SPECIFICATION OF CONSTRUCTION AND DEVELOPMENT OF RECONFIGURABLE MACHINE SYSTEM

Štefan VALENČÍK

Author: ***Štefan Valenčík, Assoc. Prof., PhD.***
Workplace: ***Technical University of Kosice, Faculty of Mechanical Engineering, Department of Production Systems and Robotics***
Address: ***Boženy Němcovej 32, 041 87 Košice, Slovakia***
Phone: ***+421 55 602 3238***
E-mail: ***stefan.valencik@ tuke.sk***

Abstract

The paper presents the base of knowledge from the field of architecture and development of reconfigurable machine system of producing and operating technique, including their formation to specific machine system in the accordance with strategy of development. The core of paper makes new approaches solutions, which results in the technical new conceptions of automatic structures, which are able to work in specific place.

Key words

producing technique, operating technique, dynamic module, integrated kinematics

Introduction

Development and application machine system (production and operating technology) opens new themes, what brings advanced technical and economic effects. Determining factor on development machine system are demands of technological process, specialization level their manufacture and unceasing stress on the cost reduction and beating up ratios between loads and utility value. This is the answer to orientation producers on innovation change policy's and rescheduling firms' programs regarding marketer adaptability, effectiveness production and service activity.

In the sphere of productions and application machine system, the innovation direct to motional module, control and creation integrated configuration with its utilization in wide - spectrum technical difficult operation with visual system and position system. It raises the share of such technology into final and service activities.

Main solution

Trend

Current trends oriented on development and exploitation capital asset are ahead into the bargain, that is needed to search solution with new and high effect. This solution are mostly coupled with effort about complex, concentrated solution function in the frame of assembly machine, devices and the system with propagator function building modulated and its integrated stays (assembly). Their applying allows develop new conception machine and furnished with sufficient process parameters, with high effectiveness, low weight, with bigger

control range and high process reliability. Contribute to some growth concentrated productions, combination several methods, raisings performance parameters, simplification textures technological place of work and primarily to filling claim to custom prepared mechanical systems with custom limited technical and economical parameters.

Intention of integration and reconfiguration of machine system should be considered as e.g. „ increase in modality machine of the chain and entire concatenation features and activities". Application logistic structure and development lets high variability applications this techniques thereby, that being downloadable technological professions and maybe lightly arrange and by the change lightly re-arrange. Deepening the integration of logistics and associated production technology helps manufacturers to shift production of fulfilling the requirements of the market. It is desired mainly in the production phase focusing on the integration of product design with respect to the requirement for greater adaptability and agility, and the orientation of industrial experience in an innovative change in corporate restructuring and strategy systems.

Goals

The objectives of integration and reconfiguration of the machine rather than specific objectives (e.g. increased locomotion modalities module or possibly a reference interconnection module). Objectives must be clear and specific, realistic and stimulating at the same time, internally consistent and quantifiable as possible so as to comply with the mission and objectives of integration of material flow. The material is considered to be achieved in a transparent manner. The aims and objectives may not always comply with the technical and implementation options that sometimes contradict each other and thus produce pressures on resources and review how the system works machine. Therefore, the mission profile and the integration of machine reconfiguration scheme should be based on the logic structure constituting of estimated potential agents of development and action potential production companies, such as:

- developments in the field, advanced technological methods and structures, our compatibility and European legislation,
- specific needs, the company seeks to provide, in accordance with the needs of industry practice for innovative change strategies and corporate restructuring schemes, respecting market adaptability, production efficiency, competitiveness and raising the level of service provided,
- way in which the needs will be provided, modalities machine chain, intermodal hubs using the tool and a subject node.

Analysis of potential aims not only to obtain adequate answers to the questions above, but is intended to reflect the strategic measures to develop an integrated and reconfigurable technology. This achieves consistency in the process of developing and maintaining a strategic relationship between the goals, state of the art-production and application status.

