One of our clients came to us with a request for support in the consistent design and complete digitalization of the planning and management processes in component production. Simultaneously, production planning that was implemented in a major product life cycle management system (PLM system) needed to be revised for greater flexibility. Any modifications in production were to be reported back so that they could be taken into account in the planning of future production projects. Despite the flexibility, the process was to be implemented in such a way that it relieved work pressures on personnel and would assure more efficient planning cycles as the range of variations broadened.

The challenge

Based on these requirements, we were able to identify the following starting points for optimization of the process digitalization:

> The data for the production planning are scattered among separate systems. While measurement data are collected within the management process of the production, they have been used only in part at the site of the measurement and are available only there.

> The production planning process is not consistently defined and implemented from the production order to the production release and provision to feedback of modifications after start of the production.

> A central control unit (similar to the human brain) to which the external information (stimuli) recorded by the sensors (sensory organs) is transmitted via data channels (sensory neurons) and in which a decision about a reaction, based on context and experience, is made and communicated back to the performing resources (muscle cells) via data channels (motor neurons) for execution does not exist.

The solution

Before a complete and consistent digitalization of the processes and the realization of optimization potential could even start, work had to be done on the architecture. The first step was to analyze the processes from the perspective of an end-to-end view; afterward, we designed a 4-layer architecture for the implementation. We did not commence design, automation, and integration of the processes until the work on the architecture had been completed. For the process work, we used subject-oriented business process management (S-BPM) and a suite of tools that supports S-BPM in modeling and implementing processes.

End-to-end view in the process

We took the first step for structuring and reducing process complexity by inserting an end-to-end view in our client’s process architecture. This enabled us to decompose a process monolith into six separate processes. The functional scope was defined for each process and clearly delineated from the others. The end-to-end view is moreover an approach for the complete and consistent identification of the required business objects and their life cycles. Every process now has its own dedicated trigger which can be used to launch it. At the same time, both the business object that is the required entry for the process and the business object in which the process takes place and that is provided for output at the completion of the process are identified. From this perspective, it is possible at a later time to derive important business statuses for the specification of the life cycle of a business object and consequently to recognize key points for process measurement and process management. The end-to-end view of the process resulted in the following clear structure shown in Figure 1.
One of the major pillars in the design of digital transformation is process digitalization in the sense of the consistent and complete automation and integration of processes. A look at a client project reveals how the implementation works.

The end-to-end view of the process revealed the following business objects (along with others), including the appropriate, relevant, business definitions.

The planning order is received by email as a structured Excel file or a structured Word document. The planning for every planning order is prepared and coordinated on the basis of a related master plan until the planning release can be given by the central management committee. The determination and specification of the components that are to be procured begins when the planning release is issued. After settlement of the specifications, the procurement release for purchase of the components is issued. Consequent to the procurement release, the provision of the components is monitored along the lines of the time schedules. When provision of the components has been secured, the assembly of components from own and third-party production is tested until the start of production can be fixed with complete dependability.

After the start of production, all of the modifications during the production process are communicated to the planning office as modification reports. Every modification report is analyzed to determine the reasons for the particular modification. If there are systematic modifications, the required planning modification is specified and is taken into account for future planning as a master plan adjustment.

Architecture structure for process digitalization

In the next step, we supplemented the process architecture by the addition of another layer based on this clearly structured end-to-end view. The result was an architecture comprising four layers. The process logic was encapsulated in its own layer for consistent and complete process digitalization. This approach made it possible to decouple the process for the requested process digitalization from the restrictions imposed by existing interfaces in the legacy systems.

The process with the business process functions and process logic is located in the process layer. The process is characterized by its subject-oriented nature. The business process functions are executed as the internal behavior of a subject, i.e., of the process subject. They are synchronized during process execution via their communication relationship, the exchange of messages. The

---

**Figure 1: The End-to-End View of the Processes**

1. Planning Order to Planning Release
2. Planning Release to Procurement Release
3. Procurement Release to Provision of Components
4. Provision of Components to Start of Production
5. Start of Production to Modification Report
6. Modification Report to Master Plan Adjustment

Source: Detecon
process logic is implemented in a workflow engine. Each process function is implemented either as a manual activity or automatically by a web service call or automatically by a number of web service calls within a business context. So the services required for complete and consistent digitalization are orchestrated according to business procedures along the process logic and brought together with the manual activities in the process layer.

