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Project Master Document adaption in order fulfillment process

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TIIVISTELMÄ

Tämä kandidaatin työ käsittelee uuden projektinhallintatyökalun kehittämistä ja käyttöönottoa ABB Oy Moottorit ja Generaattorit liiketoimintayksikössä, Tahtikoneet -tulosityksikössä. Työ esittelee erilaisia projektinmallintamismenetelmiä ja syvennyy ABB Tahtikoneilla käytössä olevaan Gate malliin. Gate mallin ymmärtäminen on välttämätöntä, koska uusi projektitoiminnan ohjaustyökalu, Project Master –dokumentti, on luotu olemassa olevan projektimallin pohjalta. Lisäksi Project Master -dokumentin tavoitteet ja rakenne on tarkkaan analysoitu, jotta sen käyttöönotto helpottuisi.

Project Master -dokumentti pyrkii parantamaan asiakastilauksen täyttämistä selventämällä tilauksen luovutusta myynnistä projektinhallintaan. Toimistoprosessi, erityisesti vastuut ja tavoiteaika-taulut, selvennyvät myös Master –dokumentin käyttöönoton jälkeen. Project Master –dokumentti on rakennettu kehykseksi koko toimitusprosessille sisältäen tarkastuspisteet jokaiselle projektimallin gatelle ja päivitettyt pöytäkirjat projektitapaamisista. Lisäksi projektin eteneminen esitetään selvästi status merkinnöillä ja visualisoidaan värein.

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ABSTRACT

This thesis discusses adaption of new project management tool at ABB Oy Motors and Generators business unit, Synchronous Machines profit centre. Thesis studies project modeling in general and buries in the Gate Model used at ABB Synchronous Machines. It is essential to understand Gate Model because this new project management tool, called Project Master Document, is created on the base of the existing project model. Thesis also analyzes goals and structure of Project Master Document in order to ease implementation of this new tool.

Project Master Document aims to improved customer order fulfillment by clearing order handover interface. Office process, especially responsibilities and target dates, become also clearer after Master Document implementation. The document is built to be frame for whole order fulfillment process including check points for each gate of project model and updated memos from all project meetings. Furthermore, project progress will be clearly stated by status markings and visualized with colors.

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ABBREVIATIONS AND SYMBOLS

BOM	Bill of Material
ECP	Engineering Check Point
ERP	Enterprise Resource Planning
FAT	Factory Acceptance Test
FCA	Free Carrier
FP	Freezing Point
MRP	Material Resource Planning
OTD	On-Time Delivery

1. INTRODUCTION

This thesis studies adapting and implementing new project management tool, Project Master Document, at ABB Oy Synchronous Machines. Master Document was first developed by ABB AB machine factory in Västerås, Sweden. In order to implement it to Synchronous Machines it had to be adapted according to project lifecycle at Synchronous Machines. Thus, it was important to study first project model in theory and real project life cycle. Contents of Project Master Document were discussed together by persons with different project group roles. The document structure and logic were created according to Synchronous Machines' needs.

General nature of project and principles of project management are studied in this first Chapter. Common project models are described in Chapter 2 'Modeling of project'. Chapter 3 'Project Gate Model at Synchronous Machines' introduces project lifecycle in theory and basis of Synchronous Machines' practice. Chapter 4 'Goals for Project Master Document' discusses the aims of implementation this new project management tool. Chapter 5 'Structure of Project Master Document' introduces details of Project Master Document. Chapters 4 and 5 can be used as internal directions at Synchronous Machines when implementing Project Master Document.

Projects at Synchronous Machines are order fulfillment projects in which company aims to fulfill customer's order according to agreed framework. Typically these projects are sub-projects of wider investment projects from customer's point of view. Thus, remarkable financial stakes exist and on time deliveries are essential, in other words, there are great stress on project management (Pelin 2008, pp. 34-35).

According to Artto et al. 2008, project business is managed action which has clear targets set by company management (Artto et al. 2008, pp. 17-18). Characteristic for project business is demanding engineering and need for high quality which together cause projects' costly nature. Projects have predestined limitations on time, costs and scope. Projects also tend to contain follow-up and customer participation (Artto et al. 2008, pp. 24-27).

Typical for project is wide workload; project duration is normally several months (Pelin 2008, p. 34). Project is taken care of by project group which consists of specialists who have different responsibilities and whose involvement during project varies. Also people outside the company, for example external surveyors, usually participate in the project. Responsibility of whole project lies on project manager (Pelin 2008, p. 34 & pp. 69-71). At Synchronous Machines one project manager has several ongoing projects to be taken care of simultaneously, number of projects is depending on how demanding they are. However, it is to be noticed that project manager is only responsible of the order fulfillment phase of project, selling and support after delivery are not project manager's responsibilities.

There are plenty of views on how a project should be managed. Project management includes different tasks in organizations depending on the nature of project and organization structure. The more individual a project is, the more it needs management besides product manufacturing because risk level of product engineering and manufacturing rises. However, goals for project management are usually similar. Project management aims to fulfill the scope of project as well as project's financial objectives and schedule. Project manager also takes care of customer communication during project (Pelin 2008, pp. 265-269).

2. MODELING OF PROJECT

Different project life cycle models have been developed in order to manage projects. With the help of models project manager can put pieces together and understand project in its totality. However, models are not only for management, complex project lifecycle can be visualized with models so that whole project team is able to follow the progress. Project modeling clarifies responsibilities during project and secures relevant tasks to be done (Forsberg et al. 2003, pp. 14-20).