Methodology-procedure

The starting solution is the analysis of stimuli showing the need for greater synergy of elements, nodes and complete and wider application of mechatronics principles. Linked to this is to identify characteristics that affect the composition of the machinery of the system and its impact on the achievement of the objectives of application. The result is a logic machine patterns between the system and the area of application in the form of the model. The model represents a starting base profiling machine systems, which represents our logistics development. The aim is to develop logistics ongoing, linked sequences of individual

machine modules (reference, connection, motion), as well as construction machinery reconfiguration availability defined systems and performance parameters.

Based on the above methods and to develop modular analysis of individual machine modules comprising reconfigurable machine system, a case may vary. To improve the user properties are used to address kinematics structure of anomalous elements and their mutual relations, thus creating space for new concepts of plant and equipment of modular organization. Furthermore, the specificities of these concepts mean that they can change the spectrum of tasks, again spread over different modules and used to address new challenges. Moreover, can integrate additional features, e.g.: adding motion to change individual modules and operating system machine work opportunities. Combining machine modules can generate complete machine systems ready for use according to user specification.

Specification of construction

Efforts to complete work on a single machine leads to the development and use of new structures for technology and handling systems and also raises the need for new concepts of elements and nodes in them applicable and machine accessories. The machine system of this handicap can be partially eliminated solutions concentrative functions and activities into one location by reducing changes position and orientation. Make changes to reduce the position and orientation in the machine system is possible only on the development of movement possibilities, i.e. development components (drives, transformation and interaction elements), modules (moving and working mechanisms) and integrated assemblies (handling, production and support equipment).

Identification of the elements, modules and links machine system

The entire board of the work concentrated on production and assembly is based on the relative relationship between the working tool and work object. The basis for the realization relationship is system architecture for machine-Fig.1, which comprises a set of active and passive modules linked to the base structure of the machine [5].

