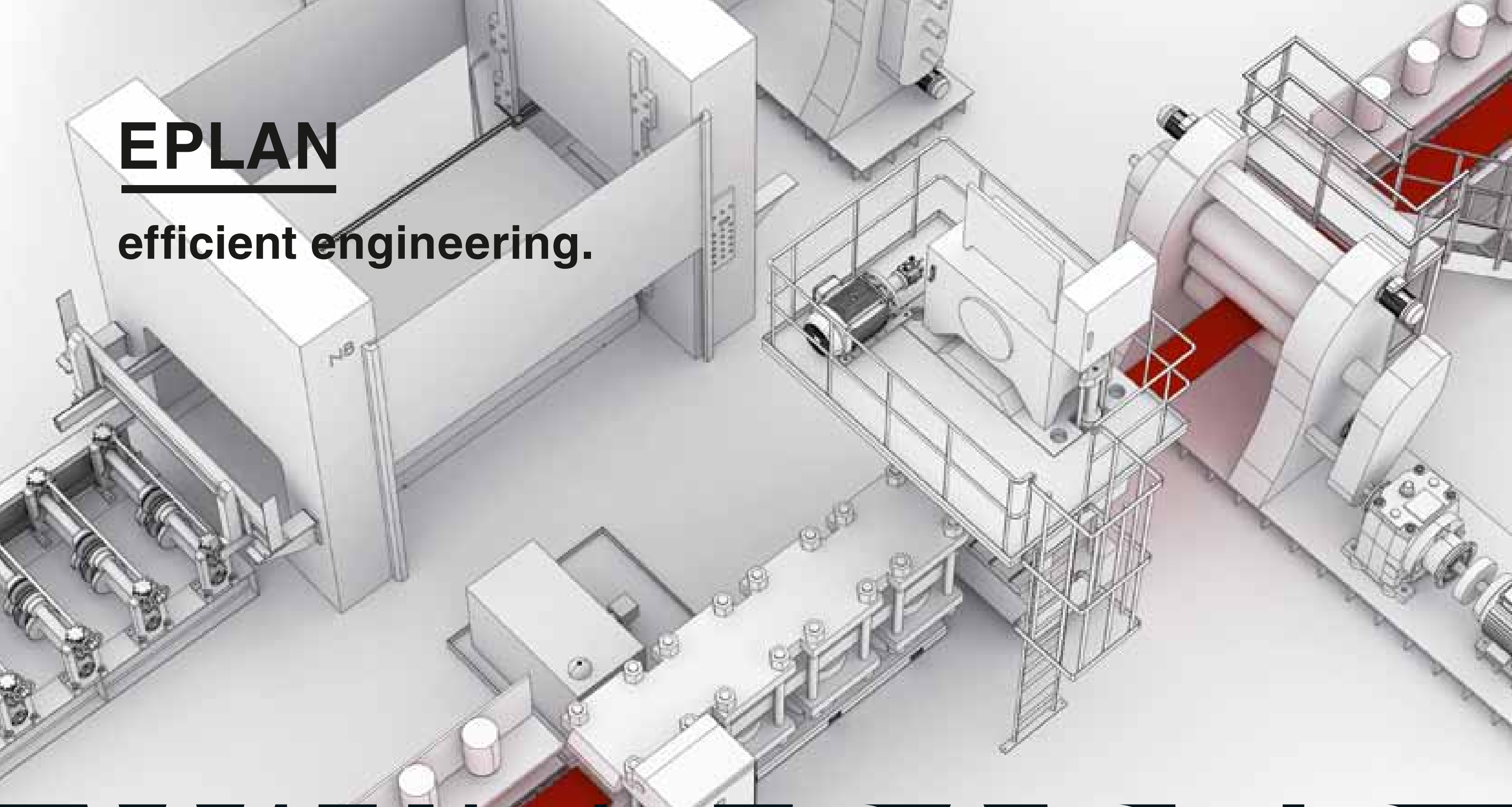
EPLAN

efficient engineering.



WHITE PAPER

Designing large plants

Reusing and automating engineering workflows – with a focus on smelting and rolling mill engineering

Optimisation potential for fluid power, electrical and automation engineering

Contents

Introduction

The current situation in the global market poses substantial new challenges for designing large plants.

In a study on the subject, Germany's professional organisation for large plant design, the VDMA (Verband Deutscher Maschinen- und Anlagenbau / The German Engineering Association), discovered the following on the global outlook for large plant design*:

- Competitive pressure within Europe and between Europe and Asia has increased substantially.
- Chinese providers are particularly aggressive with low prices and a high willingness to take risks.
- South Korea is acquiring greater market shares.
- European plant design still remains the technology leader, but cannot keep up with Asian providers in terms of prices.
- Developing a technological leadership by driving innovation forward is seen by many businesses as the correct approach for their future survival in the market.
- Standardisation and modularisation are among the measures in focus for increasing cost-efficiency.

*(Source: The German Engineering Association)

Fig. 1: Engineering in metallurgy and rolling mill technology – global and decentralised

Businesses themselves also face global challenges internally. Engineering, once a centralised undertaking, is being distributed around the world. This helps not only to better cater to local markets, but to assist in making engineering and manufacturing cheaper. A given volume of engineering representing thousands of hours can thereby, based on quantity and demand, be evaluated, calculated, divided up, offered and finally processed.

Through decentralised processing in design and varying know-how in different locations, this field is gaining new vibrancy thanks to improved quality, costs and delivery periods.

Due to the price war, businesses in large plant design are increasingly using highly comparable – and thereby directly competing – measures for structural optimisation, such as:

- Cutting back design hours.
- Using cheaper parts.
- Reducing the plant functionality.
- Reducing documentation.
- Using low-cost labour for commissioning.

Despite the considerable individuality of plants and all the complexities of the processes involved, modularisation, reuse and optimisation of internal processes are seen as the structural measures that can meet the global challenges.

For engineering departments in large plant design, this means:

- Offering and then selling plant engineering at attractive prices.
- Optimising the engineering process in order to save on engineering time and thus costs.
- Maintaining a high level of quality in the design, so that manufacturing, assembly and commissioning can be carried out on schedule.
- Providing customer satisfaction through the quality of the plant and the on-time start of production.

Leading businesses in smelting and rolling mill technology, such as SMS Siemag or Tenova LOI, have reacted to changing conditions in recent years and have significantly restructured and optimised their engineering process from the bottom up. Following the implementation of an intensive modularisation concept at their own plants and the introduction of efficient, automated engineering systems, these companies can now automatically link reusable templates and data from basic engineering to customer-specific plant documentation or to automation programmes. This automated development process is accompanied by a considerable reduction in design times and is associated with exceptional documentation quality.

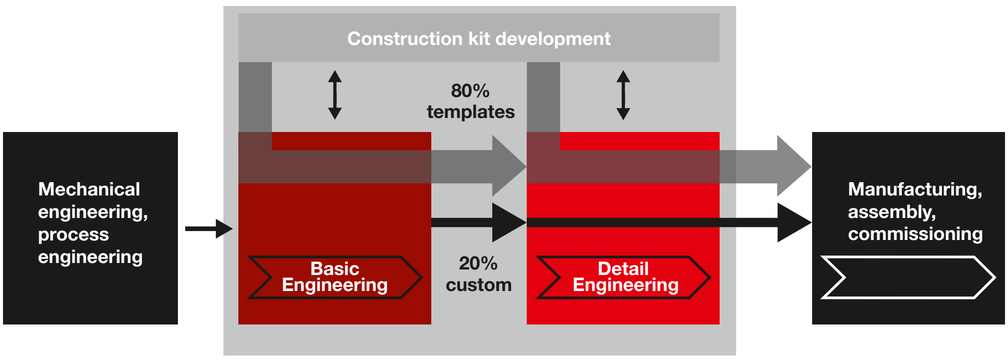


Fig. 2: Module-based engineering process in large plant design

This white paper outlines the areas of activity which are relevant to the implementation of a modularisation and reuse concept as well as for the realisation of automated engineering processes. Focus is placed on basic and detail engineering in electrical, plant automation and fluid power (hydraulics, water lubrication, etc.). Additionally, empirical values and outcomes which have become evident due to the implementation of these engineering methods will be explained and quantified.

This white paper does not examine the topics of optimising mechanical engineering and process engineering.

Engineering large plants

Brief overview

Hundreds of hydraulic and electrical drive systems, numerous PLC controllers and thousands of signals all pose significant challenges to engineers and designers during the different engineering phases. The main requirement of many engineering departments, therefore, is to develop a concept for reuse and to achieve a large increase in quality through the automatic generation of documentation and programmes consisting of lists and templates; and to do all this while also making large savings on design time.