The services for the automation of the process and integration of the production resources, data-carrying systems, and legacy systems are located in the integration layer. The services are integrated into the process by means of service calls from the process layer. The file structure of the services is modeled along the lines of the business capabilities required for the execution of the process. In the present case, these were the capabilities that our client requires for planning and managing his production processes. We defined these business capabilities in consultation with the client independently of the present structure of the production, the IT system landscape currently in operation, and the implemented processes. The file structure aligned with business capabilities is what makes it possible to differentiate clearly, retrieve, and thereby achieve the greatest possible reusability of the services. Figure 2 shows a part of the service repository created in this way. We decided against the integration of an enterprise service bus (ESB) for the realization of the integration layer because the highly standardized services available from the ESB do not, from the business perspective, satisfy the process requirements.

The data objects are located in the data layer. The data objects, differentiated along business lines and free of overlap, were allocated to the business capabilities required for process execution. At the same time, a system that assumed the create, read, update, and delete functions for the data object was allocated to every data object. This approach clearly defined responsibility for data maintenance without any overlap. In this way, the redundant maintenance of the data and the required validation and consolidation of the data within the framework of process execution could be reduced to a minimum. The standard PLM system that was already in place was retained as the central data-carrying system, a step which secured the investments in the PLM system. In the future, a far greater share of the necessary changes will be covered using the standards in the PLM system. It was possible to significantly reduce the expenditures for necessary client-specific modifications to the PLM system by shifting the implementation to the process layer.

Figure 2: Architecture Structure for Process Digitalization

![Architecture Structure for Process Digitalization](image)
The production resources are located in the **infrastructure layer**. Functions are defined for each resource and make the resources available for release via services in the integration layer. Production management can carry out modifications such as optimization or error correction in the functions rendered by the resource. Since any such modifications are now “made public” by the services, any such changes are transparent to the process subjects as part of the service change documentation or release documentation. Minor modifications are documented within the framework of a new revision. If any such changes have an impact on the compatibility to input and output values, a new secondary version is issued and provided as an improved alternative in the integration layer. Major changes that also involve modifications in the definition of the interface are made public in a new primary version. Which version is used in which process is made visible through the connection with the process layer. This lays the foundation for discussions between business users, managers, and IT personnel regarding future use and advanced development of the functions made available by the production resources.

**Subject-oriented design of the processes**

We used a subject orientation for characterization of the processes in the process layer and a workflow engine that made it possible to generate the process application for implementation of the process logic from the process models. This aspect must be emphasized: no more programming is required for the implementation of the process logic because the application is generated from the models. This means that changes in our client’s process logic now lead solely to modeling expenditures. Changes in the process involve development expenditures only if and when the web services for process automation and process integration must be modified, supplemented, or newly developed. Thanks to the creation of a process layer characterized by subject orientation, our client is able to reduce significantly the change cycles and change expenditures. This process layer gave our client the ability to implement changes in the process flexibly and quickly. Even before the project was completed, our client had determined that he now had at his disposal an instrument for the design of agile processes which could be used for differentiation from the competition.

The question still remains whether the business users and the process subjects are capable of working with these flexible and quick changes and of adapting their daily work to them. Our client was able to answer this question with a clear “yes”. The justification for this “yes” was just as simple as the method we used for the design of the processes in the process layer. The business users from production planning and management designed and modeled their processes and any necessary changes themselves. The process logic they had designed themselves and the collaboration in the process could be experienced and tangibly handled immediately after being modeled in a process application.

**Critical success factors in process digitalization**

The use of the S-BPM approach had an especially positive impact on the following critical success factors in the process digitalization.

*Utilization and acceptance of the modeling language among business users*

Only five symbols in combination with natural language generate unambiguous statements. The business users immediately grasped how the modeling works. It was a particular moment of revelation for us when the business users realized that the description of process functions and their explanations could be seen 1-to-1 in their process applications as well and not only in the models. In this way, the process models served not only to describe the process, but were also usable as operating procedures in the process application.