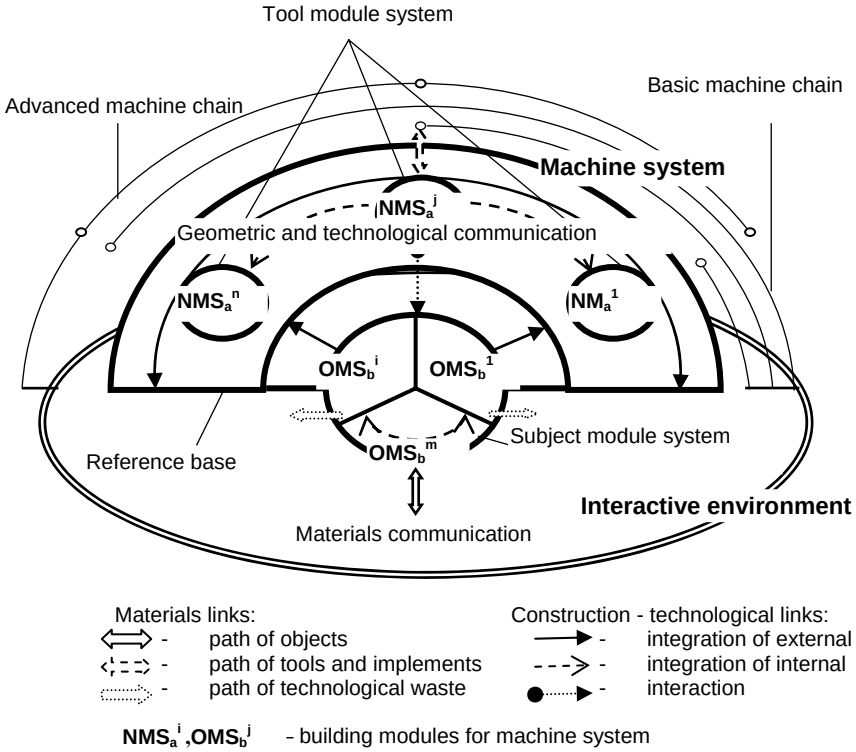


Fig. 1. *The integrated model system for machine*

Its technical appearance is based on mechanical systems implementing the transmission of movements and forces, with the ultimate effect of location and clamping (object, instrument), keeping the working member (tool) for the direct or transposed implementation of manufacturing operations, changes in position (location, location, orientation) course in during manufacturing operations, and addressing the subject, respectively exchange facility for other manufacturing operations. Model presented in Fig. 3. is built on the idea modularity, and its essence is the variability in the way of grouping the construction of modules into a basic or advanced machinery chain to the reference base for the implementation of the requirements of manufacturing operations. Thus the concept of providing set of learned functions and activities, either differentially within individual working parts (tooling, subject) or concentrated machine system through an integrated structure.

The strategy of integration and reconfiguration of machine system

In the development of machine system with integrated and reconfigurations effects are based on the requirements of applied fields and the technical capabilities of the components that are abstracted into a model-Fig.2. From this could clarify the influencing factors and functional ties.

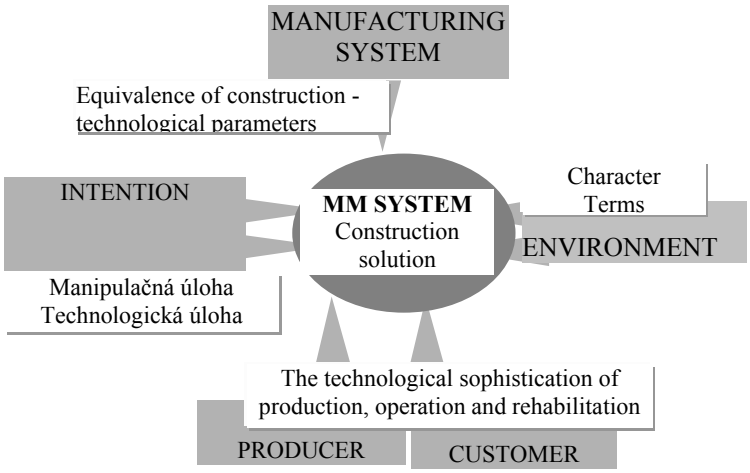


Fig. 2. *Factors affecting the structure of the machine system*

The analysis focused on the purpose of handling / confirms the role of technology influencing machine system, in particular the mechanical, physical and topological nature, weight, accuracy and stability of position control method and sorting and object exchange rate of production.

Analysis of the nature and terms of application environment confirms influence machine system, in particular the work area (location, shape, size, input), technological dislocation axis (location, access, function), an interactive relationship systems (function, identifying, blocking, movement forward - backward), energy (distribution, transformation, branching flow), mechanical (unification, separation, variability) and realized the nature of technology / process handling (processing / handling tools, process parameters-load, accuracy, stability and performance time modes).

Analysis of the production system confirms the influence of particular machine based on its technical parameters (power-productivity, positioning accuracy, kinematics and dynamic properties), design parameters (baseline layout for the premises, the building interface),

connecting mechanism, the program and energy treatment of cross-links (energy and information interface), and integrated technology-related activities (handling, transport, storage and ancillary).

Analysis of the impact of the manufacturer and the user confirms the influence of particular machine based on the technological possibilities of production, guaranteeing fixed service and maintenance activities, the level of servicing and maintenance, the maintenance of operational capability.

Specification of development

Use of logistics integration and integrated solutions for the creation of systems, structures, machinery seeks clarification and streamlining of design and technology links between the various machines modules including the information linked to the production stage [4]. It is based on taking the intermediate developed and linked sequences of individual machine modules (reference, connection, motion) and is focused on methods to integrate modules, based on systematic methods of construction, which aims at a process-oriented assembly machinery system.

Developments structure

Machine modules may be grouped into more complex units with respect to the level of engineering and technological compatibility, i.e. skills interfering energy, information and mechanical connections needed for final technology (service) process machine system. Depending on the method of grouping, spatial planning and design and technological results may be machine systems to develop new and more integrated level, i.e.:

- the full technological, resp. handling equipment (a basic model of machine),
- the multifunctional machine discrete system (a complex machine system),
- the integrated multifunction machine (machine logistics system).

