

# Introducing Architecture Modeling at a big software product company

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**Abstract:** It's been a long journey between the first steps in architecture modeling and the wide distribution among all major development locations of SAP, a large, global software product company. This article analyzes the approaches, obstacles, and success factors from a historical point of view and gives an outlook on future steps. It gives some insights on the difficulties rolling out a modeling method on large scale using a positive example.

## 1 Architecture Modeling at SAP: Why and how

The roots of architecture modeling at SAP [SAP] reach back to 1990 when Hasso Plattner, founder and then board member of SAP, learned that it is possible to describe a complex software system in an understandable way and that this description could help his company to capture this vital knowledge for the future. SAP produces business software products for enterprises. In 1990, SAP had 1700 employees, and was about to release the first version of SAP R/3. Today, approximately 40% of the 54000 SAP employees work in development, creating, extending, and maintaining a huge code base<sup>1</sup> in a massive division of labor, distributed among 300 development labs in 120 countries all over the world.

The organization of development and the efficiency of the support organization require standardized development processes and big alignment efforts. Especially handing over product code to other teams during its lifecycle requires an effective knowledge transfer. Most approaches actually used for this handover are informal. At SAP, architecture models proved to be very helpful here; in most cases, architecture models at SAP are used solely for communication purposes such as alignment, knowledge transfer or conservation.

Starting 1990, SAP began using an architecture modeling approach later known as 'FMC' (Fundamental Modeling Concepts, see [FMC], [KGT06]). Later, in 1999, SAP embraced the UML [UML] and combined the FMC approach with the UML notation where appli-

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<sup>1</sup> In January 2012, the SAP ERP solution, which is only one part of the SAP Business Suite, had 1 224 624 175 lines of ABAP code

cable. This combination was called TAM (Technical Architecture Modeling, see [TAM]) from 2005 onwards.

Of course there are many other modeling approaches used for business modeling, especially when looking at the platform of the SAP Business ByDesign Solution, or the business models in the SAP Solution Manager. Nevertheless, for the description of technical architecture, such as technology platform and frameworks used in the SAP products, FMC and TAM are used across the company today.

## 2 History

This section presents the most important milestones regarding architecture modeling at SAP.

1990: On request of Hasso Plattner, Prof. Dr. Siegfried Wendt and his research assistants started describing the R/3 basis system. This also was the beginning of the SAP Architecture Bluebook series (internal technical reports about architecture of technology or products). The modeling approach introduced by Siegfried Wendt and refined in the following years was later called FMC (Fundamental Modeling Concepts).

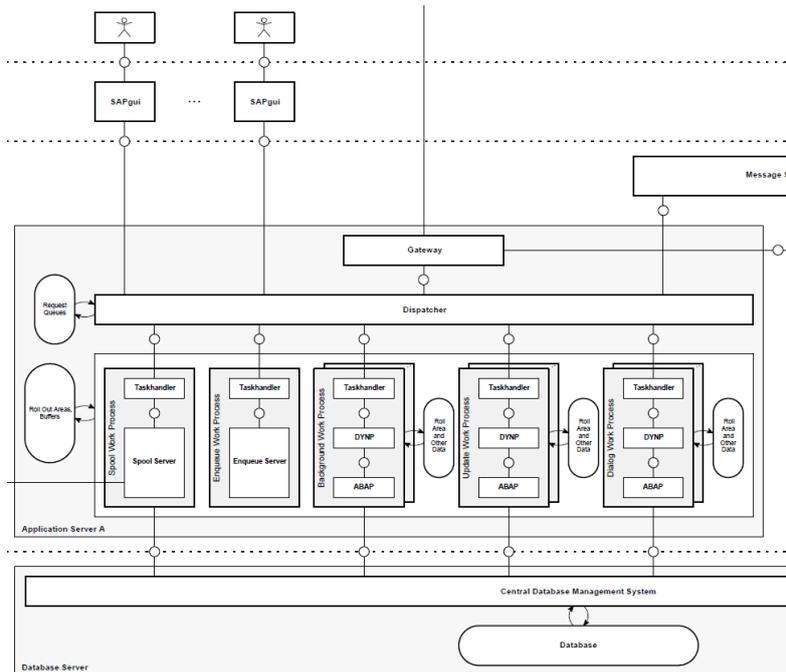


Figure 1: Excerpt of an FMC Block diagram in an early SAP Architecture Bluebook about the Dispatcher and Taskhandler in the R/3 Application Server [BME04.02].