*Willingness of the business users to contribute during the modeling workshops*

During the first workshop, we spoke “only” about the communication relationship among the process subjects and determined what information would have to be shared. This led to our addressing critical points in the collaboration model among the process subjects. The business users found out in the very first workshop that tasks were in reality not distributed in the way foreseen in the company’s governance model. We conducted an exhaustive discussion of these topics so that we could achieve an
improved, yet feasible, process sequence in our client’s organization. The constructive criticism from this head-on confrontation with current issues and the easily understandable presentation of a solution using only two symbols (the subject and the message) caused any initial reservations on the part of the business users to evaporate.

Lasting acceptance of the workshop results and interaction with IT

Representatives from IT and production IT participated in the workshops alongside representatives from production planning and management right from the beginning. This was initially only symbolically important as a way to show that the business side and IT were working together on a model. During a later project phase, when web services for the automation and integration were implemented for the refinement of the process, we went beyond the symbolic gesture to show that business users and IT spoke one language and were talking about the same model. The business users had the tangible experience of seeing their business models being used by IT and realized 1-to-1. The business users accepted their workshop results as models that were permanently established at the working level and as their own processes and applications.

Management support

With the use of S-BPM, we observed a phenomenon which made it substantially easier to gain the unqualified support of management. The business users regarded themselves as the owners of the designed processes and saw how these processes were implemented 1-to-1 in process applications. This proprietary sense prompted the business users to make their own attempts to convince management of the correctness and necessity of the process implementation. Our client’s business users assumed the role of project marketing. During the meetings for presentation

Figure 3: The Adaptation of the Agile Scrum Rhythm for the Subject-oriented Process Digitalization

Source: Detecon
of the interim results, the business users themselves took the floor and presented the process application and its benefits. Management’s reaction was logical: “If our employees are convinced of the value of the process application and have been given a lever that will help us to achieve our goals, then we will support it.” As of the first presentation of the interim results, the project was no longer our project, carried out by us consultants for our client. The project was now our client’s project and belonged to the employees from the business side and IT; we, the consultants, were merely companions along the road.

**Agile procedure in Scrum rhythm**

The project was organized on the basis of the Scrum rhythm so that the complexity could be made manageable. We proactively designed the communication of the project results to match the rise in the business users’ understanding of their process. We aligned the process releases to the end-to-end processes and differentiated them in accordance with the growing process automation and integration. At the end of every sprint, a process application was presented as a process increment in the sprint review. The process application became more refined with each successive sprint – the degree of automation and integration grew from one sprint to the next. Figure 3 shows how all of the process backlog items always contributed to the creation and modification of a process application as a process increment.

**Continuous improvement is the goal**

Speed and flexibility in production planning and management require the integration of all of the process subjects, IT, and data and production resources. Information must be obtained in real time and provided to the appropriate personnel without delay so that they can realize the modifications immediately or initiate them themselves. This is especially important for the actors who work with the processes every day. The subject-oriented process modeling gives the business users the chance to model their processes themselves and to adapt them constantly. The modeling approach brings business users and IT together at one table – misunderstandings and communication problems are reduced significantly and modifications are integrated quickly and transparently for all concerned on the basis of the Lego principle. All of the subjects work in a single workflow that unifies the involved systems in a “single user interface”. The subjects have all of the information relevant for their work at their disposal. Since subject-oriented process modeling tools generate the executable process applications directly from the process models, changes can go “live” quickly and easily. In collaboration with our client, we design holistic production planning and simplify the assessment as well as the continuous improvement of structures and processes in production.


Frank Lorbacher is Managing Consultant. He has had over 20 years of experience working with BPM in various industries. His focus is on the conceptualization and implementation of agile processes in service-oriented architectures. He is an expert for process digitalization and the related process transformation.

Michael Spiller is Consultant and advises clients of the Automotive sector on the topics of digitalization of processes and enterprise architecture management. As a certified Scrum Master he is concerned with agile process modeling and implementing.