Guiding the development of machine systems is that the critical structural and technological ties are being diverted away from the machine base (reference module) and is distinguished by hierarchical level. For the basic machine model system (MS) may symbolically express the following relationship:

$$MS = KT \xleftrightarrow{k,t} \left\{ \left\{ NMS_a \right\}_{a\ =\ 1,\ldots,\ o};\ \left\{ OMS_b \right\}_{b\ =\ 1,\ldots,\ p} \right\}, \tag{1}$$

when

KT - single function design and technology base (reference module)

NMS_a - modular tooling system (motion and work-tool modules)

OMS_b - subject-work piece modular system (fixtures and motion-subject modules)

a – number of instrument module,

b – number of subject module,

$\xleftrightarrow{k,t}$ – symbolic expression of design and technological ties.

Reference assembly of machine systems- Fig.3 / formula 1, comprising a structurally unifying construction modules, which are mutually firmly resp. mobile connection. Usually one of them is not moving-reference / 1 / and is design and technology base connecting / 2 / and motion / 3.4 / modules. The function of machine motion immediately fill-in such as:

- portal module / 3 /, unable to realize the desired movements of technology resp. manipulation tool,

- desktop module / 4 / is able to implement rotating (rotation tilt) movements of the subject.

Connection modules complement system (reference represent either an enlarged base or serve to enhance the properties of active modules) and allow a customized combination of construction and assembly of modules in different configurations and sizes.

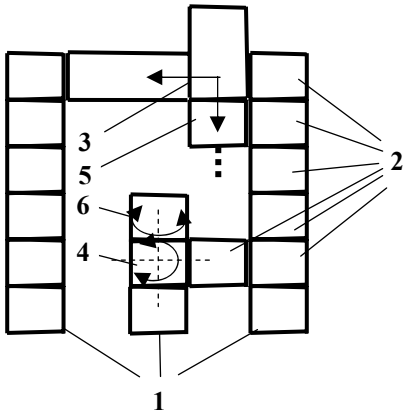
In this way, can be define a standard form of the basic model of machine (technology, handling). Viability and perspective logistics structures and machinery, systems must be understood primarily in the greater connectivity through the inferable functions and compatible tool subjects and modules. This is a multifunction machine systems solution that can integrate the basic and additional functions unrelated links. The structure of a complex machine system (CMS) can make a symbolic relationship:

$$CMS = DKT \xleftrightarrow{k,t,v} \left\{ \left\{ NMS_a \right\}_{a\ =\ 1,\ldots,\ o};\ \left\{ OMS_b \right\}_{b\ =\ 1,\ldots,\ p} \right\}, \tag{2}$$

when

DKT - multifunction discreet design and technology base (reference module),

$\xleftrightarrow{k,t,v}$ - symbolic expression of design and technological capabilities and linkages variations.



1- Reference module
2- Interconnect module
3- Biaxal portal motion module
4- Biaxal desktop motion module
5- Tool module
6- Subject module

Fig. 3. *Reference assembly machine system*

Complex machinery systems integration extends between the base and reference module and interconnecting machinery, motor module so that it can be arbitrarily assigned as appropriate (via fixed or mobile links) with respect to the reference module respectively between them. Integrated solutions machinery discrete systems based approach, although able to cover wide requirements, but not always the rational way. This is caused by more or less by the curricular and modular tooling system operates as an information link and other technological or structural ties are developed in isolation, has always been based on pre-given design and technological features building modules. Therefore, today more and more new solutions are representing the immediate concentration of functions and activities directly between the subject and modular tooling system- fig.4. This requires continuously address the structural and technological ties and tool of the subject modular system in order to mutually integrate their physical activity.

