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Know-How and Quality Assurance Using a Web Based Reuse-Atlas

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Using exemplary designed equipment-modules, aspects of a quality assurance as well as the reusability of the engineering data are discussed here. The main concept, to document the undertaken assumptions and decisions during development and design of the equipment-modules, has been briefly developed and applied to the different modules, which were designed in cooperation with Uhde, a company of ThyssenKrupp Technologies. Developing the modules for different levels of plant complexity, such as structural-group and plant-group modules, allows more efficient planning of the new plants and easy modification of the old ones. Doing this, the Reuse-Atlas for quality and know-how assurance of this equipment-modules is developed as an online based application. The developed Reuse-Atlas favors the reusability of the equipment-modules and makes an internal know-how of a company or a division available to all employees involved in one project via Intranet or Internet. Due to easy and user friendly handling as well as extendable possibilities of this web application, planning works and computer-aided learning in the field of the modular plant design with the web based Reuse-Atlas could be well supported and accelerated.

1. Introduction

The plant planning and design is very demanding task in regard to its complexity in the different project treatment phases. Beside theory and experiment the computer-aided simulation, modeling, process design as well as planning has reached an important role in process and plant engineering. Computer-aided work brings for the research as well as for the industry many advantages, towards time-consuming, expensive and sometimes dangerous experiments. Due to its varied applicability in many industrial sectors as well as the visualization possibilities e.g. in the form of flow sheets, diagrams and animations, the computer-aided tools and programs have reached also big popularity by users.

The fast growing demands for process plants along with the extension of global-scaled collaborations require new efficient efforts on data management, know-how and quality assurance in the field of plant design. For example an employee in a typical European company wastes in average 67 minutes per day in an ineffective searching for information, which leads in a company with 1000 employees and an average annual salary of 50.000 Euro, to annually eight million Euro expenses. This was clearly shown

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in the study results of the Marketing Research Institute carried out by Vanson Bourne in May 2007, where 610 managers from European companies were questioned (Kaiser, J., 2007).
In regard to the numerous constructed plants the possibility for reusing the available examined solutions in new projects has still not received enough attention. In order to exploit the potential of available examined solutions in developing new projects in the field of plant design, an online based management application for quality and know-how assurance could be used. The reusability of the technical know-how could lead to improvement in the efficiency of project development, project quality and consequently reduces cost. Here using the exemplary designed equipment-modules, different aspects of the quality assurance and the reusability of the available engineering information in the field of modular plant design are discussed.

2. Modularization and engineering reuse for a better quality and know-how assurance in plant engineering

The idea in module-oriented plant design is based on the definition of the process engineering units – modules, which are functionally independent. A module should be considered as a designed part of a plant with known size and level of complexity. Modules are the process engineering units designed and built in all parts of a plant inside the module borders which specify the same functional, constructional, spatial and automation characteristics. According to the complexity and applicability of the modules, they include apparatus, machines, pipes, EI&C (Electrical, Instrumentation and Control) -devices, valves and all other related process equipment (Hady et al., 2007). Figure 1 represents the modular concept of the engineering reuse.

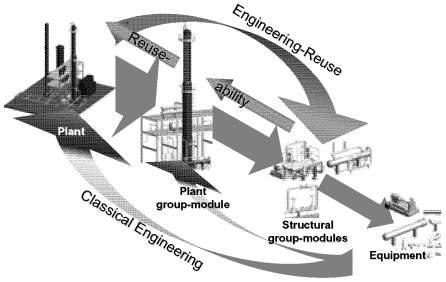

Fig. 1. Modular concept of the engineering reuse

A modular plant consists of plant group-modules which are designed in a modular way. The plant group-modules are flexible process engineering units which are designed from smaller ones, namely from structural group-modules (Fig. 1). The plant group-modules are responsible for the basic operations and the structural group-modules are responsible for the basic functions as long as the whole process is covered by the plant. The configuration and layout of plant group-modules depends on the number of required basic operations. Unlike the plant group-modules, the structural group-modules are fixed process engineering units. They can only be affected with small constructional or layout changes such as near piping, order of armatures and supports. The adaptability

of the structural group-modules to the conditions of new plant group-modules during the engineering reuse will be covered with a degree of flexibility around 10 to 20% for possible changes.
For a modular concept of engineering reuse (Fig. 1) various structural group-modules were developed. Figure 2 shows some examples of shell and tube heat exchanger structural group-modules (left side), and pump structural group-modules (right side) in various layouts and applications:

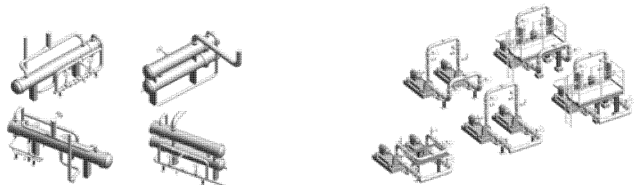

Fig. 2. Shell and tube heat exchanger structural group-modules (left side) and pump structural group-modules (right side) in various layouts and applications.