The basic idea of modeling project is to recognize main tasks during project and to form project phases on the base of them. Normally model is created by ordering phases according to their timing. Expansive phases can be dealt to subprojects if needed. At the end of every phase a measurable result, such as approved design drawings, should exist (Pelin 2008, pp. 99-100 & pp.110-115). Characteristic for phases is also varying participation of

project group members. Designer, for example, is needed mostly at the beginning of project (Pelin 2008, pp. 69-71).

In below chapters a few common project models are introduced. The differences of these models lie in their linearity. How good any model is, can be evaluated by thinking how well the actual project lifecycle fits into the frames of model. Basic problems with existing project models are their oversimplifying, stiffness and lack of constantly existing actions (Forsberg et al. 2003, pp. 20-21).

2.1 Circle model

One of the simplest ways of modeling project is to describe project life cycle as a circle that begins and ends in the same point. Project phases are located on the circle one after another, as can be seen in Figure 1. Whole circle can be circulated as many times as needed, but only one direction is allowed (Forsberg et al. 2003, pp. 20-21).

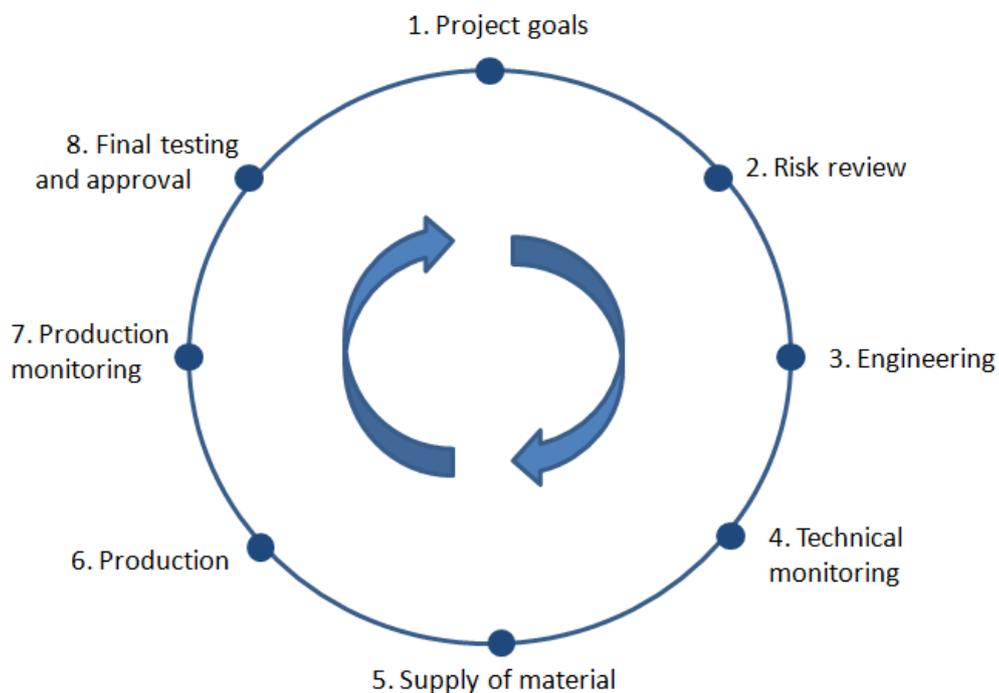


Figure 1. Circle model which includes typical phases of order fulfillment project.

The advantage of circle model is that phases can be returned over and over again. Change management improves while phases, such as risk review and monitoring, can be repeated

before implementing changes. However, circle model may not be the best choice for modeling order fulfillment project, because of the physical results from several phases. If whole circle needs to be repeated, unnecessary phases are repeated, too. Circle model also fails to model constant project actions because phases are seen as sequential.

2.2 Waterfalls model

Waterfall model is most used when it comes to modeling project. It is suitable for projects with linear schedule. Basis of this model is that project is divided to sequential phases and not any phases are overlapping, as Figure 2 presents. Each phase is closed after it is fulfilled. Advantages of waterfalls model is simplicity, clear scheduling and checking (Forsberg et al. 2003, p. 22).