Requirements and challenges

Large numbers – incentive to act

In large plant design, and therefore also in smelting and rolling mill engineering, the "law of large numbers" applies:

- Hydraulic and electrical drives are built in the hundreds or even thousands. These are monitored, controlled and regulated by an even larger number of sensors.
- Numerous IPC controllers are put to use to automise the overall facility.
- Thousands of signals throughout the plant are transmitted to the automation system via decentralised control systems and a fieldbus or via master cable and field junction boxes.
- Numerous consoles in the plants enable on-site operation while the systems are running.

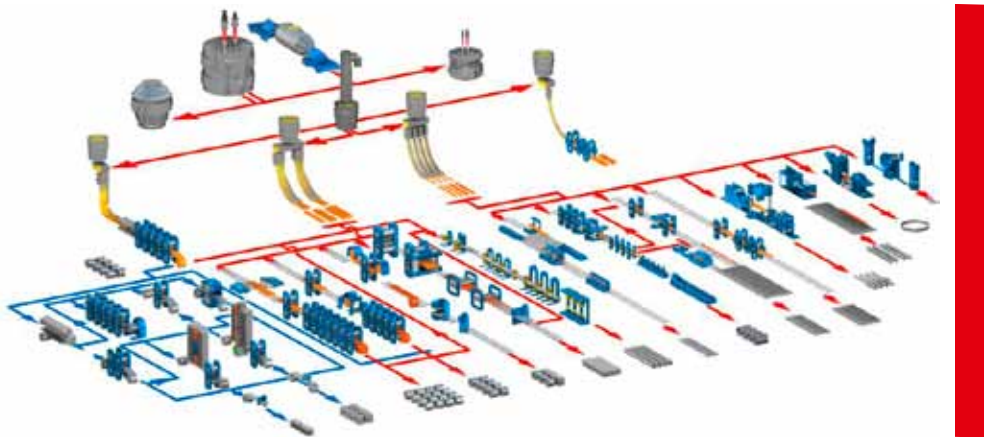


Fig. 3: Process chain for steel production (Source: SMS Siemag)

All of these actuators and sensors are structured and processed into motor and component lists, signal lists, instrumentation lists etc. during basic engineering.

Fig. 4: Many similar components: roller bed drive (Source: SMS Siemag)

Companies and individual staff members understand the challenge of reorienting themselves to support large numbers at every stage of the design, its limited resulting level of repetition, and also the challenge of adapting work methods and the various engineering phases accordingly.

In basic engineering, this means effective data processing in databases, lists and tables, and in detail engineering, the creation of reuse in design. Moreover, it is widely accepted that the amount of manual processing steps should be kept to a minimum for reasons of time and quality. The main requirement of many engineering departments, therefore, is to achieve a large increase in quality through the automatic generation of documentation and programmes consisting of lists and templates while also achieving big time savings in design.

Reuse

The large number of similar functions and devices is an incentive for adjusting the engineering process to a certain level of reuse. The answer to the question of modularisation and the reuse of templates is obvious.

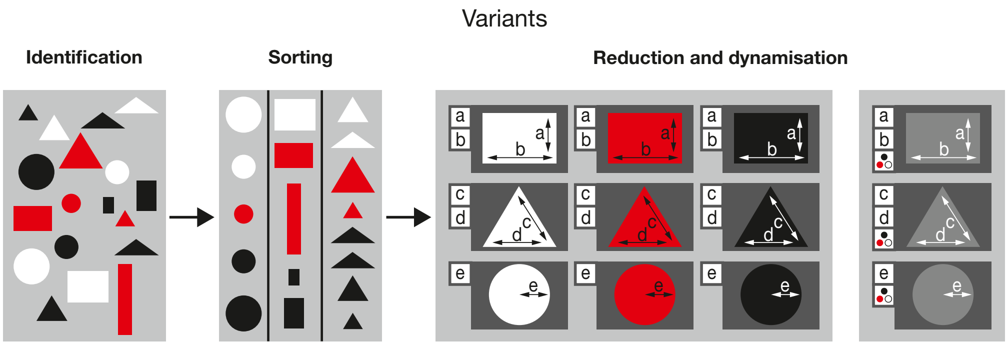


Fig. 5: The challenge of variants

The key questions for a reuse concept are:

- Does the variance of the plants allow for modularisation?
- Which variants in plants should be converted to templates?
- Are the templates generally applicable or can only be used for a certain type of plant?
- To what degree can the templates be dynamically used for different requirements?
- How is the challenge of continuously changing parts taken into account in the templates?

Revisions and customer specifications

Customer specifications and revisions during the engineering process are important factors in large plant design. They affect details relating to plant functions, and also frequently to design or structural definitions such as control or drive system concepts. Continuously tracking changes throughout all the design documents and programmes while also staying within the project plan's time frame is a demand invariably placed on engineering departments. Project-wide changes to part are particularly challenging due to the large number of devices.

Quality

How is a 10,000-page circuitry diagram checked for accuary, e.g. potential cross-references? How is data consistency ensured between hydraulic schematics and the electrical schematics throughout the entire plant? How are the details on plant functions (existing Yes/No, identifiers, addresses, texts, etc.) kept consistent between the hydraulic system, electrical system and the PLC (Programmable Logic Controller) programme? How are inadvertent mistakes made during the manual design process detected before manufacturing begins? To what degree is manufacturing required to check the accuracy of the design? How much time do erroneous schematic diagrams and PLC programmes cost during assembly and commissioning?

Achieving a high level of quality in design and documentation is closely associated with data consistency, methodology and automation. The question for detail engineering in relation to the aforementioned market situation is: How can engineering be implemented faster and cheaper while still meeting the high quality requirements?

Interdisciplinary collaboration

Gains in quality and time are also incentives for improving collaboration between different engineering departments. With an interdisciplinary approach in engineering, it can be expected that:

- The same things will have the same names.
- Resource-intensive and paper-based coordination between departments can be removed.
- Revisions will take effect across all design data.
- Engineering times will be reduced.

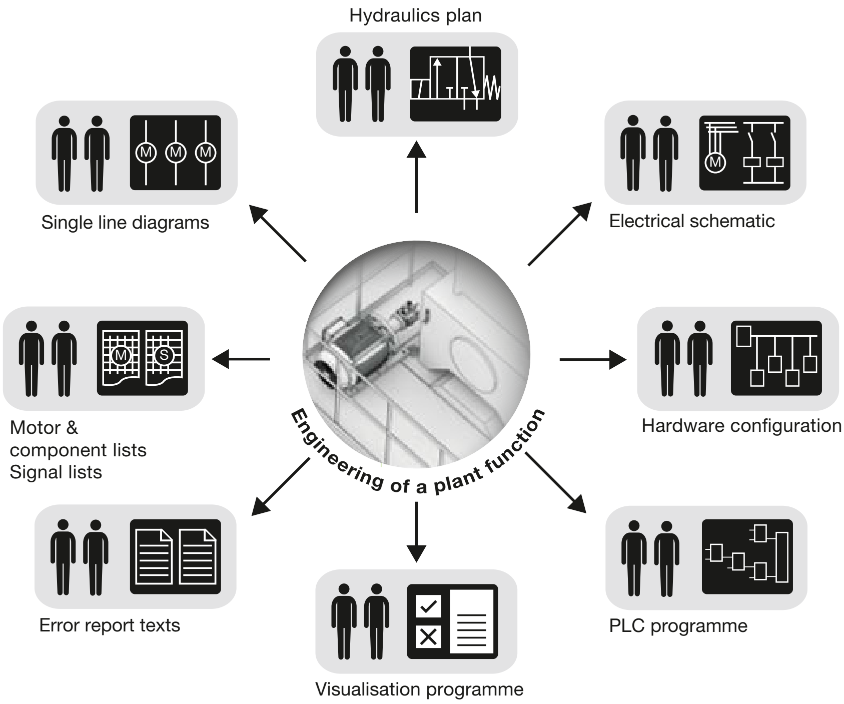


Fig. 6: Challenges of interdisciplinary collaboration in engineering

Infrastructure

For large plant design, the project-specific layout of the infrastructure is of particular importance. For the infrastructure, all plant components assigned to multiple functions are identified. This usually involves a range of supply systems. An electrical power supply feeds many loads with voltage. Many signals from sensors with different functions connect to one PLC input card. Data modules for regulations or alarms are responsible for multiple functions etc.