A simultaneous consideration of all experience-based requirements on the planning process in a different project treatment phases such as Basic and Detail Engineering as well as their results, leads to the development of the modularization criteria. Therefore the modules of different complexity in 2D and 3D world such as structural group-modules and plant group-modules can be defined and developed. This modular planning process for engineering reuse shown in Figure 3 (left side) improves the engineering in points of planning quality and reusability. Moreover, a design characteristics for engineering reuse can be represented by the equipment layout. An equipment layout provides an engineer all required information for design of a structural group-module. Figure 3 (right side) represents the proposed standardization of an equipment layout.

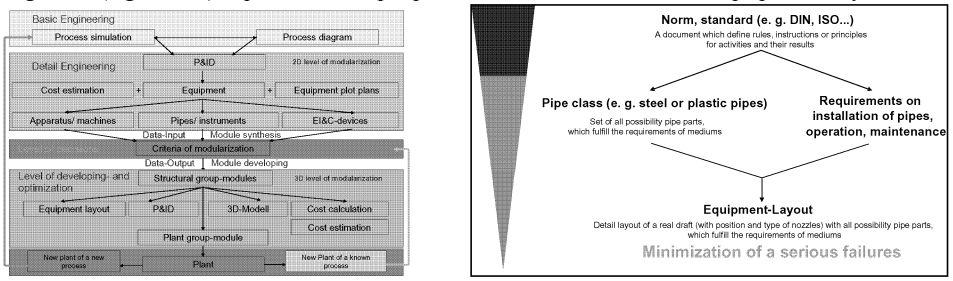

Fig. 3. Modular planning process for engineering reuse (left side) and standardization of an equipment layout (right side)

Minimization of the serious failures during the development and design of structural group-modules is a direct result of applying the equipment layout. The equipment layout shows not only the two-dimensional representation of a structural group-module which corresponds to design characteristics visually but also implies a specific documentation of the developed modules. Moreover all planning decisions undertaken during the design of a structural group-module can be made more transparent and

useable using equipment layout. Figure 4 shows the equipment layout of a shell and tube heat exchanger structural group-module.

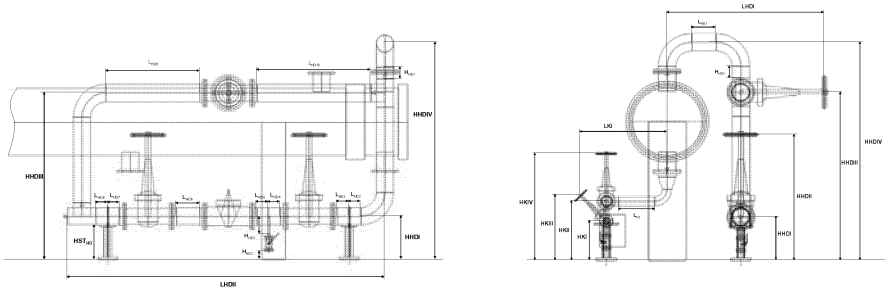

Fig. 4 The equipment layout of a shell and tube heat exchanger structural group-module with all required design information in different views

As a result for using an equipment layout, a variety of less appropriate solutions can be eliminated and the material costs in each module can be minimized since it guaranties an optimum space for the near pipes.

3. Reuse-Atlas as an online application for engineering reuse, quality and know-how assurance

All of above mentioned consideration such as: equipment layouts, 3D-CAD models, know-how principles and quality characteristics and all other included documentation corresponds to the developed modules, build a main structure of the Reuse-Atlas. Moreover such a Reuse-Atlas should have:

- Online documentation system (via Intranet or Internet)
    - Handling via web browser
    - Quick accessibility to the documentation of the modules
    - Engineering up to date
- User friendly interface, easy and intuitive handling
- Possibility to be continually extended by users to cover the documentation of new modules
- Adaptability to the requirements from design and project engineers (for each structural group-module or plant group-module)
- Potential to fulfill the user consideration

Moreover, the stored modules and the know-how of modules can be reused every time when a new project is executed. As an outcome for using Reuse-Atlas, repeatable design duties could be avoided, planning works are accelerated, the know-how and the quality of the modules are assured even though the experienced engineers are no longer involved in the project. When a project reach to an end, the developed modules can be revised and possible corrections in the Reuse-Atlas under “Know-how principles” can be applied. Figure 5 shows a user interface of the Reuse-Atlas.

