FUNCTIONAL AREAS AND ARCHITECTURAL FRAMEWORK FOR THE MANAGEMENT OF THE ELECTRON BEAM WELDING INSTALATION

Assistant eng. Dzharov V.[1], Assoc. Prof. Eng. Koleva E. [1,2]
Institute of Electronics – BAS[1]
University of Chemical Technology and Metallurgy – Sofia, Bulgaria[2]

djaki_6@gbg.bg, eligeorg@abv.bg

Abstract: *Management is the process of processing the information aiming decision making to resolve problem or to achieve the target. High advanced automated processes, including the vacuum system with pump and pressure control, management of the cooling system, management of the manipulator, high voltage control and emission current, the control of the electron beam movement and its characteristics, as well as computer-based automatic control of the beam power distribution, must be integrated on the basis of the use of systems for operational management of production. The present work presents the hierarchical structure and architectural framework for the management of an installation for electron beam welding, evaporation and surface modification.*

Keywords: AUTOMATIC CONTROL, INFORMATION, HIERARCHICAL STRUCTURE, ARCHITECTURAL FRAMEWORK, CONCEPTUAL MODEL

1. Introduction

Management is a process of processing the information to make a decision in order to solve a problem or to achieve the target. Information systems are intellectual means of reducing the risk of decision making in the management of a selected real process.

For the modeling of objects and processes in the software industry, a standardized approach should be used to ensure the integrity and expediency of the models used. Standards provide a formal model for data exchange between business systems and manufacturing systems. The models define the management of production operations, the activities of an enterprise that take production schedules and perform the actual work required to produce products and ensure production visibility [1].

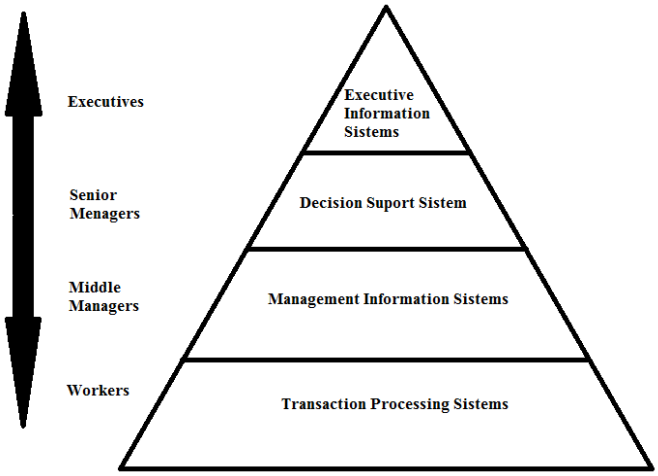

Fig.1. *Basic groups of information systems*

According to the hierarchical level of management and the used information technologies, the following main groups of information systems are differentiated (Fig.1):

- systems that automate office operations and collaborative work - serve all levels of government and ensure the integration of newly acquired knowledge in business;
- systems handling transactions (TPS – Transaction Processing Systems) – serve the operational management level;
- management information systems (Management Information Systems)– serve the tactical level of management;
- systems, decision support (Decision Support Systems) – serve the tactical level of management;
- systems supporting the Executive Director (Executive Support Systems)- serve the strategic level of management.

2. Models, hierarchical structure and conceptual ontology meta model of EBW

The hierarchical structure according to IEC62264-3 standard, which divides production into different stages of its management. The standard defines the activities that occur in the management of production operations [1].

The choice of a model for designing and developing the specific system or functionality is subjective, each company has to find or build its own approach (method) in developing their projects, while trying to exploit the strengths and abilities of each member of the company [2].

Storage modules can be dedicated to a particular material, group of materials or storage.