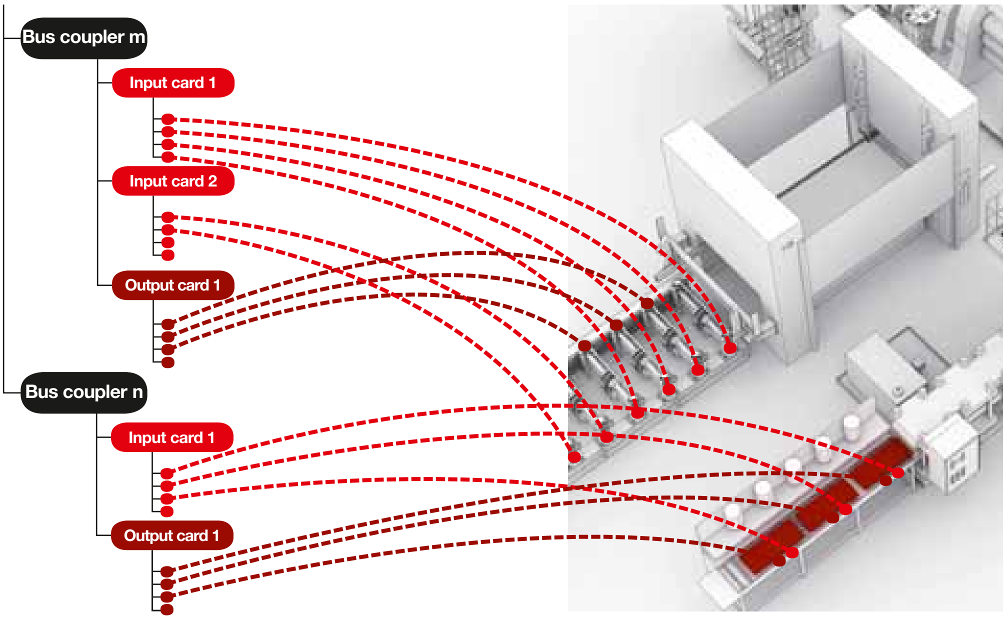


Fig. 7: Collection of signals and the design of control hardware

A significant potential for improvement can be achieved here. For example, by designing the bus topology automatically based on the number of signals or designing the power distribution for the PLC system automatically based on the number of modules instead of manually counting the signals or the modules.

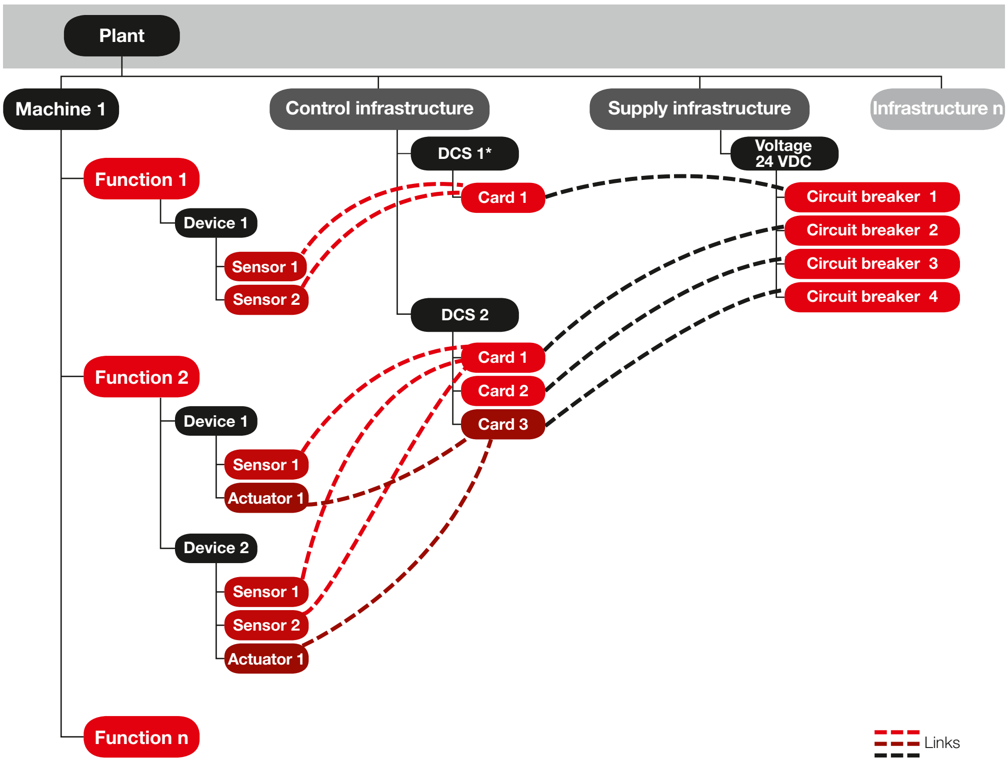


Fig. 8: Assigning signals to PLC cards and PLC cards to electrical supply (*DCS – Distributed Control Systems)

Resource planning with fluctuating workloads

A further challenge is managing the workload of engineering departments and individual staff members during long project durations, which means preventing workloads from being either continuously too high or too low. Especially during excessively high workload phases, ensuring quality in detail engineering while operating under time pressure can be a tightrope act.

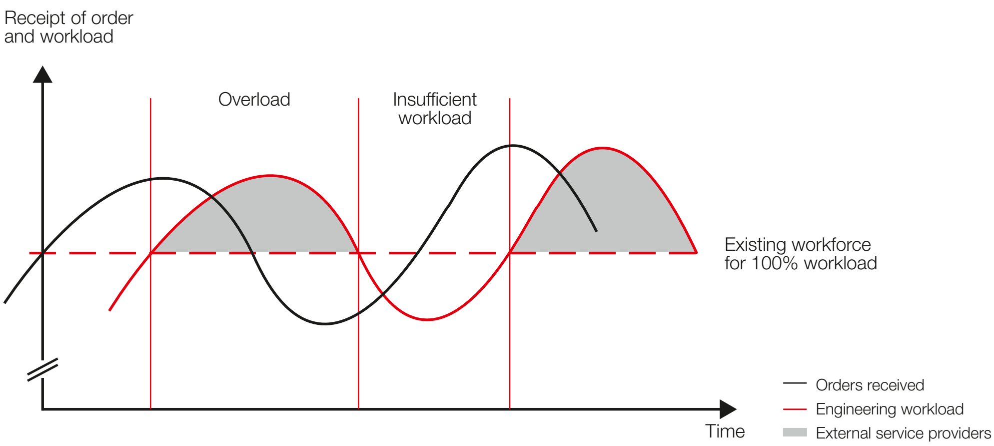


Fig. 9: Resource planning with fluctuating workloads

Some businesses turn to cooperation with external design services to compensate for fluctuating demands on resources. One challenge in this approach, alongside the question of their availability, is that external service providers have their own know-how and their own conceptions about the implementation of design projects and want to bring these to bear. A variety of variants and a ballooning of individual solutions then has to be curtailed to ensure quality in design.

Brief overview

Detail engineering in large plant design is extremely demanding. The design process is often characterised by manual "copying and adjusting" methods. Reuse requires a methodical procedure and transparency in relation to variance. Revisions during the course of the design lead to major changes for different disciplines. Depending on a project's progress and the complexity of the revision, a project-wide revision in detail engineering can lead to a delay of weeks in manual operations.

Current processes

Sequential processes cause long throughput time

The design process in plant construction starts with process engineering and mechanical engineering. Planning data for actuator and sensor technology is derived during design. This data forms the basis for further engineering in fluid power, electrical and automation. Data transfer is a constant process. In process and mechanical engineering, revisions or supplementary measures inevitably occur and a way of working them into fluid power, electrical and automation must be found. The design of fluid power, electrical and automation also progresses sequentially. From the very start of the design the following applies: One department depends on the results of another upstream department and must wait for them – or, due to time limitations, begin work immediately and allow for gaps in their own engineering, which then require effort to gradually clarify. Against the backdrop of ever decreasing time frames, lead times are thus often stretched out during design.

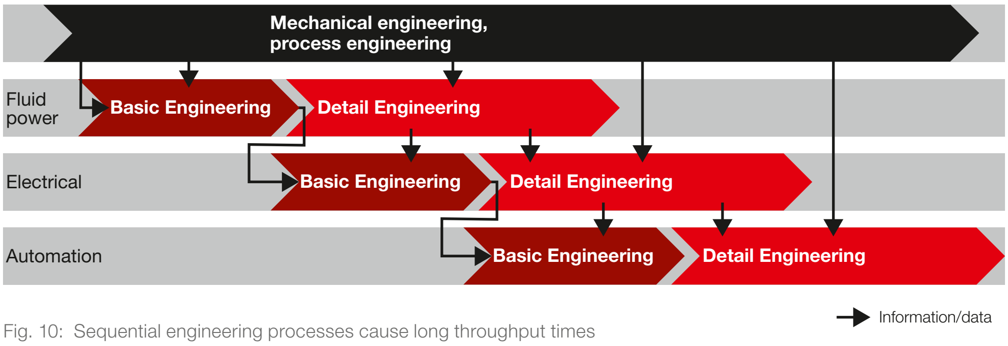


Fig. 10: Sequential engineering processes cause long throughput times

Only slow increase in data consistency and huge amounts in engineering

The basic engineering phase makes up around a third of engineering effort depending on the plant type. Difficulties are due in particular to the fact that receiving information from upstream departments or customers is generally slow. This is compounded by the problem that binding data formats are rarely defined for exchanging data between businesses and different departments. Although the use of motor and component lists has become an established practice in drive engineering, this varies in its creation and format from business to business and often also from department to department. In detail engineering, the detailed documentation (fluid power schematics, electrical schematic, PLC programmes etc.) is designed on data in a table format produced by basic engineering. The quantity and quality of the data which detail engineering requires from basic engineering only become satisfactory much later on. Nonetheless, departments and staff members are under time pressure to start with detail engineering, in order to produce, on time, detailed documentation for internal communications, for customers or for manufacturing.