Fig. 5. User interface of the Reuse-Atlas

The left side of this Reuse-Atlas characterises the level of visualization. The information regarding to the 2D equipment layouts and the 3D modules could be also obtained here. The Reuse-Atlas gives also an access to the designed modules with a 3D-CAD software. Therefore the available models of modules could be easily reused. The right side of the Reuse-Atlas describes the documentation of the modules. Here the know-how principles and dimensional characteristics of the given modules could be found. Both of those aspects: visualization and documentation interact each other. According to the above mentioned characters, planning of a new plant could be proceeded completely modularly. The web based Reuse-Atlas was implemented on the basis of the HTML and PHP for a web development as well as other Open-Source-Software such as Apache HTTP Server for a web server and MySQL for the applied database of users, know-how principles and quality characteristics.

4. E-learning, e-teaching and knowledge management regard to modular plant design with a Reuse-Atlas

An intensive “on the job” training over a certain period of time in a competent team is often required in order to giving new employees responsibility and independently at their work. Reuse-Atlas is an online application which can be used for a quicker and better e-learning and e-training of inexperienced employees in the area of a plant design. The knowledge stored in the Reuse-Atlas, which illustrates design rules, instructions and principles of the developed modules, gives basis for understanding of decisions and acceptances during their development and design.

The learning process e.g. at the universities, looks similar to the above mentioned “on the job” training in the industry. Lectures should give students opportunity to make them familiar with e. g. possibilities, periphery and limitations of the commercial programs and tools. Within the scope of the course „Computer Aided Plant Design“ which is lectured on the Chair of Process Dynamics and Operation at the Berlin Institute of Technology, an industrial example of a complete planning and design process based on a process simulation, estimate of costs, dimensioning and layout design of process units, apparatus and machines included 2D- and 3D- plant design activities will be used. At the same time aspects of the implementation of a basic flow diagram in a simulation based diagram, process flow diagram (PFD) and piping and instrumentation diagram

(P&ID) will be considered and adapted. The planning process is carried out with ChemCad® for the process simulation and estimate of costs, MSVisio® or ComosPT® for the planning activities at the 2D level and with the planning tool Aveva PDMS® to represent a plant in the 3D-world. Beside the classical approaches new developments of our Chair will be also used, as for example MOSAIC (Zerry et al., 2004) for the process simulation and Reuse-Atlas for the modular plant engineering at 2D and 3D level. The main intention of the lecture „Computer Aided Plant Design“ is to show, how some technical and engineering problems, which appear during the processing of a project, could be solved. Beside the technical contents of this course, some ways of problem solving during the modular plant design will be shown and acquired with help of Reuse-Atlas. Due to the fact that the Reuse-Atlas is a "know-how warehouse" and is accessible via a web browser, the students can learn online, how the basic design rules and principles are transformed to the prepared examples of the equipment-modules. Due to the possibility to follow through the undertaken acceptances and decisions during the development of modules with Reuse-Atlas, we were able to inspire the students with works in the area of the modular plant engineering successfully.

5. Conclusion

The main intention to develop and use of a web based Reuse-Atlas is applying the feed back from the modules which have been designed for supplying information in both the visualization and documentation levels, towards building a new plant. Reuse-Atlas provides the possibility to recognize and describe the interrelations between know-how principles and quality characteristics during the module development and design. Therefore consolidated knowledge based on experience available in each company could become more transparent and useful for new and inexperienced engineers.

Due to the fact, that engineering reuse and the application of the predesigned modules depends on their arrangement and configuration, the Reuse-Atlas should support the optimal development and design of the equipment-module layouts. Moreover, a learning and understanding process of a modular plant design via Internet or Intranet should be more efficient.

The question whether the application of the web based Reuse-Atlas and thereby of the modular plant planning reduces time of design work activities or not, is not answered till now. Developing such a Reuse-Atlas could be considered as a first steep toward qualitative evaluation procedure in a modular plant design. That is the suitable approach to response to the long time question, how far the modular plant should be developed, designed and used.

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