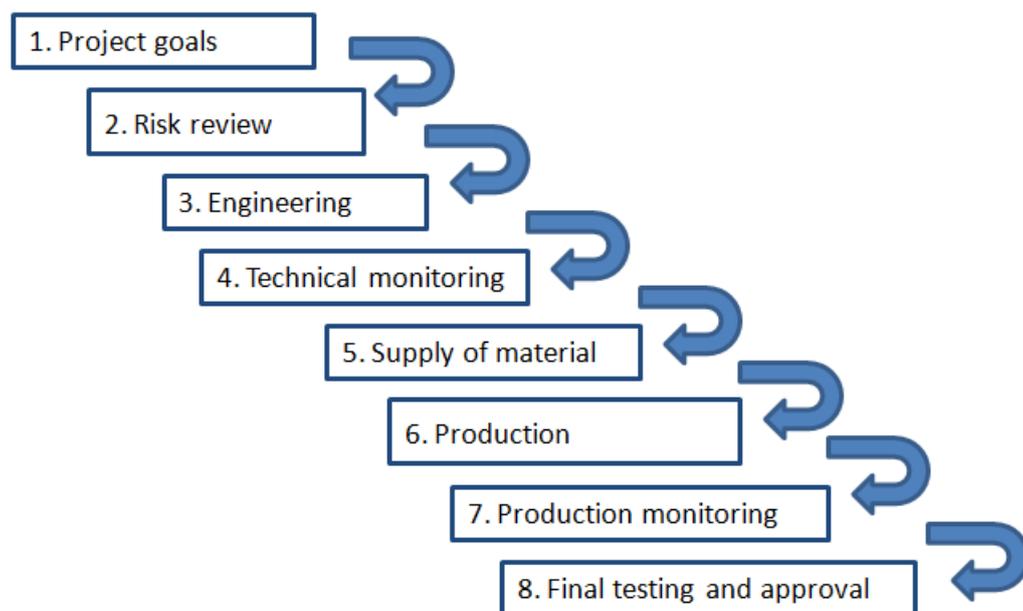


Figure 2. Waterfalls model which includes typical phases of order fulfillment project.

Usually projects following waterfalls model include preliminary and detailed engineering, testing and customer acceptance. Typical problems related to waterfalls model are difficult change management and incomplete information flow caused by lacking loops between phases. Thus, both customer and supplier feedback during project is hard to implement. Also no feedback from other ongoing projects is collected systemically during project (Davies & Hobday 2005, pp.169-179).

This thesis concentrates on Gate Model which represents waterfall models. Project Gate Model consists of gates and phases. All activities take place during phases. Gates act as quality control checkpoints to ensure phases to be finished before continuing to next phase. Next phase begins only after the previous gate is approved, and to finished phases is no longer returned after gate approval. Company can modify number of gates and phases according to its needs (Swanstrom 2009).

2.3 Spiral model

Spiral model has partly overlapping phases and some phases are returned over and over again, as Figure 3 shows. Returning to phases ensures feedback to taken care of during project. Spiral model is suitable for complex projects with non-linear schedule. It is mostly used with software development process. This model aims to better risk analysis, more realistic scheduling and finally, better customer satisfaction. However, spiral model is seen confusing and project progress is harder to follow (Forsberg et al. 2003, p. 23-24).

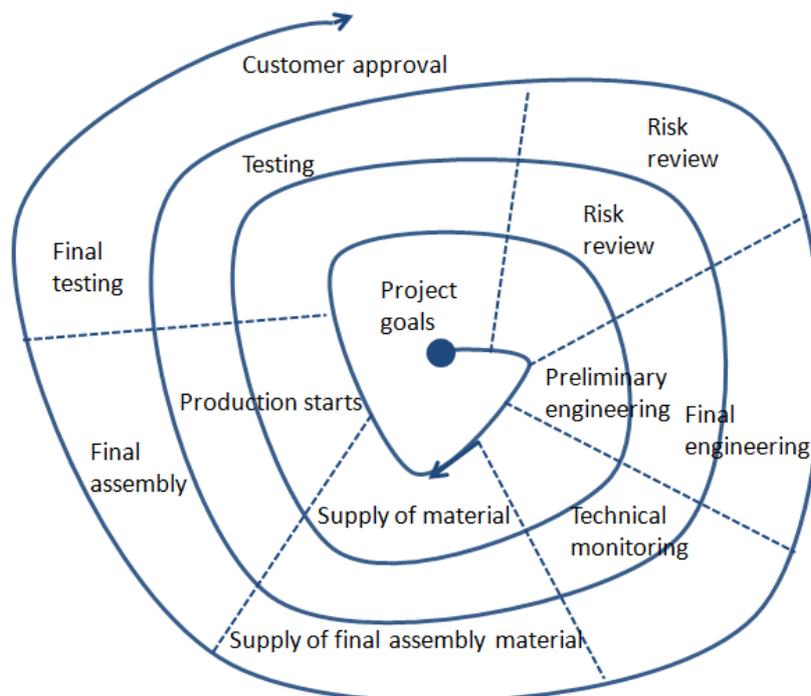


Figure 3. Spiral model which includes typical phases of order fulfillment project.

Figure 3 represents spiral model adaption in order fulfillment project. Spiral model has both circle model and waterfalls model features. Its great advantage is that model can be modified according to real project. Contents and location of phases and how overlapping phases are can easily be changed according to real project lifecycle. Thus, functionality of spiral model depends on the structure used.

3. PROJECT GATE MODEL AT SYNCHRONOUS MACHINES

Gate Model is widely used at ABB but its content differs in business units. At Synchronous Machines project lifecycle is introduced in the factory quality plan. There are three separate parts which are selling, order fulfillment and support. Gate Model covers first two phases and actual project management takes part in order fulfillment. Support takes care of the project after delivery.

