work. In principle it is a flowchart, the next step is to obtain as much as possible information about technical places in detail sections JUMBO and LARGE, that means to equip these technical places. It was important to definite how to treat with technical places and their equipment. E.g. technical place we can not to replace somewhere else, than where they are just located. Compared to that technical equipment of places is possible to move also on other technical locations, but it has its rules too. Communication with people, who work in maintenance section, is also very important. Problems „how to assign reports to the system SAP as much as effectively and simply“ are solved with them, and also „how to work with these reports next“. Also it was necessary to train and explain them the way of operating in system SAP R/3. During this the data about technical places and mainly about their equipments are pasted.

Requirements for maintenance management:

- display a technical reality - equipment, piece of list of spare parts,
- reports,
- work processes,
- maintenance plan,
- commissions,
- statistical processing,
- integration of IS into the company.

Structure and kinds of maintenance

Maintenance and reparation of technical system includes these proceedings:

- inspection - inquest of the real state,
- maintenance - preservation of the requisite state,
- reparation - restoration of the requisite state.

Organization of maintenance pursues also the next technical maintenances that do not line in maintenances indeed, but they should be done in centralized maintenance system – by scheduling and realization of commissions:

- new construction or reconstruction of equipment,
- cleaning,
- inspection,

- tool - making and preparations,
- aid in production and so on.

Hierarchical structure of division production has this form: Technical place – equipment – constructional unit – spare part.

Maintenance and reparation policy

The maintenance and reparation policy includes these three areas:

1. **Root data** – this area includes data which stay in system longer time and it creates the processing mainstay of each company processes.
2. **Planning** – it includes maintenance report which forms maintenance before order transaction and further maintenance plans in terms of planned maintenance.
3. **Order transaction** – amounts to function of scheduling and order transaction like e.g. scheduling of materials, capacities, requirements for material and achievements order, as well as following loads.

Organization structure of repairs and maintenance

Planners are defined like planning groups of maintenance in terms of company maintenance planning. Units of capacity for maintenance are administrated like workplace in the maintenance and reparation. The maintenance workplaces are mostly assigned to the company which plans maintenance but it is also possible to use maintenance and reparation proceeding from other workplace maintenance. For description of fitting company process was diagram PM (Plan Maintenance) chosen. This diagram shows report establishment and progress of maintenance function.

A MODEL OF THE REPORT PROCESS IN FAULT

The Tool ARIS Toolset is used for the modelling of report process in fault. Company policy of LG. Philips Display Company, Plc. does not allow a direct check (intervention) into SAP system from the outside. That is why this model projected in ARIS is used as a pattern for the customization (setting and adaptation) of PM module (plant maintenance) directing SAP system. As a matter of fact the preset modulus PM acclimatized to the given requirements and conditions of the company according to the given model.

Figure 2 shows, how the maintenance and reparation system is solved. We can see, how the spare parts run to each operation (Mask Screen, Thermal, MMM, Chemprep and Reclaim).

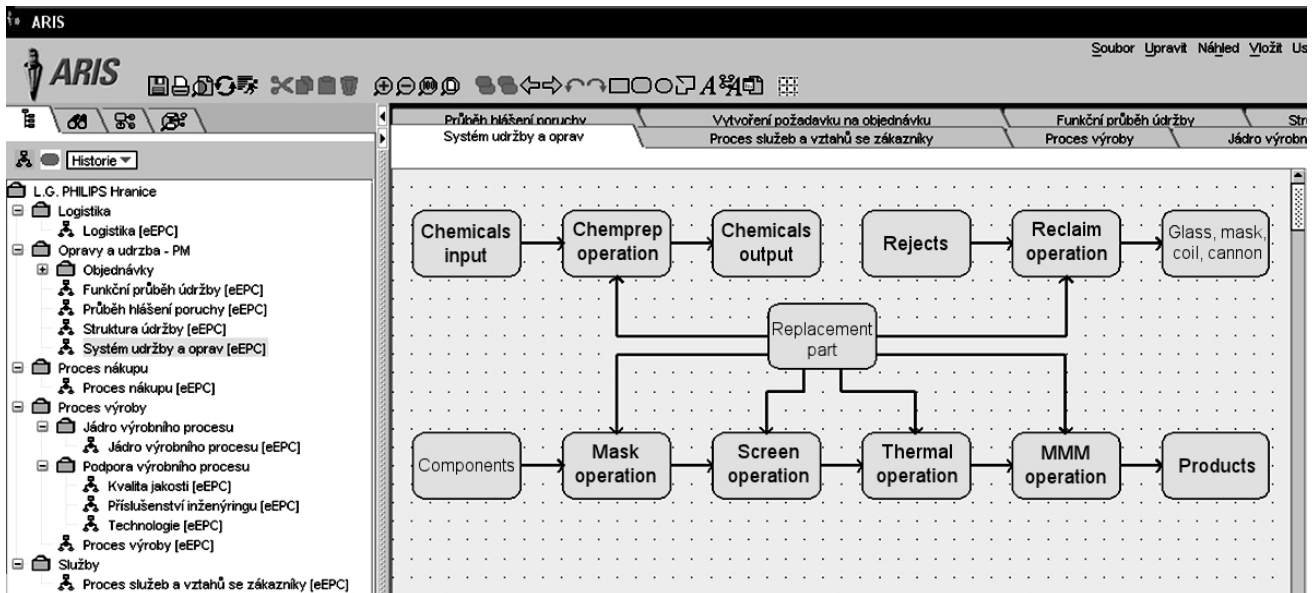


FIGURE 2
REPAIRS AND MAINTENANCE SYSTEM

Figure 3 shows Requirements for order process creating.