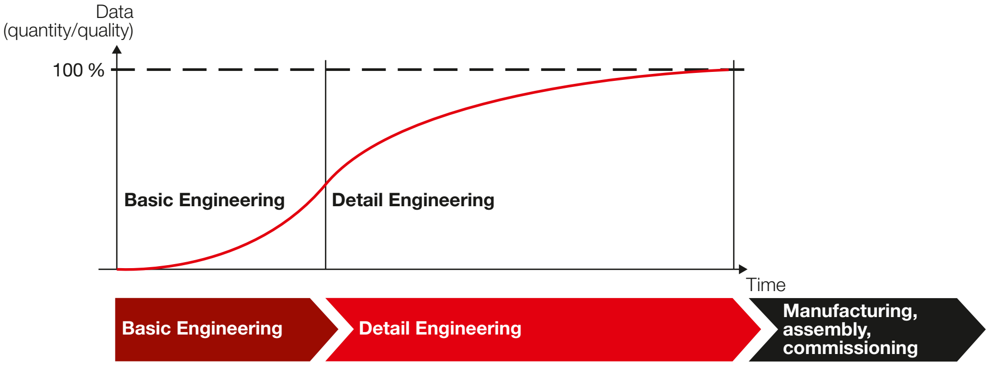


Fig. 11: Growing data consistency in engineering

In large plant design, detail engineering is characterised by manual "copying and adjusting" practices. A section is copied and taken as a template from older documentation ("Where have we done something similar before?"), adjusted to the new project in a new document, duplicated and completed with detailed information. And this is done for the aforementioned large number of functions and components. Hundreds of the same or very similar pages have to be modified manually specifically regarding technical data, interruption points, text elements, plant identifiers, etc., and in particular parts. Or in plant automation, a drive system call-back module for the plant's many electrical drives are manually used and adjusted in one of the PLC programme's call-back modules.

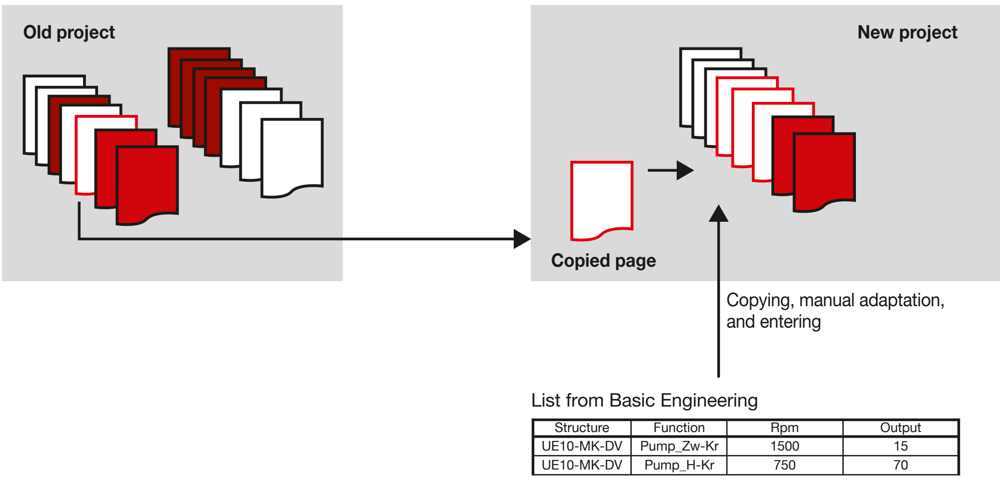


Fig. 12: Manual copying and adjusting in detail engineering

On the basis of this work method, detail engineering is a strenuous task of little interest for designers and is bemoaned by many for being equally boring and tedious. This large quantity of work in detail engineering takes weeks, is highly prone to errors due to manual labour and is initially made difficult by incomplete documents from basic engineering. If early detail documentation is required, it cannot be finalised initially and must be repeatedly and continuously adjusted throughout the project's duration and subsequently checked for consistency.

Reuse only partially achieved

Many businesses have attempted to modularise their plants in order to develop both generally applicable and plant-specific templates, but have not achieved their goal. This is because the principle of reuse often fails in machine and plant design due to the high level of variance in plant functions, together with an unmethodical approach during concept design.

A further reason for this failure of reuse concepts is that parts are always changing. Especially in the case of field devices, we see that although the function actually remains the same, a different part is used nonetheless. For example, a temperature sensor from manufacturer A instead of manufacturer B is erroneously installed without the design in the electrical schematic necessarily being updated. In electrical or fluid power systems using different parts but the same function constitutes a variant. This must be taken into account in the templates. This pushes the number of templates and the administration and management workload even higher.

In the automation of plants, the level of abstraction is higher. Therefore, many automation departments have created templates for function modules with changeable parameters. These are not usually coordinated with electrical and fluid power systems. The programming procedure remains manual as it was before. The automated generation of programmes is a rare phenomenon.

Revisions cause extensive additional work

Changes during the design of a large plant leads to changes in many documents from different disciplines. The spectrum of changes, be it due to customer or internal reasons, is broad. Revisions affect the plant identification system, the automation system, the drive concepts, the parts etc. The later a change is made (or becomes apparent), the greater the resulting costs. Depending on a project's progress and the complexity of the change, a project-wide revision in detail engineering can lead to a delay of weeks in finalisation.

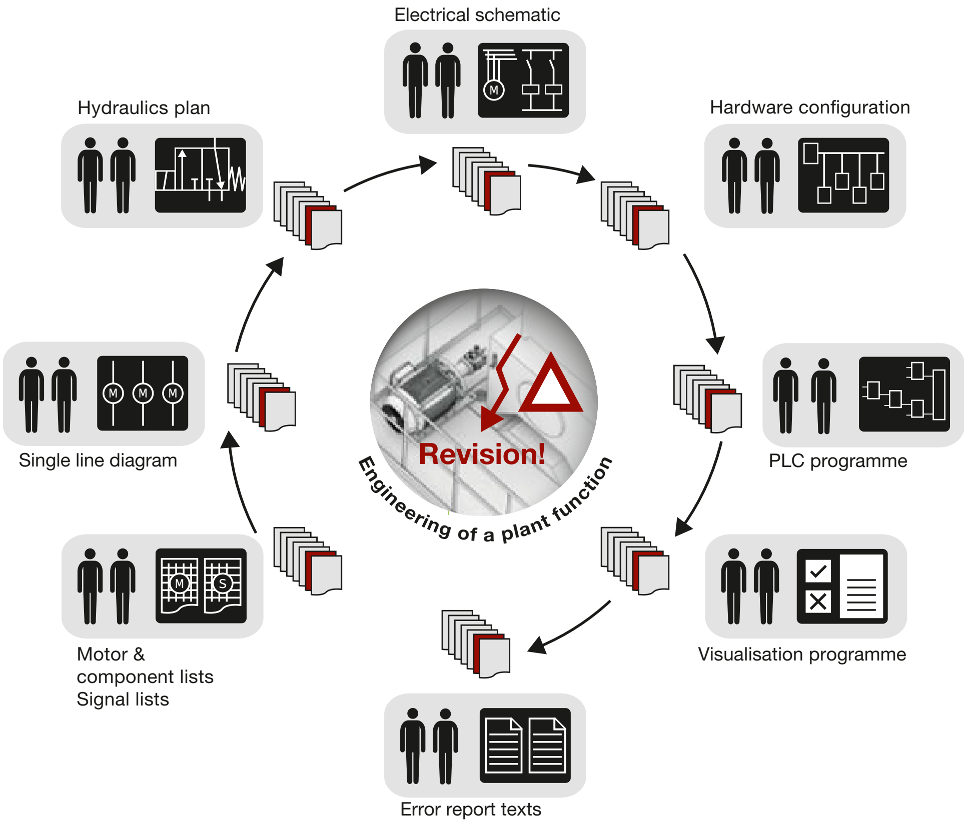


Fig. 13: Coordination and implementation workload for changes

It can be generally noted that only a few machine and plant design businesses have defined a process for managing revisions in the design process. Much time and money is lost though implementation which is neither coordinated nor checked across departments.

Large effort for satisfactory quality

Manually produced design documentation and automation programmes are currently checked for errors at considerable effort, in order to ensure quality for downstream manufacturing, assembly and commissioning. In many businesses, mechanisms for quality assurance are not present. Quality can only be assured through time-consuming manual examination and comparison.