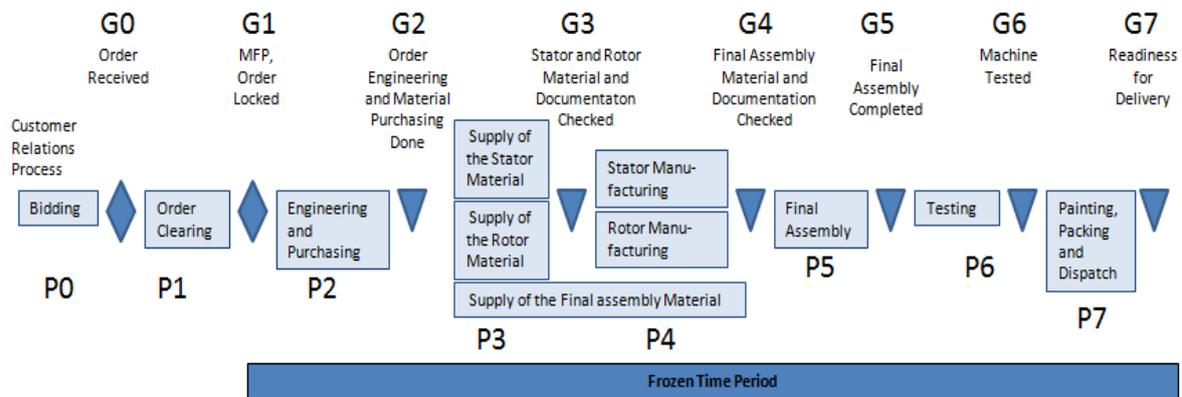


Figure 4. Gate Model at Synchronous Machines as represented in Quality Plan. Gates are marked with letter G and phases with letter P.

As can be seen in Figure 4, there are eight phases and eight gates in Gate Model. Azipod motors make exception, they are completed at ABB Propulsion Unit's factory. Thus, their project management at Synchronous Machines covers only first five phases of Gate Model.

3.1 Selling

In principle selling phase begins after customer order request is received, but in practice major part of selling is continuous taking care of customer relationships. Typical customer investment project starts with competitive bidding. The major responsibilities for seller are to create product according to customer's wish and company competence, and bid for that. It is of high importance for seller to deviate the customer's requests that cannot be realized. Otherwise there will not be any possibility for final product to correspond to customer's order (Arto et al. 2008, pp. 63-65). At Synchronous Machines sales manager takes care of order during selling phase. Usually project team, or at least project manager, is named at this early stage of project. Selling is marked as Phase 0 in Figure 4 because it is not part of actual project phase.

3.1.1 Bidding

Idea of bidding is to answer on customer's order request. Company can choose whether to take part in competitive bidding or not. If company chooses to participate, the seller forms a bid on the basis of company targets and evaluated costs of order fulfillment. Previous archived bids are used as reference to new bids. Successful bidding ends up in an agreement with customer (Arto et al. 2008, pp. 68-74).

At Synchronous Machines order phase design that includes preliminary technical specification and machine specific mechanical drawings is done in bidding phase, so that realistic bids can be formed. Soon after successful bidding order fulfillment starts to formulate. Production planning department does preliminary production plan noticing order data and load situation of the factory.

3.1.2 Order clearing

Project is started up in order clearing phase. The purpose of this phase is to define project's scope and move main responsibility of project from sales manager to project manager. Order clearing is the interface between selling and project management. It is utterly important

to thoroughly take care of it so that final product will correspond to customer's order (Artto et al. 2008, pp. 48).

Order clearing is first phase of Synchronous Machines' Gate Model, as Figure 4 shows. Order is handed over and first project meetings, kick-off meeting and possible design review, take place during that phase. The phase ends to Gate 1 'Order locked' after project is freezed.

Order handover

The idea of order handover is to make contents of customer's order clear to project manager. All documents are gone thorough and also unwritten information, for example customer expectations, is passed to project manager. Customer order's commercial and technical information should be considered thoroughly (Artto et al. 2008, pp. 90-91). At Synchronous Machines responsibility has typically changed to project manager only after kick-off meeting, no separate order handover has existed.

Kick-off meeting

Kick-off meeting is held at the project start up. Purpose of this meeting is to go customer order information through with project group and form project schedule (Pelin 2008, p. 78). At Synchronous Machines kick-off meeting is held for all projects. Seller convenes project group, including project manager, mechanical designer, electrical designer, buyer and production planner to project's kick-off meeting. No project specific production planner is named, production planning department takes care of all projects together. Kick-off meeting is called as soon as possible after order is recorded. Target dates for each gate are agreed in the kick-off meeting. Timing of critical components, i.e. components that need to be purchased at early stage of project because of their long delivery times and specific requirements, is also agreed in kick-off meeting. After the kick-off, order acknowledgement is sent to customer.

Design review

Reviews are held during project in order to confirm that manufacturer can fulfill customer order according to agreement (Artto et al. 2008, pp. 94-95). Optional design review is held at Synchronous Machines before Freezing Point if the machine structure differs remarkably from the delivered machines or there have been quality problems with similar kind of machine design. The purpose of design review is to make sure that customer's requirement and initial data are understood correctly before engineering begins. All order information is gone thoroughly and systematically through in design review.

Freezing Point

The idea of Freezing Point, i.e. FP, is to get basic order information locked by predestined date so that order fulfillment can properly begin. Scope of order should be checked and approved by both customer and manufacturer. Freezing of project aims to decreasing risk level of project (Artto et al. 2008, pp. 243-244).

At Synchronous Machines order clearing phase ends in order freezing which is Gate 1 in Figure 4. Essential information for engineering, such as machine frame size, machine type designation and main connection side, need to be cleared out before engineering starts. Also other information needed from customer should be gathered before freezing. That is customer delivered items, voltage regulator type, painting and testing among others. If these are not announced in time, factory standard solutions are used and customer is charged additional costs for changes.