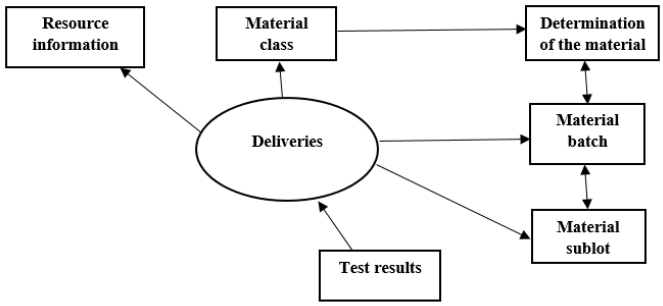

Fig. 2. *Model Deliveries*

For the Model Deliveries (Fig. 2) the methods for inserting a new record, editing an existing record, adding a record as a line to another object, for changing an existing row in another object. The methods for adding and editing lines in another object can be used for objects in the classes "Resource Information" and "Material Definition". The same methods have been implemented for class objects "Batch of Materials". The methods implemented in the "Batch Materials" and "Subtotal Materials" classes respectively are to create a new record, edit an existing record, and delete a record.

The conceptual model (Fig.3) is a recommended model representing a set of things (artifacts) through a set of concepts, the relationships between them and constraints on the assumption of a "closed environment". Highly sophisticated automated processes, including the vacuum system with pump and pressure control, management of the cooling system, management of the manipulator, high voltage control and emission current, the control of the electron beam movement and its characteristics, as well as computer-based automatic control of the beam power distribution, must be integrated

on the basis of the use of systems for operational management of production.

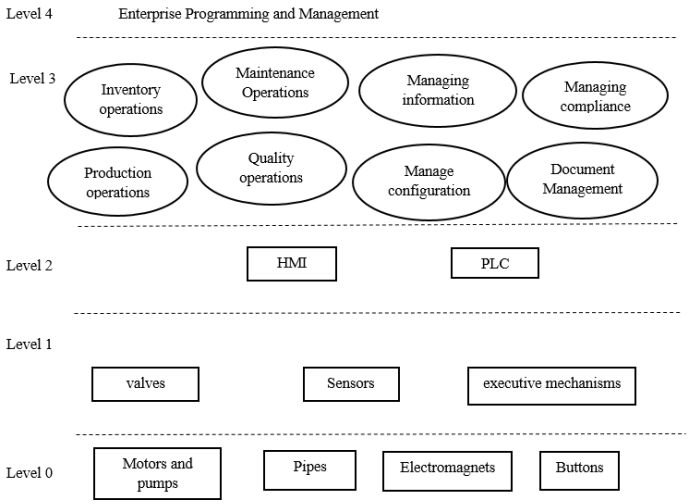

Fig. 3. *Conceptual model*

In Fig. 3 conceptual model for electron beam welding plant is presented:

Level 0 - Production - at this level are included all field execution devices that serve to directly collect information and manage the processes of starting and stopping available pumps, cranes and valves.

Levels 1-2 - Production Control and Automation - at these levels control and visibility of the process takes place;

- Level 1 receives sensor data, which also serves as a feedback for the vacuum pressure obtained in the vacuum chamber.

- To Level 2 is connected PLC and HMI, which serve as a connection between management and executive devices and for direct management and process change.

Level 3 - Management of production - the maintenance of production information is centralized to provide greater control and availability of records. The conceptual model is a recommended model representing a set of things (artifacts) through a set of concepts, links between them, and constraints on the assumption of a "closed environment". The highly sophisticated automated processes, including the vacuum system with pump and pressure management, cooling system control, handler control, high voltage and emission control, electronic beam movement control and its features, as well as computer based automatic distribution control of the power of the beam must be integrated based on the use of systems for operational management of production. Level 3 is being implemented:

- Inventory operations.

- manufacturing operations;

- maintenance operations;

- quality operations;

- information management;

- configuration management;

- compliance management;

- document management.

Level 4 - Enterprise Programming and Management – includes designing, deploying, controlling, analyzing, and optimizing, combining management methods and IT tools techniques.

The conceptual ontological meta-model is a description of a number of objects and concepts, knowledge about them and links between them, and ontology is called the explicit specification of conceptualization and consists of terms organized in taxonomy, their definitions and attributes, as well as the related their axioms and rules of inference. Concept means categorization. Object-independent ontologies containing top-level categories (concepts) such as space, time, object, event, action, quantity, measure [3,4]. It can be represented by an architectural frame (Fig. 4).