Fluctuating workloads vs. resource planning

Due to the long project durations in smelting and rolling mill engineering, the workload of engineering departments is subject to strong fluctuations. Departments are therefore overloaded when the order situation is good, but insufficiently tasked when orders are low. The optimal allocation of labour for design departments is therefore difficult to achieve.

Businesses turning to external services to cope with spikes in workload levels leads to significant costs. In addition, and often of greater relevance, such businesses are doing so in phases of high order levels and good economic performance and are thus highly dependent on the availability and know-how of external workers. If no external workers are available, the central department has to handle the (too) large volumes of engineering under high time pressure.

High workloads in infrastructure engineering

Designing infrastructure is characterised by manual tasks and is therefore a time-consuming activity:

- Signals are counted and categorised in order to layout PLC cards.
- The length of delays is determined by requirements, simultaneity and the operational conditions of the drive systems.

Due to the large number of functions, actuators, sensors and signals, infrastructure engineering makes up over 50% of the engineering of a large plant. For infrastructure design, rules are mostly defined within the company or specified by the customer. This exceptional level of effort is due to the large number of components which depend on each other and must be linked together in accordance with the design rules.

This is further complicated by changes in the plant's functions (in particular if signals or loads are added or taken away), which also have an effect on infrastructure. A resilient infrastructure design can thus only ever be created after basic engineering has been completed, and even then it is still subject to further changes.

Brief overview

In the future, repetitive manual engineering tasks will be automated. Lead times will be reduced by the interdisciplinary parallelisation of engineering and revision processes.

Setting objectives

Based on entrepreneurial trends and the described requirements in large plant design, the objectives for the engineering process of the future can be defined:

1. Automation of manual engineering tasks which repeat themselves, i.e. automated generation of a large proportion of the order-specific detail engineering documents currently being manually produced.

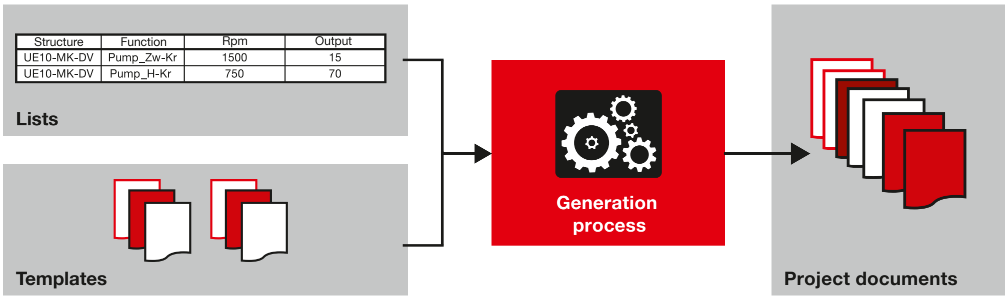


Fig. 14: Automated generation of design documentation based on templates

2. Rule-based evaluation of infrastructure.
3. Reduction of lead times throughout all engineering phases through the interdisciplinary parallelisation of engineering processes.
4. Reduction of the workload due to revisions in detail engineering thanks to a interdisciplinary coordinated process.

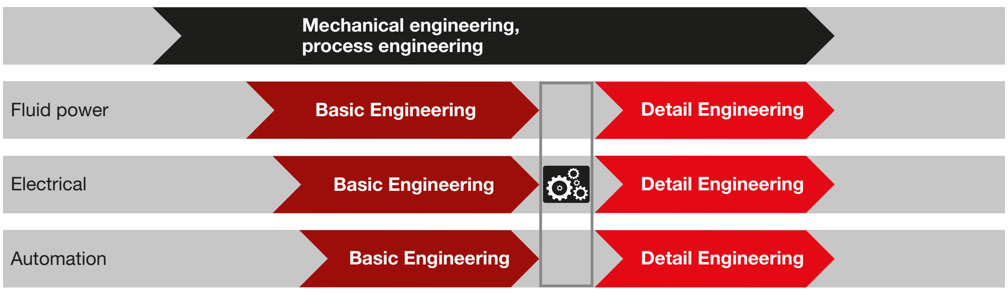


Fig. 15: Parallelisation and automation of engineering processes

5. Optimisation of the engineering process for more efficient completion of systematic changes.
6. Reduction of manufacturing, assembly and commissioning times thanks to the qualitative improvement of documents produced in engineering.

7. Improved scalability in the use of engineering resources through the automation of design processes together with the flexible involvement of external services.
8. Flexible use of time savings, e.g. for starting engineering later on.

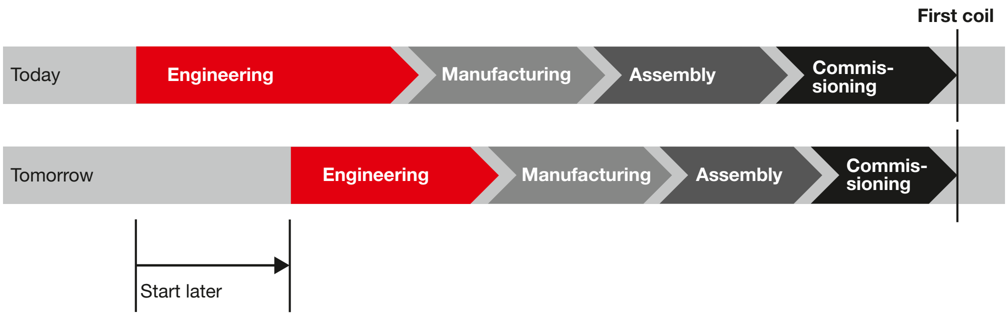


Fig. 16: Results: Reduction of engineering, manufacturing, assembly and commissioning times

EPLAN problem-solving competence

Brief overview

The keyword is: modularisation. This requires a commitment to a consistent company-wide understanding of functional plant structuring and is closely linked with consideration for plant variants, options and characteristics. Reuse across different types of plants requires interdepartmental regulation and harmonisation. As part of this, internal departmental (construction) solutions have to be put to the test and the facilitation process has to be geared towards finding a solution which is binding for everyone.

Successful implementation of automation solutions in engineering requires a consistent and methodical approach. This is the basis and the prerequisite for the creation of an engineering module in special plant design.

Success here originates in three broad areas of activity:

1. The method.
2. The person.
3. The supporting tools.

The method

Modularisation

Coordinating and defining project templates on the basis of plant modularisation is a great challenge faced by design departments and by entire businesses. Modularisation requires the establishment of a company-wide understanding of the functional structure of a plant. This means that the plant's functions are structured top-down to the lowest level – that of actual devices – in order to enable the encapsulation of functions and thus their reuse.

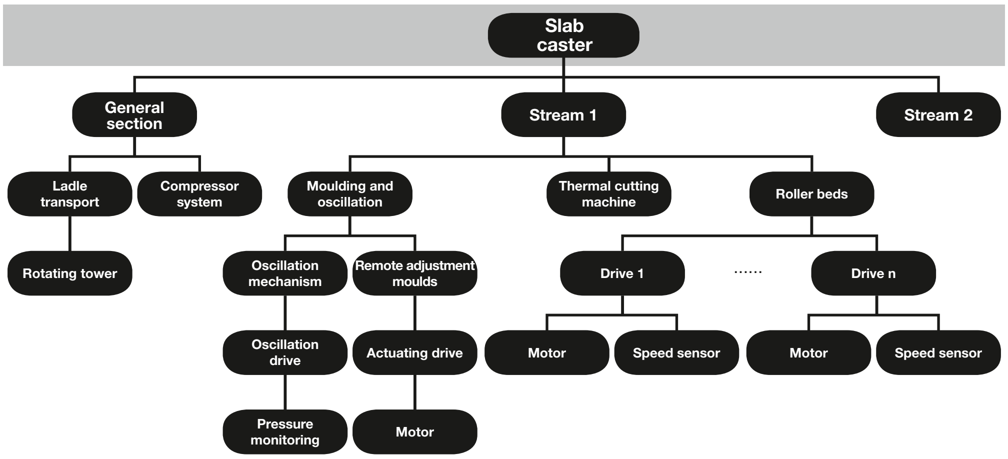


Fig. 17: Excerpt from the functional structure of a slab caster

Determining a functional structure is closely connected with the intensive observation of plant variants, options and features. The recognition of variants and the driving forces behind them is of particular relevance. Knowledge about plant variants is necessary to develop defined and sustainable templates for engineering and for determining the criteria by which variants are selected. The selection criteria, the driving forces for variants and the function properties are compiled in basic engineering and revised for specific projects during the design.

Interdisciplinary modules

With the functional structure, the specification for creating an engineering module is defined and a milestone is reached on the path to reuse in engineering. The functional structure is an abstract view which is defined with discipline-specific content. This means that the fields of

- fluid power engineering,
- electrical engineering,
- automation,
  - DCS (Distributed Control Systems),
  - PLC (Programmable Logic Controller),
  - HMI (Human Machine Interface),
- and documentation (test reports, commissioning documents, etc.),

provide the individual functions with their particular share of design information. For example, if a function has a hydraulic component which has to be illustrated in the hydraulic diagram, the corresponding fragment of the hydraulic diagram is assigned to the function.