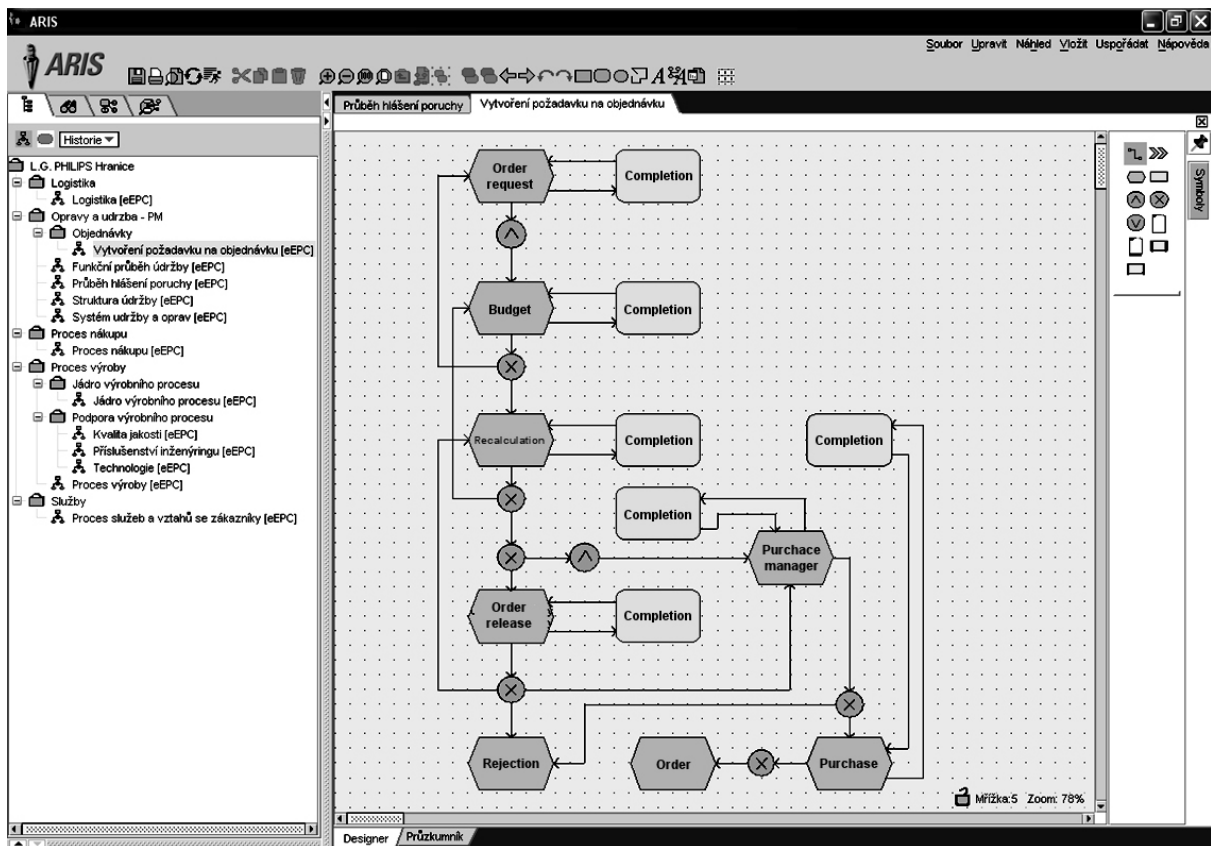


FIGURE 3
CREATING OF REQUIREMENTS FOR ORDER

CONCLUSION

In this contribution requirements and needs are described which are needed for development of business mock-up maintenance on the reparation and maintenance section. A suitable modelling tool was chosen – it is a product ARIS Toolset, which was produced by the IDS Scheer Company. The next part includes a model of the process of default report, for which the existing company process was used and the model in the reparation and maintenance section. This model was used for the customization of modulus PM in SAP in LG. Philips Displays Company, Plc. The model was created on the ARIS Web Designer server; it has a different graphic interface, than ARIS Toolset. Anyway, the functions are the same for the both products.

For the evaluation of expense and planning of the maintenance in the company it is useful to use analysis and reports, which we can obtain from the company information system SAP in schedule form. The schedule could be compiled by e.g. export in MS Excel, where we can form generate different kinds of diagrams. From these diagrams and charts it is possible to evaluate the state of expenses (cost analyses on several technical places, analysis according to the kind of the order), productivity, maintenance scheduling and so on. In this way it is possible to follow the economy of simulated processes and subsequently to do hits to their textures (their optimization).

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