

THESES

Thesis 1

Development and application of system, which applies modular principles and contains standardized elements is an efficient tool to design and build individual production lines. Therefore, I have formulated a process model of modular production line development. The model contains the introduction of process-steps and the supporting system-tools. To have formalized the modular model based on the collected, classified and analyzed properties of existing traditional production lines. Using the developed methodology I coordinated the design and building of several modular prototype machines hence proving the efficiency of the system-model for the development of modular version of individual production lines.

Thesis 2

I have worked out the specification database system (SDS) that is the result of analysis, syntheses and systematization of specifications of hundreds of earlier built equipment. All the properties can be simply and quickly defined by SDS, which are needed to specify a newly designed modular production line. A special software was developed to support database operations of SDS (data input, data storage, complex find and create reports), that was used to develop and build several equipment.

Thesis 3

For systematic handling of modules of the production lines and for exact identification of those connections an element-library system (ELS) has been developed. The ELS model is built based on the modular system model that is the result of combination of building blocks and the partial product models. The ELS is effective in the selection of needed modules and support combination of modules during design of modular production lines, and was proven by several industrial applications.

Thesis 4

I have developed the correlation matrix of SDS and ELS (SDS-ELS matrix) that is capable to create exact connection between properties of existing modules and technical requirements of current problems. Using the correlation matrix we can not just simply and quickly identify element-connections of databases (SDS and ELS) but can also determine connection between properties of identified elements. The correlation matrix was used for the design and build of all implemented modular equipments.

Thesis 5

An important step of modular system development is the selection of the needed modular elements and the determination of their specific properties as well as the exclusion of not-needed elements. To solve this problem the Pareto-principle was used that I have named *Pareto module-filtering*. During my research, I have used Pareto module-filtering for the selection of all main modules and demonstrated it in details in my research paper for manipulators. Pareto module-filtering is suitable for abstraction of existing solutions and choosing of needed modules during the development of a modular element-family – it has been proven by the application of this principle to build modular machines.

Thesis 6

Exact identification of modules by a suitable code-system needs to be ensured during development of a modular system. To create the codes, earlier coding methods and drawing number structure of the specific area are essential. Those codes must unambiguously identify the designated modules, their main properties as well as generate and configure the corresponding drawing numbers. I have definite connections between codes, drawing numbers and element-library system. The system has been tested and proven on real industrial applications.

Thesis 7

A catalogue-system must be created for the efficient handling and overview of developed modular system. To fulfill all related requirements, three-type of catalogues are needed. First type is *development catalogue of modular element-family* that contains in ordered form the properties and the status of modules under development, and also the background and the result of developed modules. Second type is *interactive design manual* of modular system that supports designers to choose most suitable modules and also to fit that into a new modular system. Third type is commercial catalogue of modular system that introduces and offers modular units as purchasable and suitable standardized commercial items.

By using the developed catalogue-system the modular system can be unambiguously identified as well as simply and quickly applied. The application of the developed catalogue-system is compulsory in the machinery plant where I have made my research in acknowledging its effectiveness.

Thesis 8

Most significant tool of the modular system is the modular design software (MDS) that was developed to fulfill all requirements. Basis of the software is the SDS-ELS matrix that connects user demands and possibilities of existing modules and combines these with the integrated Enterprise Resources Planning system. The MDS program facilitates flexible and user-friendly handling of developed modular element families that have been proven by several industrial applications.

Thesis 9

The developed design process model and methodology is applicable not just to solve complex development tasks of new production lines but also to adapt it to traditional equipment design. A production line has been developed that contained not just modular special machines but also traditional ones. By the development of a hybrid production line the flexible integration of the modular system and traditional system has been proven.