3.2 Order fulfillment

Order fulfillment phase includes order engineering, purchasing, manufacturing and constant follow-up. Responsibilities of main tasks are on different project group members and project manager takes care of these progressing according to planned timetable. Customer communication and change management are also project manager's responsibilities (Artto et al. 2008, p. 49). In Figure 4 is shown that at Synchronous Machines order fulfillment is

the actual project phase, a frozen time period which begins after order is freezed and ends when products are delivered.

3.2.1 Engineering and purchasing

Characteristics for order fulfillment project are demanding engineering and external material purchases or other use of external resources. Usually in project business all products are somewhat individual, thus several engineering work hours are always needed. Lately the trend has been that the part of supplied material increases while own-manufacturing decreases. Therefore well-organized supply chain of material is more and more critical for project's success. Essential in purchasing is to choose suppliers, ask for bids and maintain good supplier relationships (Artto et al. 2008, pp. 175-185).

At Synchronous machines engineering starts with electrical engineering which takes few weeks. Electrical designer creates technical specification and main connection drawing for machine. After electrical design is completed, mechanical engineering starts. Mechanical designer completes machine specific drawings and chooses standard machine application drawings. It takes couple of weeks to finish mechanical design, depending on complexity of design and reference projects available. It is noteworthy that engineering lead time varies significantly upon customer specification and need. Machines are always designed to meet latest IEC 60034-1, International Standard for Rotating Electrical Machines, requirements and other requirements if agreed.

Designers are responsible of machine structure functionality. Mechanical designer also creates Bill of Material of the order, i.e. BOM, which includes machine structure and components. Purchase requisitions are created on the base of BOM. Thus, purchasing can begin only after machine structure is created by designer. Critical materials make exception; they are purchased with early stage requisitions to shorten delivery time, as described in Chapter 3.1.2. Purchaser is responsible of getting materials according to engineer's specification and according to planned manufacturing schedule.

ECP

Project can include several check points where certain preliminary result of project is evaluated and approved (Artto et al. 2008, p. 126). At Synchronous Machines Engineering Check Point meeting, i.e. ECP, is held right after mechanical engineering is completed. The idea of ECP is to verify machine structure, status of purchase requisitions and manufacturing start-up through with the project group. Especially status of critical purchases is relevant to check, so that manufacturing can begin according to planned schedule.

3.2.2 Supply of the material

Usually order fulfillment projects result in physical product. Before manufacturing can be started, resources are checked. This means production load, material availability and instruction are considered (Artto et al. 2008, p. 49). This happens during Phase 3 of Synchronous Machines Gate Model and it ends to Gate 3 when readiness for stator and rotor manufacturing is checked. In reality some materials needed later are supplied after the gate closure, for example winding manufacturing can begin before stator frame is received. Supply of the final assembly material continues through Phases 3 and 4. It ends to Gate 4 when needed materials are received and documentation checked.

3.2.3 Stator and rotor manufacturing

Manufacturing is the part of project when physical products are formed on the base of engineering and purchases. Manufacturing proceeds according to schedule created by production planner and machine design created by engineers. Project group supports manufacturing and follows progress. Notifications are made if deficiencies are confronted. Inspection records are done in order to ensure quality during manufacturing (Artto et al. 2008, pp. 49-50).

At Synchronous Machines manufacturing's share of project lifecycle is typically relatively short comparing to office process. This is because of demanding engineering and long delivery time for special materials. Target durations for manufacturing are between four and seven weeks depending on product group. Manufacturing consists of three phases which

are stator and rotor manufacturing and final assembly. Production begins with stator and rotor manufacturing which form Phase 4 in Figure 4. Stator manufacturing begins with coils and stator core manufacturing. Then stator is wound and impregnated. Finally stator core is installed to machine frame. Rotor poles and possible rotor center are installed to shaft at the beginning of rotor manufacturing. After that rotor is impregnated and balanced. Control, incoming inspections and testing exist during manufacturing process. Manufacturing meetings can also exist.

3.2.4 Final assembly

At Synchronous Machines last part of manufacturing, Phase 5 'Final assembly', can take place only after Phase 4 and Gate 4 is approved. This is because both stator and rotor are physically needed for machine final assembly. Final assembly takes care of installation of rotor, bearings, cooling unit, end shields and exciter or slip rings. Terminal boxes are connected and pipelines etc. are installed in final assembly. After final assembly machine is ready for test use.

3.2.5 Final testing

Project can be finished only after final product is approved by customer, in other words product is corresponding to agreement. Usually after manufacturing is finished, a Factory Acceptance Test, i.e. FAT, will be held at the factory. The idea is to check whether product meets customer's expectations, agreed requirements and also factory standard requirements. Normally product is investigated by both physical and functional aspect. Customer and external surveyors can take part in testing (Pelin 2008, pp. 355-358).

Figure 4 shows that Phase 6 'Testing' ends to Gate 6 after machine is accepted in FAT. At Synchronous Machines FAT is done to each machine after final assembly. Test program combines with the IEC 60034 standard. Test engineers take care of technical part of testing and prepare test programs and reports. Project manager hosts FAT. Normally this is only time during project when project manager and customers meet. During FAT customers check that machine is manufactured according to order. If something is found missing or otherwise being against agreement, manufacturer takes response to fixing it before deli-

very. Some actions that are outside order can also be agreed between project manager and customer but they may cause additional costs.