In the first phase, management had to learn that modeling a complex technology platform with many millions lines of code (C / C++ / ABAP / RSYN / etc.) takes more time than expected. One idea was to make the best out of it and to found a group of SAP employees (not only university assistants anymore) for this task, the basis modeling group, in 1993. Since colleagues working in this group get both a good overview and a deep insight into one area, the idea was to educate future software architects in this group, by letting them work for two years with architecture modeling. This idea found many obstacles in reality. One of them is that for being an architect it is not sufficient to know the architecture and be able to describe it. As a consequence, the basis modeling group was turned into a service group in 1996.

In 1997, there was one of the biggest success stories of the SAP architecture bluebooks, the outcome of the architecture modeling efforts of the research assistants and the basis modeling group: With the help of the SAP architecture bluebooks, it was possible for IBM employees to port the R/3 basis system to the AS/400 system, needing only little support by one SAP employee.

1999: SAP embraced UML and changed existing architecture documents to UML notation; the predecessor of TAM was defined.

Nevertheless, for managers architecture modeling mainly meant writing architecture bluebooks which was very expensive and could pay off years later, if at all. There were few specialists for modeling and writing, and their time was usually already booked with many projects. A broader roll-out was not planned in this time. In contrary, in 2000, after the basis modeling group finished the 48<sup>th</sup> SAP Architecture Bluebook, the group was transformed into a central architecture team in platform development (later called SAP NetWeaver Architecture). A number of people continued using the modeling method, and the architecture bluebooks were still a good source of information. The downside: until 2006, many new technologies and products were created without proper description by a bluebook.

An internal UML classroom training was developed to transport among others knowledge about architecture modeling with FMC and TAM to interested colleagues.

Between 2000 and 2006, many changes happened at SAP, not only regarding technology strategy. The SAP NetWeaver Platform, including among others a Java Application Server, a Portal, and a Message Hub, brought new architecture into the company, and again the necessity to describe the architecture for knowledge transfer and alignment. This time, the approach was different: Instead of letting a group of specialists create high quality architecture documents with high effort, a formal development process forced developers and architects to create formal documents describing architecture and design themselves. When formalizing the development process in 2004<sup>2</sup>, the need for a standardized architecture description lead to re-activating the modeling best practices: Looking at the models in the formal documents, the variety of notation and approaches made obvious that it was not sufficient to request architecture models, but also to standardize

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<sup>2</sup> The formalized development process was called PIL (Product Innovation Life Cycle).

the model notation as well - Standardized Technical Architecture Modeling (TAM), published in 2006. TAM defines a subset of UML which is used for architecture modeling at SAP and adds FMC block diagrams. As a result of the standardization, the demand for education and modeling services increased dramatically.