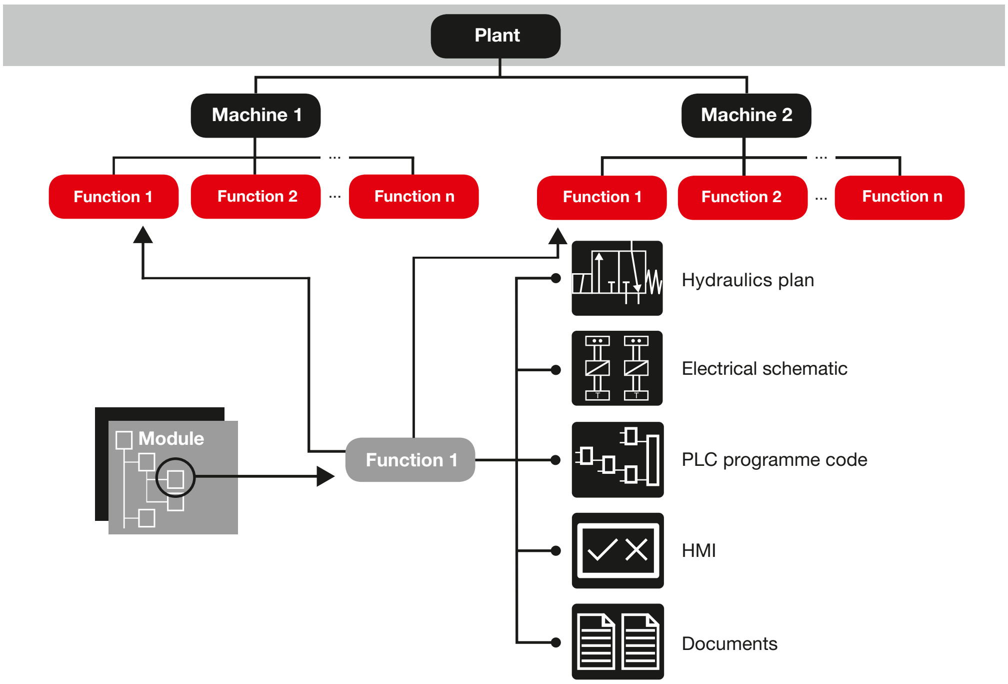


Fig. 18: Multiple use of interdisciplinary modular elements

The same approach also applies for electrical schematics. If the function has an actuator or sensor whose signal is relevant to the automation programme, the relevant fragment of PLC programme coding is also assigned to the function. Each function is provided with the necessary discipline-specific fragments (templates) which it needs for the development of its own individual design documentation or programme segment. A module is thus created from functions which are provided from across disciplines. Applied during the design, the different discipline-specific templates of a single function are simultaneously available. This technique enables the parallelisation of the previously sequential engineering processes of fluid power, electrical and automation.

Dynamic variant technology and rule sets

On the basis of a functional structure, a plant can be configured and the discipline-specific project documentation can be compiled from individual templates.

However, functions have variants which influence diagram presentation or programme characteristics in various ways. In large plant design, the assignment of static templates to functions is not productive because the large number of variants requires a correspondingly high number of templates – to the point of being unmanageable. In order to avoid developing and maintaining a large number of static templates which are in many parts redundant, a technique using dynamic templates is required. Considerations aren't made in terms of pages of diagrams or programme modules, but rather in a more finely divided and fragmented manner. Parameter setting techniques for functions and templates make it possible to compile a hydraulics plan or a page of an electrical diagram (in accordance with information from basic engineering) from multiple fragments. The same applies to the dynamic compiling of a PLC functional module from many coding fragments, e.g. the invocations in the call-back modules of drive systems outlined in the introduction.

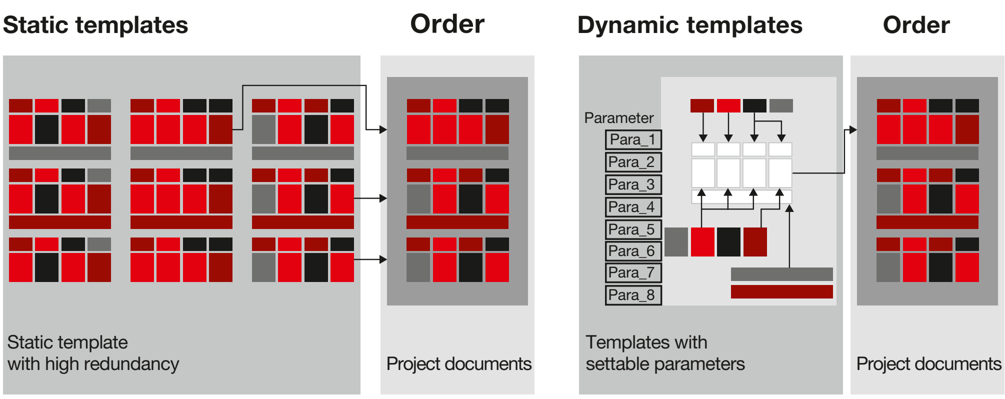


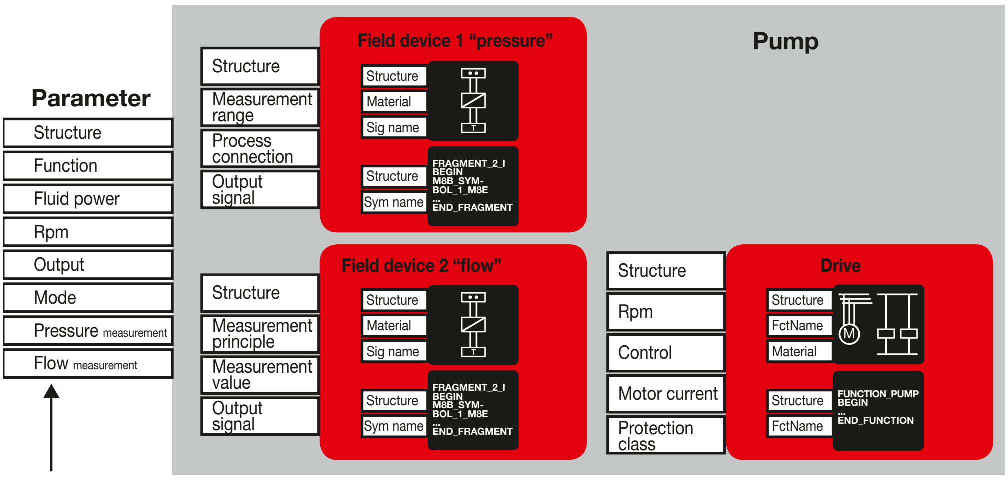
Fig. 19: Dynamic instead of static templates

The effects of parameters on functions and templates are recorded in rule sets. In this way, a comprehensive set of rules about order-related and/or generally valid design dependencies is created.

The central questions here are:

- Which parameters are necessary to clearly determine all the required characteristics of a function?
- How are these parameters to be mapped in basic engineering?

Pump with definable parameters



List from basic engineering

Structure	Function	Fluid power	Rpm	Output	Mode	Measurement pressure	Measurement flow
UE10-MK-DV	Pump_ZW-KR	Water	1500	15	S1	Yes	Yes

Fig. 20: Setting the parameters of functions and templates with data from basic engineering

Setting the parameters of functions and templates together with design rules makes the variance between plants manageable and serves as the technical basis for automation in special plant design.

Automated generation of detailed documentation

The basic engineering lists are not only where the plant structure is mapped, but also where the data and parameters for individual functions are contained. From these lists and the suitable dynamic templates, the documentation and programmes are automatically generated in detail engineering with the engineering software tool. In doing this, not only is detailed information on individual functions linked to templates, but structural information on the plant is also taken into account. The generation process also supports the processing of systematic revisions. Changes of systematic nature are made in the basic engineering lists. If necessary, the corresponding templates have to be adjusted. After this, the up-to-date documents are generated.

Decoupling of parts and template

The decoupling of parts and template is an important method for realising a reuse concept in special plant design, and is especially relevant to design documentation for fluid power and electrical. The part number is an indicator of function and assists in defining functions in basic engineering. Information on which templates suit which part numbers is recorded in the rule sets. In this way, the right template is automatically pulled up based on the part number. The part numbers are not entered as fixed data into templates, but are introduced dynamically into the documentation during the generation process. The template itself is part-neutral. This enables the universal use of templates and a considerable reduction in the number of templates required.