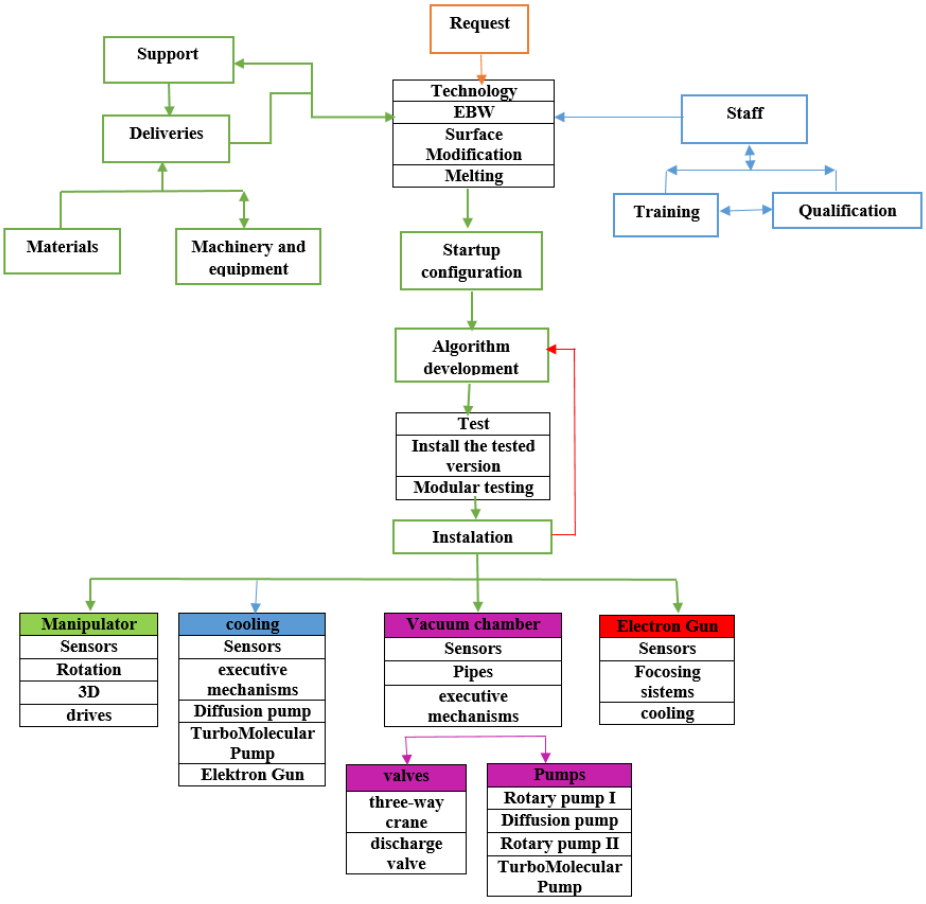

Fig. 4. *Architectural framework Installation for Electron Beam Welding*

Fig. 4 presents the electron beam welding installation's algorithm with the interconnections between the different models. The technology may be included depending on the request (EBW, Surface Modification, Melting). From the Deliveries model the required materials are obtained. The Personnel model is implemented to identify and select the required qualified staff. A record of the staff working hours can be made and the algorithm is followed to work on request.

3. Conclusion

In the present work is presented an integrated system for management of the electron beam welding process based on a conceptual system, including other additional processes: surface modification, electron beam evaporation, melting and electron beam diagnostics. The main objective is to integrate and organize the knowledge of the process and to present the possibilities for improvement, modeling and control of the technological processes in the installations for the electron beam processes.

Acknowledgements

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References

[1]. ISO 62264-3 Enterprise - Control System Integration Part 3: Activity Models of Manufacturing Operations Management;
[2]. маг. инж. Пламен Василев, „Съвременни подходи в системите за оперативно управление“, докторска дисертация, ХТМУ, София, 2016 г.
[3]. http://www.et.tu-dresden.de;
[4]. Dennis Brandl, Peter Owen, „Manufacturing Operations Management“, , BR&L Consulting, Eli Lilly & Co, University of CAMBRIDGE,
[5]. L. Koleva, E. Koleva, I. Batchkova and G. Mladenov. Integrated control system for electron beam processes. VIET 25 − 29 September 2017, Sozopol, Bulgaria, 2017.