3.2.6 Painting, packing and dispatch

Delivery term is agreed in sales phase. Delivery term defines actions that need to be done before ownership of product changes to customer. Invoicing is possible only after the goods are delivered according to agreed delivery term. Most used delivery term at Synchronous Machines is Free Carrier, FCA. FCA means that order is fulfilled when customer picks the goods up at the named place, usually at the factory. Seller is responsible of clearing the goods for export and loading the goods if the picking-up takes place at seller's premises (ICC 2004, p. 149).

At Synchronous Machines the last phase of Gate Model aims to Gate 7 'Readiness for delivery'. After machine is accepted in FAT, all actions agreed with customer are done to it. Then the machine is final painted, accessories are attached and finally the goods are packed. Needed documents for delivery are also gathered.

3.2.7 Project finishing

Project end tasks are normally distributed to several persons. However, responsibility of project lies on project manager until project is finished. Usually project is seen to be finished after products are delivered, product is approved by customer, final project documents are delivered and project is evaluated (Artto et al. 2008, p. 50). Other departments usually take care of delivered product. Sold services increase cash flow and good experience typically leads to new order. That is why customer relationships management is of high importance also after project (Artto et al. 2008, pp. 47-48).

At Synchronous Machines project manager's responsibility of project ends when products are invoiced and rests of agreed documents are delivered to customer. New project evaluation actions, project score card and end meeting, have also been implemented as project final tasks. After project is finished customer communication is directed to local Machines Support or Machines Services.

4. GOALS FOR PROJECT MASTER DOCUMENT

Project Master Document implementation at Synchronous Machines aims to world class project management. In other words, customer satisfaction, On-Time Deliveries, i.e. OTD, and cost efficiency should improve after successful Project Master Document implementation. But before implementation this new tool, it need to be adapted according to Gate Model and practices existing at Synchronous Machines. Master Document adaption will continue also after implementation, because functionalities of this tool can only be ensured by feedback gathered in pilot use.

The document is to be generic so that same document can be used at all ABB Synchronous Machines factories around the world. That is why the language used is English and document is structured avoiding factory specific information. Also as a result of implementing Project Master Document, project documentation can be widely understood which improves project management in projects divided between two factories.

Especially the interface between selling and order fulfillment is crucial to project's success. A successful project meets customer's expectations but in order to make proper business, the scope of project should be well-defined between customer and seller before freezing point. Of high importance is also exact communication between seller and project management during order handover. Project Master Document introduces check list in order to clear order hand over. Check points ensure that all important data is available and some easily forgettable details in order are noticed. If there are too many unclear items in check lists, status is 'No go' for order handover.

Implementation of Project Master Document aims to improve project management during order fulfillment process, too. Project Master Document visualizes project progress and it is filled actively during project. Document's sheets are in chronological order according to Gate Model used at Synchronous Machines. At the top of each sheet is a status marked that is based on the information filled in the sheet. Options for status are 'Completed', 'In progress' and 'Not started'. Sheet's status 'Completed' means that certain phase is approved, gate is closed and progress is allowed. Color markings on the status fields and the sheet tab reflect also sheets' status, so that overview of project's current state is easy to get.

Basically Project Master Document has two types of sheets, check lists and memos. The document introduces new memo formulas for project meetings. Previous memo formulas were used as reference and their heavy structure was lightened. Memos had many fields to fill and they included also unnecessary information. Project basic information had to be filled for each memo separately. On these accounts memo formulas were of little use.

Project Master Document introduces also check lists for project group members. Check list sheets ensure that all vital functions are accomplished before progress in project is allowed or check if something specific exists in customer order. The idea is only to check, not to define product information. This is because many information systems already exist where product information is found. Filling of product information in Project Master Document would complicate change management and cause extra work.

Project Master Document is designed to be easy to use. Work load of project manager or other project group members should not be remarkably increased after implementation of this new tool; on the contrary Project Master Document will lighten project management. Previously memos were separate files and archiving caused problems. The new master document is to replace earlier memo formulas so that all project management documentation is in one master document that is available for all in project archive. Sheets can still be separated in different files when only certain memo is needed.

5. STRUCTURE OF PROJECT MASTER DOCUMENT

Master Document is in Microsoft Excel 2007 format that enables macros. Excel report format is used so that document has printable A4 size. Project Master Document consists of separate sheets for each project gate that handle tasks of previous phase. There are also memo sheets for all project meetings. Every sheet has a header and footer. Sheet information is in the header information, while general document information, such as version and last editor initials, is available in the footer.

Change management of active document had to be taken seriously into account when creating Project Master Document. The basic idea of document is to give real time view of project. However, Master Document also includes memos that are meant to reflect certain state of project, to remain unchanged. That is why memo sheets are locked after their status states 'Completed'. No new information can be filled in the memo or old erased. Gate sheets won't get locked at any time of project lifecycle, and thus after meeting updating possibility exists there.

Project manager owns the Master Document, i.e. is the person responsible for the whole document and active updating of it. However, sales manager is responsible for filling first two sheets 'Order Handover' and 'Scope of Supply' because project is on sales manager's responsibility before order is handed over. Other project group members update also the document, they have check list of their responsibilities. Project Master Document is factory work number specific, in other words all machines under one order are handled in same document but each project has a master document of its own.