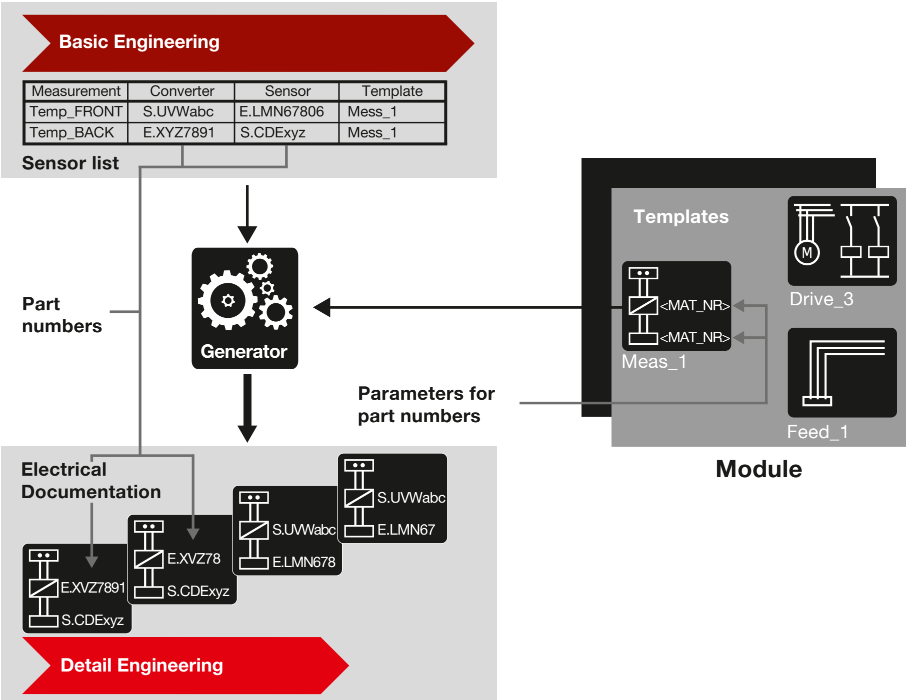


Fig. 21: Part number as a parameter: Decoupling parts and template

The person

Revision processes

In comparison to conventional copying and adjusting, concepts and automated design processes entail fundamentally new methods which elicit both positive and negative reactions from the company's staff members, especially from those who are directly involved.

The willingness and capability of individuals to come to terms with new methods, procedures and instruments varies greatly. Successful implementation of a reuse concept is to a large degree dependent on the composition of the policy team charged with its development. Success and the continuous development of the concept can only be achieved with the acceptance of new methods in departments and the entire company – and with supportive responses by the company management. Reuse and changes in methods are management themes. It is necessary to refute individual fears about new methods and workflows ("Am I involved or affected?"). The concealed fears of team and staff members often lead to the assertion: That won't work for us. In this way, changes of methods are actively obstructed. To counteract this, the reasons for changing methods, the individual measures and the expected outcome in the company have to be communicated.

Once the new engineering methods and processes have been established, they serve as the benchmark for new staff members. The relapse of individual staff members into old ways of working should therefore be prevented.

80 / 20

In large plant design, it is hardly feasible to build a plant on the basis of reusable templates alone. The 80% principle should be followed. It is possible to determine reusable functions for around 80% of a new plant. The remaining 20% are the plant-specific proportion for which no reuse is evident. It is the task of the policy team to set this limit at about 80% in order to avoid over-automation.

For the discussion of variants, it has proven to be extremely productive to bring an external mediator into the policy team who helps the team with decisions. The mediator and the policy team must be granted a mandate by company management to reach decisions on, for example, design variants and to determine these for the company.

Coordination

Large plants are built by large companies. Reuse across different plant types usually requires the implementation of interdepartmental regulation and harmonisation. As part of this, internal departmental (design) solutions have to be put to the test and the facilitation process has to aim at finding a solution which is binding throughout the company. Finding and making these solutions consistent is a tightrope act. It is a challenge to initiate interdepartmental cooperation and to guide staff towards the objective.

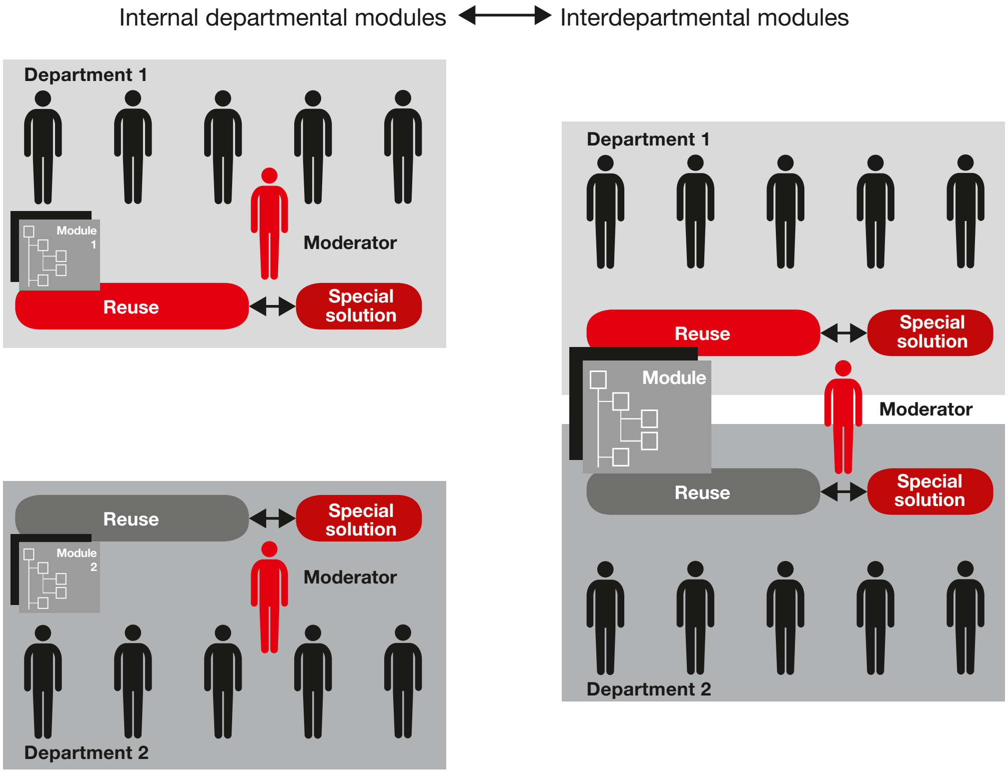


Fig. 22: Internal departmental vs. interdepartmental reuse

Reuse is doomed to failure if departments insist on their own internal solutions or if every variant possible or every single solution/variant found in the past is expected to be mapped. Here company management has the tasks of encouraging the heads of the participating departments to actively cooperate, establishing a reporting system and finally making resources available.

The supporting tools

For the realisation of module-based basic and detail engineering, the solution from EPLAN Software & Service provides support in:

- Mapping interdisciplinary modules (fluid power, electrical, automation, documentation) from a functional point of view.
- Understanding functions in the module with discipline-specific dynamic templates.
- Providing the functions and templates with parameter options.
- Mapping a set of rules for functions‘ object dependencies and setting of parameters.
- Inputting lists for from basic engineering and their automated use.
- Facilitating the parallel generation of project documents.
- The design and maintenance of interfaces with CAE, automation and documentation systems.

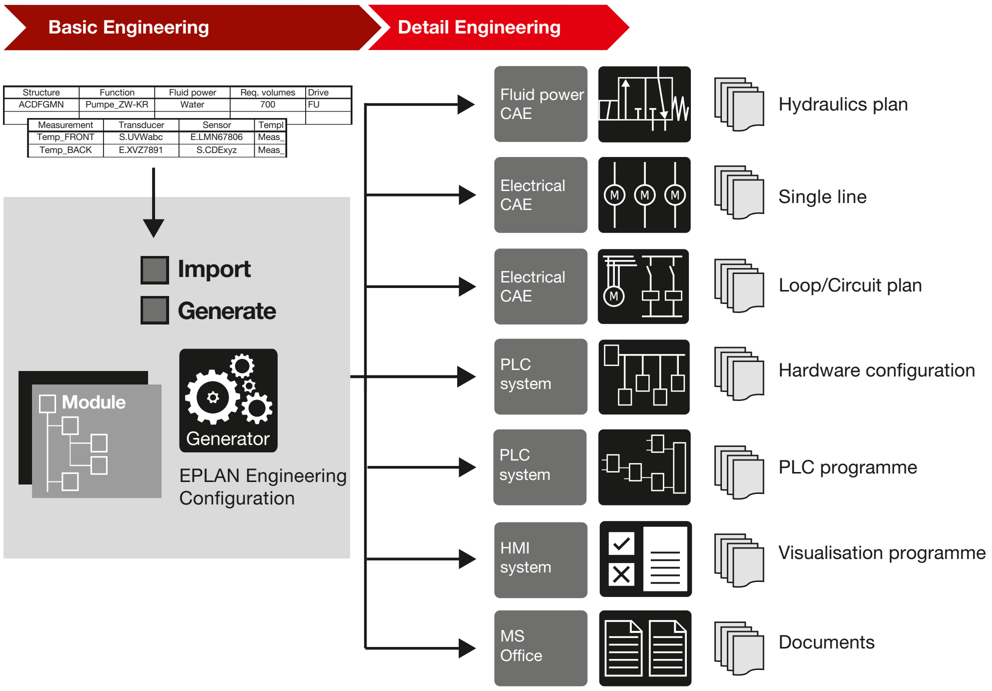


Fig. 23: Interdisciplinary and automated processes

Experiences and effects

Brief overview

The realisation of module-based basic and detail engineering reveals significant potential for savings. The numbers speak for themselves:

- 30% to 70% reduction in detail engineering
- 80% of documentation generated for hydraulic and electric systems
- 100% evaluation of hardware configuration
- 50% of PLC programmes generated
- 80% evaluation of plant infrastructure

Engineering phases

The high proportion of generation and the resulting reduction in manual processing have a substantial influence on the basic and detail engineering phases. The engineering time to be calculated for orders is cut dramatically. Saved time can be actively accounted for.