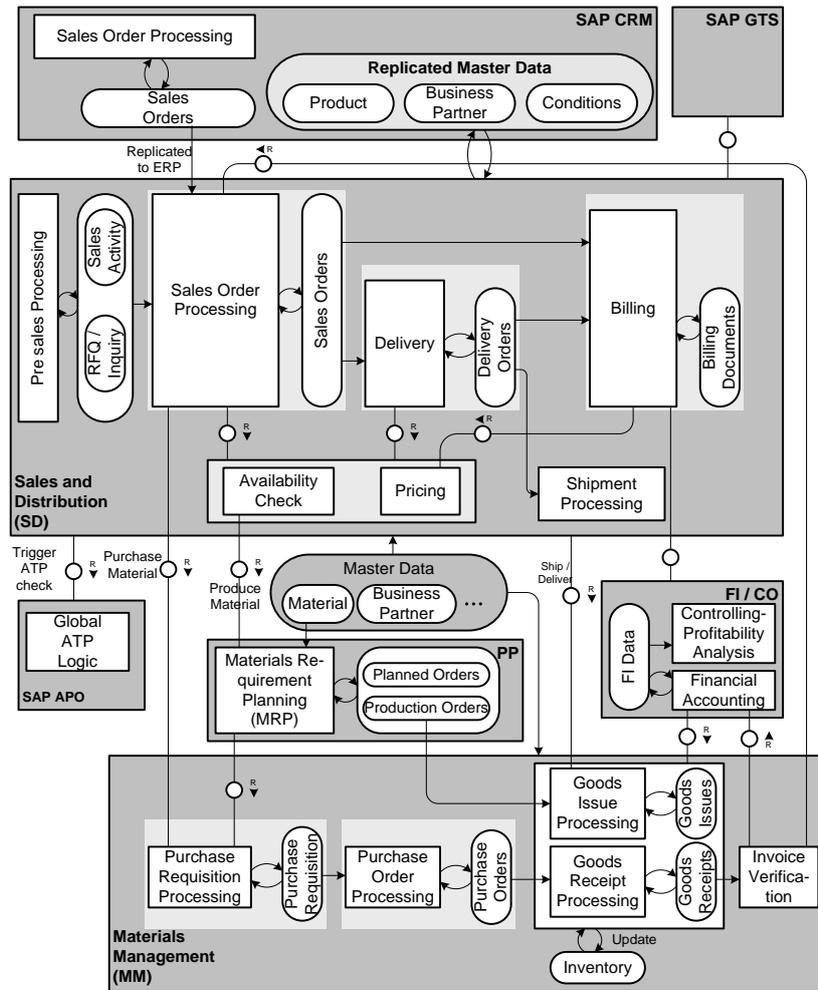


Figure 2: TAM Block diagram showing SAP ERP Sales and Distribution, taken from the SAP ERP Bluebook [Kar08]

Dr. Vishal Sikka, now board member and CTO of SAP, supported the idea to revive the SAP Architecture Bluebook series, this time with focus on application architecture. Although again a central team is responsible for the SAP Architecture Bluebooks, the way to create them has changed in the following years: While in 2006 the members of the central team worked mainly as authors, their role changed to bluebook consultants in the meantime - more and more authors are now coming from the development or support

organizations. At this time it is important to highlight the fact that especially the support organization (Installed Base Maintenance & Support - IMS) is highly interested in architecture bluebooks about the applications they have to support. They see the immediate benefit of these architecture models, and are willing to invest the time of their best colleagues to get these models.

In 2007, there was an event where Hasso Plattner, now head of the supervisory board, demanded architecture models to deep dive into the technology basis of SAP Business ByDesign. This made clear for development managers that architecture models are not only required by the development process, but also by top management. Plans for a quick and broad roll-out of TAM into the development organization within a short time luckily didn't realize. Instead, a growth in education offerings and more services around modeling were possible in the following years, leading to a slower, but sustainable roll-out of architecture modeling through the complete development organization.

In 2007, the former UML classroom training was transformed into a real architecture modeling course for TAM. The format of the course also changed: Now it is one day classroom training with much interaction and practice (7 exercises in 8 course hours, including breaks), complemented by a modeling workshop some weeks later. This focus on practice is very important, and the workshops give the participants a forum to present their models and test whether they work for knowledge transfer. In the next years the course became one of the best rated courses in internal education and also scaled successfully in all major development locations, starting 2008.

Additional roll-out material and services complemented the classroom training. One service was going through the presentation material about technical topics at external and internal SAP fairs such as the SAP TechED [TechEd], with the goal to replace free-style diagrams with TAM.

2009: The modeling training has become an integral part of the education of new software architects (Architecture Curriculum). TAM is mandatory for documents required in the development process, especially Architecture Definition, and has to be used in the Architecture Concept Document, the formal document describing a planned architecture, which is used as reference and for reviews. Furthermore, TAM is part of the company-wide development policy.

2010: More and more groups found an education need for architecture modeling and included the modeling training into their standard education offering. In Germany, the course was offered 22 times in 2010.

Today, 2012, the modeling approach TAM is used in development and support across the company. SAP employees working in development are used to work with TAM. Most development documents for architecture and design contain TAM diagrams; there is no reason to use free-style graphics anymore. 20 architecture bluebooks have been written since 2006, with focus on business applications. 41 trainers worldwide allow giving the modeling course at 15 major development locations from Shanghai to Vancouver. The course has been included in standard education of architects, info developers and the

custom development organization. Of course this means that the roll-out has not yet ended, but is transforming into an ongoing education offering.