Product information in check list sheets is avoided, because they are built in purpose of only checking, not defining. Optional specify field exists at the end of check lists so that important notifications can be made. Check lists are filled by marking 'X' or 'x' in the correct answer box. Usually there is 'Yes', 'No' and sometimes 'N/A' options to choose. 'N/A' should be used when asked item is not relevant. Check list have also questions without set answer options and with dropdown menus. Check list are built so that only one field can be chosen.

Some fields are marked as critical fields by exclamation point in the hidden column 'A'. All users can unhide the column if needed. When all critical fields have 'Yes' or possible 'N/A' chosen, the status 'Completed' appears at the top of sheet and color of status field and sheet tab becomes green. If all critical fields are blank, the status of sheet is 'Not started' and color is red. If 'No' is chosen at least in one critical field, status states 'In progress' and color used is yellow.

Master Document includes several macros that add user friendliness, calculate status for sheets and improve visual look of the document. Macros are written in VBA code. One

macro is run automatically when document is opened and it calls other macros when needed. Basically macros are called per sheet when changes are made to sheets.

Misunderstanding of fields is prevented by explanation comments, field formatting and data validation. Purpose of comments is also to define how specific answers should be filled. Also the length of answer fields defines how specific answers are wanted. Title fields are locked so that Project Master Document formatting and contents won't be changed. Copy fields are also locked in order to avoid incongruent information in different sheets.

5.1 Cover sheet

The cover sheet of Project Master Document is named 'Basic information'. General information of project is filled in there and it is automatically copied to other sheets. If this information needs to be updated later, changes are done in the first sheet. Corresponding fields in other sheets are locked so that any changes won't be made there.

'Basic information' sheet includes 'Project facts', project group members and project schedule. 'Project facts' part is copied to the top of every sheet so that sheets can be used separately when necessary. That part covers customer purchase order number, project name and project identification number in Enterprise Resource Planning, i.e. ERP, systems. Also technical details; product group, degree of difficulty and type designation of items are part of 'Project facts'. Product group and degree of difficulty can be used later to filter the contents of Project Master Document suitable for product group.

Project group members are named and project schedule is filled in cover sheet. First sheet is filled as soon as the information needed is available. This information has to be filled during project progress because they are marked as critical fields in following sheets. In future all information on cover sheet could be automatically downloaded from ERP systems to Project Master Document before order handover.

5.2 Order handover

Sales manager fills first two sheets, 'Order Handover' and 'Scope of Supply', which aim to check that all needed information of customer order exists and customer order details are clear to project manager. 'Order Handover' sheet checks commercial data of customer order and 'Scope of Supply' sheet technical data. In addition, there is a check list for sales manager at the end of 'Scope of Supply' sheet that ensures important actions to be done before order handover. Sales manager is responsible for project until both sheets have status 'Completed' or if project manager is willing to take responsibility of project when the status is still 'In progress'.

After implementation of Project Master Document, order handover should be carried out with the presence of both sales manager and project manager. In future when the Project Master Document is informative enough, order handover could be done only by sending filled sheets. This would help handover of global projects where sales manager and project manager work in different countries.

'Order Handover' sheet

Purchase order number, project numbers and name need to be available before order handover. It is also essential to name both sales manager and project manager – giver and receiver of order. Customer details are discussed in 'Order Handover' sheet. Customer and customer contact person are named and copied to following sheets. Correctness of customer contacts in information systems is also checked. All known parts of customer chain should be filled.

Check list questions in 'Order Handover' sheet are related to agreed details in customer order. This means that relevant commercial documents are named and their availability and order is checked. Terms and conditions of agreement are gone through. Cost calculation and payment terms are discussed. Delivery terms and time is also discussed. Agreed penalty fees are listed and warranty terms are checked.

'Scope of Supply' sheet

Product group and degree of difficulty have to be chosen and machine types specified as part of scope defining. Type of order is also considered, i.e. if machine is a production order or only a design order from factory's point of view. Project management efforts differ in these two order types. Machine design in general is handled. Agreed standards, certifications and classifications are discussed. Additional sales, e.g. spare parts and control systems, are listed. Customer supplied data and items are checked. Testing and need for material certificates are defined. Documentation details are discussed.

5.3 Project meeting memos

Memos from all project meetings are filled in Project Master Document. In future, also manufacturing meeting memos can be part of Project Master Document. All memos have similar structure. Meeting time and place are recorded at the beginning of memo. Project group attendance is recorded. If some members of project group are not named, they have to be filled in the 'Basic information' sheet before first project meeting. Meeting memos have also status information available based on the filled critical fields.

If some actions to be completed in near future occur during meeting, they are listed at the bottom of each memo in 'Agreed actions' field. Their target dates and persons responsible are clearly named. They are automatically copied to next gate sheet where their state is followed with status options that are similar to options in the sheet's 'Status' field.

'Kick-off Memo'

Project group can become acquaint with customer order before kick-off with the help of filled 'Order Handover' and 'Scope of Supply' sheets. 'Kick-off Memo' sheet acts as a meeting memo and it is filled by project manager in kick-off meeting while sales manager chairs the meeting.

Project general information is gone through with check points and there are empty fields for notes. Customer details are informed to project group. Possible reference projects are

listed as project general information. If reference projects exist, project manager finds their notifications and warranty claims beforehand available for kick-off meeting and these are reviewed by whole project group. Agreed certification and classification is automatically copied from 'Scope of Supply' sheet to kick-off memo. These requirements are also gone through in the kick-off meeting in order to inform whole project group. Other general information can be filled in 'Discussion' field.