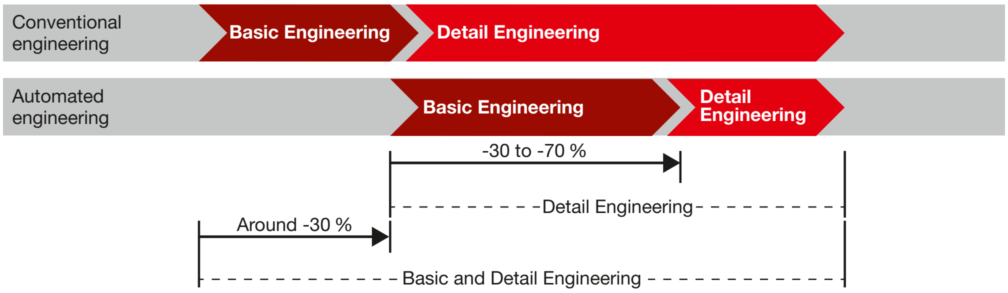


Fig. 24: Shifting of engineering phases

The basic engineering phase is intentionally expanded with the objective of further increasing data consistency for automated generation. Changes to mechanical and process engineering from the ongoing design process can therefore still be taken into account in basic engineering and don't have to be laboriously worked into the completed documentation in detail engineering. The detail engineering phase is shortened considerably. Manual processing is now only needed for the non-generated share of the documentation. On balance, the reduction in detail engineering is significantly greater than the extension of basic engineering, so that the total volume of engineering can be reduced by up to 30%.

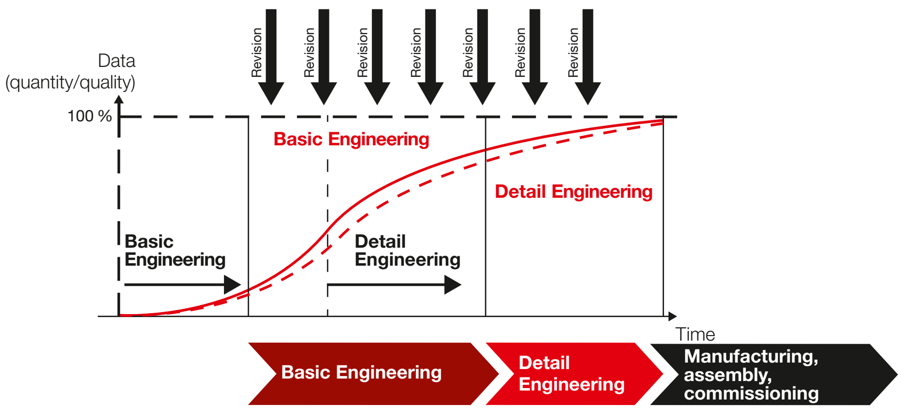


Fig. 25: Higher data consistency from coordinated internal processes and longer basic engineering

Calculation of the infrastructure

For a large plant with thousands of signals, for example, the automation infrastructure – including cards, racks, power supplies, address allocation, bus layout etc. – can be evaluated by automated means. In practice this means:

- The card at a bus coupler is designed and evaluated on the basis of the number and type of signals assigned to it.
- Power supply for electrical loads are evaluated according to voltage level, simultaneity factor, safety circuit and electricity requirement.
- Supplies for fluid power functions or power supplies for automation components (e.g. cards) are evaluated in the same manner.
- The content of data modules in the PLC is structured by automated means and provided with project specific content.

Document quality – requirements from manufacturing, assembly, commissioning and customers

Guaranteeing quality is vital, but it is usually only indirectly quantifiable. Increased quality can be observed in manufacturing assembly, initially through a fall in enquiries, then through the keeping of delivery deadlines and finally through shorter assembly and commissioning times. For many companies, improving the quality of design documentation and automation programmes is a central argument in favour of a reuse concept and the automated generation of programmes and documentation.

Added values

Along with the concrete and quantifiable effects, there is a series of qualitative added values which become apparent through automated reuse in engineering. First and foremost among them are:

- Preventing multiple developments through a coordinated and binding modularisation concept.
- Greater profitability from transparency in special and reusable solutions.
- Altogether, the company achieves a higher level of maturity.

Numbers

The measurable qualitative results of the described methods together with EPLAN Engineering Configuration are diverse and compelling:

- Up to 100% of the hardware configuration can be calculated.
- As much as 50% of PLC programmes can be generated.
- Up to 80% of a plant's infrastructure can be generated.
- Up to 80% of design documentation in hydraulics and electrical can be generated.

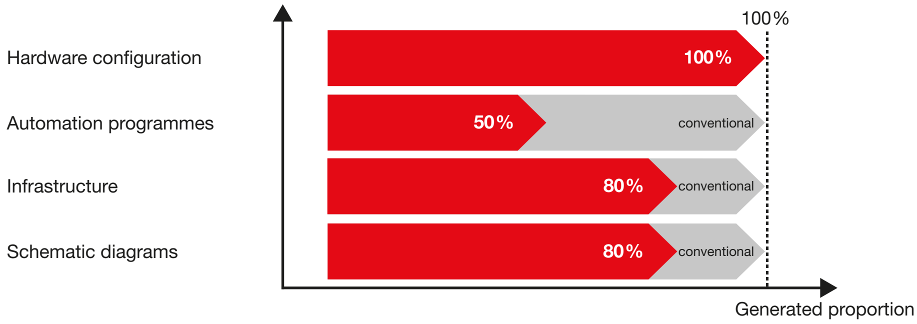


Fig. 26: Automatically generated proportion

- Detail engineering is reduced by between 30% and 70%.
- Systematic changes can be implemented in a fraction of the time of conventional methods.

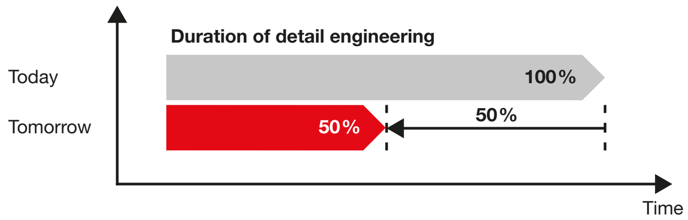


Fig. 27: Reduction in detail engineering

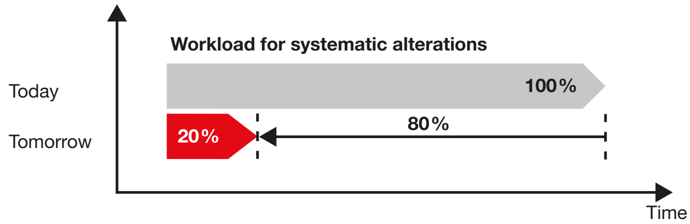


Fig. 28: Reduction of workload for systematic changes

Summary and references

With its many complexities, the engineering process in plant design can be structured, automated and thus optimised. Reuse concepts combined with a flexible and productive engineering tool and the possibilities of an individual engineering work flow are pointing towards new directions in global competition.

The fundamental demands of competition can be met:

- Modularisation creates transparency, makes the complexities of variants manageable and makes reuse possible.
- The automation and parallelisation of design procedures reduce design times, increase quality and guarantee flexible reactions to change requirements. Time savings can be taken into account in calculations and thus used for making more attractive offers or invested in further technological development.

The EPLAN Software & Service Company has been working intensively with smelting and rolling mill engineering companies for many years and deals with optimisation of design processes – with demonstrable success. Its range of services stretches from facilitation and methodical and practical consultation to reuse, advice on optimisation engineering workflows and the introduction of the configuration solution by EPLAN Software & Service.

Companies like SMS Siemag and Tenova LOI have been successfully using the EPLAN Software & Service configuration solution for years and have optimised their engineering workflows with module-based and automated engineering processes. Other leading companies in this sector are moving in the same direction and are currently implementing the EPLAN engineering configuration.

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Source material

“Was macht den Großanlagenbau robust für die Zukunft? –
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