### 3 Rolling out Architecture Modeling at a company: How?

Obviously, there were many ups and downs in the roll-out of the architecture modeling approach at SAP. There is not the best single approach, but a good mixture is required in the right sequence.

#### 3.1 Approaches

**Conviction / Belief** starting at the top (board / supervisory board) is necessary. Ideally, the majority of colleagues working in development is convinced in the end, but this is a long process.

**Education:** Enable colleagues to model by teaching the basics and let them get experience by applying the method in their own daily work. Invest in classroom trainings with high interaction ratio. High quality of learning material makes it easier to scale trainings since other trainers can do the training in an acceptable quality. Make use of local multipliers as much as possible.

**Role models:** Provide high-quality documents as good examples and provide easy access. This is the intention of the SAP Architecture Library<sup>3</sup> and the Architecture Bluebooks. Also, colleagues that use architecture models successfully and are fully convinced are excellent multipliers.

**Service:** Extremely important. When you plan to force people to model, you have to be present to help them. For example, going through the presentation material for the TechEd fairs, inform the authors that they have to adhere to the modeling standard TAM, but also provide proposals how to use TAM for their particular diagrams. It was a lot of work (appr. 250 slide decks for one TechEd), but paid out, also as education.

**Command:** Not the best approach at SAP. In the beginning, in the early 1990's, Hasso Plattner said in one of his speeches, all developers should use FMC, but no further steps were taken, such as education and service. Years later, there was a remarkable event where Hasso Plattner requested a deep dive into a big development project to see the architecture in detail, and made very clear that he expected architecture diagrams like in the famous bluebooks. The third time, installation in the SAP Development Policy, was only successful because there was a **Governance** process together with a wide foundation of educated colleagues able (and willing) to follow the policy. Furthermore, TAM is an

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<sup>3</sup> The SAP Architecture Library is a central location in the SAP intranet providing online access to the most important architecture documents and linking to area-specific repositories of architecture documents.

internal standard which is part of the formal development process at SAP ("PIL"). Governance includes reviews in which the documents are actually checked and reviewed. Though, formal checks are very unpopular, and step by step governance turns more and more to internal consulting.

Looking at the approaches, it becomes obvious that one single approach is not sufficient. It is the right mixture at the right time. For example, in the beginning, it doesn't make sense to force people (Command). Instead, Role models in lighthouse projects and education is important. Later, it is possible to add Governance together with Service, but on the same time increase education. Without conviction of top management, such a roll-out is hardly possible. To get the conviction of the colleagues working in development, they have to experience an immediate benefit from using the modeling approach. Then many of them will become role models and multipliers in their teams.

### 3.2 Success Factors

To better understand the impact of the various approaches, it is necessary to analyze some of the success factors.

***Simplicity:*** When the focus of modeling is transporting concept knowledge among humans, simplicity is key. TAM is easy to read and can be learned within a short period. Furthermore, the few simple elements of the diagrams allow using any drawing tool to create the diagrams. Since the topics and the reality is quite complex, it helps when colleagues don't have to deal with additional complexity of the modeling method.

***Flexibility:*** It is possible to apply TAM modeling on many levels, be it on application level, framework level, platform level or machine level. And - it is used on all levels. The price to pay for this flexibility is the big variety what an element can represent. For example, an agent represents an "active component that processes information". This can be an invoice verifier, a rule engine, an event dispatcher, or a memory management unit as well. As a result, the modeling method can be applied universally.

***Time:*** A roll-out in a large company takes time. Changing the way how people work takes even longer, this has to be counted in years. When the seeds are planted and enough convinced colleagues just model their architecture (and serve as role models), it will spread, but it takes years. Luckily, the time was available.

***Tools:*** The modeling method is independent from a specific tool. From the beginning, there was no real modeling tool offered for TAM at SAP. Instead, colleagues were invited to use the drawing tool Microsoft Visio (TM) with a set of stencils, although they could use any other drawing or modeling tool of choice as long as the diagrams were conforming to TAM. This seems to be a disadvantage, because it prevents taking advantage of the models, such as consistency among multiple diagrams or extracting model information for further processing. Nevertheless, looking at the way people use TAM, it

was the best way to support the success. There is even a template for Microsoft Powerpoint (TM) which was requested as well and is used by a number of colleagues.