Design, purchasing and manufacturing have their own parts which contain few check points and notes fields. In 'Design' part it is decided whether design review is necessary. Under 'Purchasing' title critical components are discussed and their final design and order dates are chosen noticing manufacturing schedule. Critical components and their timing are copied automatically to 'ECP' sheet. 'Manufacturing' part checks some important details of manufacturing that should be taken care of good time before manufacturing starts.

Project scheduling is discussed in the kick-off meeting. Freezing point is decided. Final dates for electrical and mechanical engineering are agreed and on the basis of them customer document delivery dates are decided. Purchasing finish date is decided noticing manufacturing schedule presented by production planner. These dates are filled in the kick-off memo and on base of them production planner adds project schedule to ERP system. Then production planner copies gate dates to cover sheet.

'Design Review Memo'

It is decided in the kick-off meeting if design review is necessary. 'Design Review Memo' sheet will be automatically hidden or unhidden according to needs. Usually the sheet is hidden because this project meeting is not part of most projects' lifecycle. In design review project is carefully considered from machine design, purchasing and manufacturing points of views. Project manager fills the memo. Check points ensure important details taken into account. In addition, approvers for design and purchasing and manufacturing plans need to be clearly named.

'ECP Memo'

Project manager chairs the Engineering Check Point meeting and fills 'ECP memo' sheet during the meeting. Project progress and updates are discussed together and main topics of discussion are recorded. There are also some check points that direct discussion. Purchase requisitions are gone through, especially progress of critical components is checked. In Project Master Document critical components and their schedule are copied from 'Kick-off' sheet to 'ECP' sheet. Their current status versus order date is filled. There are some empty lines so that new items can be handled as critical if necessary.

5.4 Gate sheets

Project Master Document introduces check list sheets for each gate, too. Gate sheets specify briefly tasks that need to be completed before gate approval according to factory instructions. There are check points for each project group member to confirm. That is why all project group members are responsible of filling gate sheets. Gate sheets are added to Project Master Document as pilot, and thus their contents can notably vary after implementation.

The idea is that gate can't be approved and next phase started before status of gate sheet is 'Completed'. Date of approval will be automatically updated when sheet status changes. Target dates for gate approvals based on project schedule in the cover sheet are also visible. This is how actual progress in relation to planned dates can be evaluated.

Gate sheets are also used for after meeting checking because memos are locked when their status is changed to 'Completed'. 'Agreed actions' from project meetings are copied to next gate sheet and their status can be followed with dropdown list. There are also empty lines at the end each of gate sheet for notes.

5.5 Final check list

After delivery there are still some actions for project manager to complete before project can be finished. 'Final Check List' reminds project manager of these tasks. When all essential fields are confirmed as 'Yes', order fulfillment project can be finished. That means project manager's responsibilities end.

6. CONCLUSION

What actually changes after Project Master Document implementation? In practice the major differences are that project progress is systematically checked and thus project execution risk is reduced. Check points for confirmation and reminder and updated memo formulas are introduced. All project these will be available in same document and documentation language turns to English. Project Master Document requires participation of all project group members. Thus at least right after implementation, work load of project group members can increase.

Possible causes of failure in implementation of Project Master Document are change resistance and inactively participation. Change resistance towards new tool is tried to reduce by involving many people in the development work. Especially project management department and sales department opinions have taken into account before implementing Project Master Document. Functionality of the document is tried to ensure before implementation by pilot project test use. To maximize advantages, Project Master Document should be updated actively by all project group members. Particularly project managers should add following the document to their daily routines. Risk of inactively participation exists if filling in the document is seen to take plenty of time. That is why filling in the document is made as simple as possible.

Project Master Document decreases risk level during project by adding checking to process. The more project managers need reminders, the more ongoing projects they have. With the help of Project Master Document quick view of project current state is easy to get. Check lists have also other functional aspect. They compact contents of phases and specify important tasks so the document will help training of new project group members.

Project Master Document gate sheets include planned dates and actual dates for each gate and confirm required tasks before gate approval to be completed. All this is basic information that could be available in ERP system. However, implementation of Synchronous Machines customized Project Master Document is necessary so that need for developing ERP system will clear out. Changes in ERP system are hard to implement. In future check points proved good in the gate sheets could be moved to ERP and there would be no need to manually confirm these in excel document. Thus, gate sheets of Project Master Document can now be considered as part of greater developing work, developing of Enterprise Resource Planning system.

Order Handover check list sheets and new memo formulas are the actual offerings of Project Master Document. Memo formulas lighten memo making and direct discussion in project meetings. At the same time memo archiving improves. Tool for order handover is introduced first time at Synchronous Machines. It clears interface between sales and project management, and thus decreases risks related to customer order fulfillment. With the help of handover check list, also global order handover lightens. All in all, Project Master Document aims to better customer order appreciation, wider information availability during project, responsibility defining for project group members and facilitated project management.

While Project Master Document was under development work, another wide development project took place at Synchronous Machines. This project called 'Laasti' concentrated in On Time Deliveries and functionality of whole order fulfillment process was paid attention. As a conclusion of Project 'Laasti', updated Gate Model at Synchronous Machines will be introduced in near future. The number and contents of phases and gates will be adapted according to different product group's needs. Basically this means that generators will be having lightened Gate Model and Gate Model used with motors will be more customized. At the same time the structure of Project Master Document will be updated similarly.

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