Special (professional) machine system – fig. 4 is another way to improve the techno-economic level of the integration of multiple modules reconfiguration motion. The specific solution is that multiple integrated kinematics X, Z are arranged in two parallel pairs of jointed arms. The first pair of arm ends are connected platforms providing the first movement of the instrument, and secondly, the movement of object processing. The second ends of pairs of arms are provided with multi-functional joint, which in turn will ensure distribution of the kinetic power in the dependent and independent modes of action and the curricular tool line.

Multiple integrated kinematics made partial movements in various stages of activity. Movements are being diverted away from the common linear propulsion system, through which the tool path moving in the coordinates X, Z and A (typically, this may be milling headstock) rebuilt to object tied to a fixed (floating) base respectively contrary. Otherwise, operation mode tool platform is meant to frame a working unit becomes subject platform (positioning table) moving coordinates X, Z and B. This integration results in the so-called multiple series-parallel kinematics represents non-standard reconfigurable machine system. The solution is designed to implement the demanding workloads (transmission and operational procedures for handling and profiling facility) requiring special arrangements positioning and orientation without the need for further integrated devices. Compared with individual modules using single functional - programmed multi occupational manufacturing module with the wider effects of variability (range of technology, quality, and greater time effect).

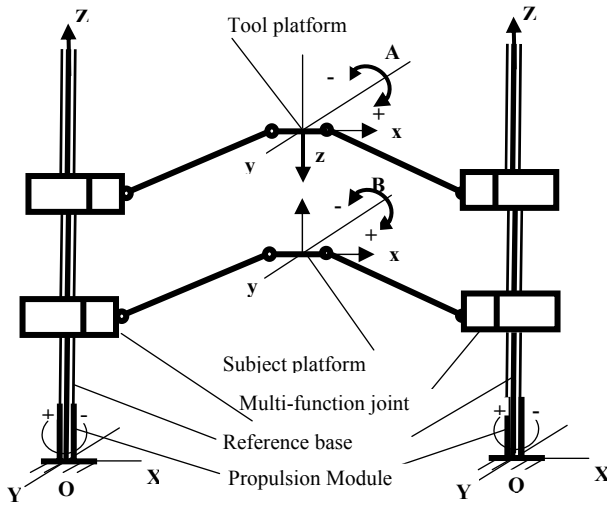


Fig. 4. *Special machine system*

Today these solutions begin to present as a logistics and are included under the new science intralogistics, whose importance lies in the detection of new principles of internal and external integration (e.g.: mechanical development, energy and information links) modules and systems ensembles.

Logistic structure of the machinery of the system (LMS) symbolically expresses the relation:

$$LMS = IKT \xleftrightarrow{k,t,v} \left\{ \left\{ NMS_a \right\}_{a\ =\ 1,\ldots,\ o;} \xleftrightarrow{k,z} \left\{ OMS_b \right\}_{b\ =\ 1,\ldots,\ p} \right\}, \tag{3}$$

when

IKT - multifunctional integrated design and technology base (reference module)

$\xleftrightarrow{k,z}$ - symbolic expression of structural links and pooling of skills / substitution motion activities in the machine system.

More real logistical structure of the machine still required to complete core knowledge base, methods, techniques and tools of development modules technology and handling technology, including the formation of the complex machinery systems.

Based on the analysis of the logistics can be compiled from individual modular machine modules comprising reconfigurable machine system, a case may vary. The system, which would still remained open, i.e. allow integrating additional functions, such as: individual movement adding modules to change the operational machine and work opportunities system to improve user performance.

Result

The present contribution provides information on creating a modular reconfigurable machine system based on more variants of design and technology links. These links allow us to implement the required functions concentrated in the lean and open assembly machinery system that can easily complement and change the role and easily ridden. Results solutions are the basis not only for creating new concepts of machine systems to the complex concatenation of production activities, but also on how to expand or modernize its manufacturing base and broad impact on production machinery based applications support systems based on new positioning elements in machining, welding and assembly.

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