DEFINITION OF THE REQUIREMENTS IN ORDER TO ACHIEVE SUSTAINABLE PRODUCTION

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Abstract
The article deals with definition of the requirements in order to achieve sustainable production in manufacturing enterprises, which are essential to enhancement of efficiency, productivity and profitability in future industrial processes. Within the development of sustainable production, it is necessary to pay particular attention of reducing energy consumption in manufacturing processes and increasing the energy efficiency of production systems. The modern techniques are designed to radically improve profitability, customer satisfaction, throughput time and environmental responsibility.
Keywords: Advanced industrial engineering, development trends, manufacturing enterprise, intelligent agent, autonomous control, energy efficient manufacturing, sustainable development, reconfigurable manufacturing.

1.1 INTRODUCTION
For nowadays production organizations it is not enough just to do things more effective. They must be unique in something. The advantage and higher chance for success could be achieved by substantial competitive advantage through innovations. Advanced industrial engineering must be able to use the opportunities of information technology and scientific methods of industrial engineering. Currently, enterprises are unable to adapt to rapidly changing market and to increasing demand requirements, therefore we focused on clarifying the possibilities for further development of today's modern techniques to achieve sustainable production.

1.2 EVOLUTION OF MANUFACTURING SYSTEMS
The design of a system paradigm relies on the customer requirements and the complexity of manufacturing environment. System complexity depends on the number of design variables and their dynamic behaviour with respect to time. Manufacturing systems have to be evolved to meet emerging needs either from the customers or from the manufacturing environment. As summarized in figure 1, the scope of customers’ requirements on products has been gradually expanded.

The earlier markets, before 1913, were short of products and customers cared only about the product’s functions. Companies aimed at cost reduction to gain more profit. Since 1960, global manufacturing capabilities became sufficient enough to introduce competition among suppliers. Customers were able to demand more than basic product functions. Therefore, how to improve product quality became the key strategy of success from the 1960s to the 1970s.

With an abrupt advancement of information technology (IT) from 1980, global manufacturing markets were gradually saturated, companies were then pressured to manufacture new products at a faster pace to catch earlier marketing opportunities. Today, people are very conscious to the deterioration of the global environment and the predictable shortage of natural resources in near future. Manufacturing companies are forced to change their system paradigms to accommodate the new needs of sustainability (Coliseum, 2011).

1.3 REQUIREMENTS OF SUSTAINABLE PRODUCTION
Traditional manufacturing systems do not take into account many aspects: waste management, pollution, restoration and the reuse of used processes in production. Enterprises may on basis of environmental impact optimize the overall structure of control tasks, or expend cost of solving economic problems related to waste. Therefore, for the manufacturing systems is necessary to let them know autonomously react on a given topic.

Enterprises can strengthen its competitive advantage in sustainable manufacturing by the adoption of new, alternative materials that allow the conservation of resources. Closely related to resource conservation is recycling of materials. In some cases recycling processes themselves face both environmental and economic challenges. Recyclability might be better incorporated into product design, to make disassembly of products at the end of their lifecycle easier. More easily recyclable and reusable materials could also be used. Improved process design and more efficient process technology may also contribute to improved resource efficiency. The requirements of sustainable manufacturing are shown in figure 2.
The current performance of the manufacturing systems determines a clear definition of system boundaries (Geyer, 2010). The current systems are developed in accordance with cost metric, quality, personalization and time. Requirements for sustainability are considerably influencing behaviour of manufacturing systems and therefore it is necessary to consider the current performance deficiencies of existing systems (Vyatkin, 2011), (Su, 2007). The newest development paradigm in field of adaptation to production requirements are reconfigurable manufacturing and assembly systems (RMS and RAS). From the perspective of sustainability, the relevant objectives of RMS are:

- to reduce the wastes through the reuse of manufacturing resources,
- to reduce energy cost through the optimization of manufacturing processes and system reconfiguration.

Numerous researches have been published on design and control reconfigurable systems to achieve these two objectives (Coliseum, 2011), (Botti, 2008).

Physical reconfiguration is oriented on the rules of machines setting while logical reconfiguration creates agents rules on base of the obtained knowledge for validation, planning and launching a new machines settings through software. The lowest level of reconfiguration can be particular achieved by changing of hardware resources and the highest level through changes in software modules or by choosing alternatives methods.

1.4 ENERGY EFFICIENCY AS SUCCESSFUL WEAPON AGAINST ADVERSE IMPACTS OF MANUFACTURING ENVIRONMENT

There are many areas and opportunities to reduce energy costs and pollution emissions within a manufacturing facility. One way to achieve an energy efficient manufacturing system is to measure and evaluate the combined impact of process energy from manufacturing operations, their resources, and facility energy from building services e.g., ventilation, lighting (Rahimifard, 2010).

The issue of fostering energy-efficient manufacturing gains more and more importance due to global mega trends like global warming, climate change and scarcity of resources. Furthermore industrial drivers constituted by rising and volatile energy prices, ever-stricter becoming legislations and increased customer awareness rise the attention to the research field (Rakyta, 2005), (Bubeník, 2005). Holistic approaches to design and operate modern green production systems are required to cope with those challenges adequately (Mavrikios, 2008). Requirements for energy efficiency of manufacturing systems are shown in figure 4.

1.5 SEQUENCE OF ENERGY PERFORMANCE COST REDUCTION

Basis for determining potential energy savings are energy audits which are also an important tool to assess the potential savings in the company. They should be a prerequisite for implementing energy saving measures. Energy efficiency law established duty to regular evaluates energy demand service in the industry (Rakyta, 2002), (Machiba, 2009). That requires action plan of energy efficiency and sequence of energy performance cost reduction.

Potential to improve the energy efficiency of industrial technologies in particular at the field of electric motors, pumps, fans and heating systems, implementation of energy management, but also more efficient light sources, which consume up to 30% of the energy in industry. The output and benefit of mentioned method are:
• agreement adjustment for the purchase of energy carriers,
• compliance with the terms of energy consumption,
• monitoring and reporting of real consumptions depending on the production and on the basis of their interventions to operation,
• automatic control of energy consumption.

1.6 CONCLUSION
The development and deployment of new energy technologies is essential for security of supply, sustainability and competitiveness of industrial sector. Energy related research has contributed strongly to energy efficiency (e.g. in car engines) and to energy diversity through renewable energy sources. Magnitude of the challenges that lie ahead, however, requires extra effort. Long-term commitment is necessary. Sustainable manufacturing as the philosophy of eliminating waste within a process, looking to isolate the value added activities and place them in a form of continuous flow energy consumption to better meet customer demand.

1.7 REFERENCES


Figure 1. Evolution Of Manufacturing Systems

Figure 2. Requirements Of Sustainable Manufacturing
Figure 3. Reconfiguration Levels And Requirements In RMS

Figure 4. Requirements For Energy Efficiency Of Manufacturing Systems