One reason for the success of drawing tools is that colleagues could simply create diagrams without having to learn a tool and the metamodel. There was an answer to the question "how do I create a TAM diagram for my development document?" and the majority of colleagues was not interested in further features. This will probably change in future (see below).

**Second row:** To spread a method among the whole company, you need a top management that is convinced of the benefit. On the other hand, when such a process takes time, it is not good to have too much attention by top management, though. Little budget requirements were very helpful here - no need for an expensive tool, no need to train each and every development colleague (because of simplicity and local multipliers). This combination allowed enough time and budget for a constant and finally successful roll-out to the development organization.

**Experienced usefulness:** Colleagues will create models when they get a benefit from it. When they don't benefit, but someone else from their team, then it's also OK. But to model something without getting a benefit from it won't work ("What's in it for me? What's in it for my group?"). Of course, TAM is required for documents in the development process. But since the colleagues experience a benefit in aligning efforts with other groups, they create the models anyway. Of course, lighthouse projects, such as the high quality architecture bluebooks, help a lot to convince other colleagues.

**Strong people representing and pushing the topic:** At SAP, there is always a face behind a topic. The success of architecture modeling in development was only possible by the motivated and persistent work of individuals such as Siegfried Wendt, Wolfgang Zuck, Adolf Pleyer, and me, the author, backed by the conviction of Hasso Plattner and Vishal Sikka.

As with the approaches, it is a combination of factors, not a single one, at the right time.

### 3.3 Target Groups

Finally, let's have a look at the user groups of architecture modeling.

**Architects** are of course primary users of architecture modeling. They get a direct benefit for communication and alignment. Furthermore, they also benefit from the more formal documents required for the development process. Architecture models help documenting design decisions together with their reasons, which help architects justifying those decisions later on.

*Developers* read architecture models and benefit from them when solving problems in design, although they don't need them to align with other groups.

*Documentation developers* (docu for end users) also take advantage from the architecture models that are now present in development and start using TAM diagrams in the product documentation [SAPhelp].

*Consultants*: Some consultant need to depict complex system landscapes of SAP customers to introduce new components or consolidate systems. They found that the simplicity and flexibility of TAM perfectly fits to their requirements, and therefore prefer using a "light" version of TAM.

*Management*: Architecture Modeling at SAP started 1990 with the need of a board member of SAP, Hasso Plattner, to get an insight in the development of the newly developed R/3 basis system. The complexity of the products that is not visible by just looking at the Graphical User Interfaces can only be handled by adequate architecture models, and a number of managers at SAP use them to get a better insight in current development.

## **4 Conclusion and Outlook**

Spreading a modeling method among all development areas of a big software company like SAP takes time. One key factor is the benefit that developers and architects get from using the modeling method, even when other groups are not using it. Approaches to spread a modeling method that only brings benefit when the models are complete (requiring months or years of modeling) were not successful.

Simplicity is the next key factor. Colleagues can use TAM successfully after attending a one day training course and getting some practice and feedback when discussing the models with their colleagues. They don't need a specific tool to use TAM, and no big investment in licenses or tool maintenance is required.

Good examples, role models, service and education are needed to convince colleagues that using TAM also brings benefit to them.

Finally, conviction of top management was needed because it sometimes took years until the benefit in development efficiency became obvious.

Although the situation at SAP is quite specific, some of the findings are relevant to other modeling approaches as well. A modeling method or tool does not stand for itself. It's about convincing people and helping them to get a benefit quickly. Lighthouse projects, role models, service, and education are needed to scale out and reach the intended users of the modeling method.

Looking at architecture modeling at SAP, the current situation allows for an extended scope to use the modeling method TAM: TAM is becoming more visible outside SAP,

for example in architecture books, product documentation, or in projects with partners and customers.

The increasing number of TAM architecture models allows for new use cases and tools to exploit existing models, even when they are just drawings. More important is that colleagues in development are used to using TAM and start thinking about further ways to use TAM models. It is going to be an interesting future for architecture modeling at SAP.

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