

MESA MOM CAPABILITY MATURITY LEVEL

19th May 2016

Nina Castor, Daniel Damberg & Emma Sjöborg

Abstract

The purpose of this study is to investigate how the maturity level of a Manufacturing Operations Management, MOM, implementation can be estimated. The report presents the ISA 95 set of standards for enterprise supply chain and Manufacturing Operations Management systems and thereafter the MESA MOM Capability Maturity Model based on the previously mentioned standards. The idea of the MESA MOM Capability Maturity level is to be viewed as a set of methodized levels that represents how well a manufacturing organization can produce required products based on different criteria. These levels can be used as a benchmark for comparison and as a tool to see where improvements can be made. We've also studied the use of MOM-systems in practice and will conclude the report with a discussion regarding our own opinions on the subject.

Contents

1	Introduction	1
2	Manufacturing Operations Management Capability Maturity Level	1
2.1	ISA-95 – Enterprise-Control System Integration	1
2.2	MOM Capability Maturity	6
2.3	Maturity Levels	7
2.3.1	Aspects of Maturity	7
2.3.2	Capability Maturity Levels	8
3	MOM-system in practice – an interview with a MOM-vendor.	9
4	Discussion	10

1 Introduction

The ISA 95 standard was developed for several reasons. Some of the purposes was to improve communications by providing a consistent terminology, present homogeneous information models and operation models. Since it is a standard it does not tell you what you have to do, unlike regulations, but what you should do to achieve good results. The standard has been developed by a diversified group of people who has been working with various parts of Enterprise-control system integration topic. This has led to a very prominent standard which provides value. In this report we are going to focus on the Manufacturing Operation Management, MOM, described in the ISA 95 as:

The interface between the economy department and the engineering/automation department. (Charlotta Johnsson 2016)

The activities of Manufacturing Operation Management is those activities of a manufacturing facility that coordinate the personnel, equipment, material, and energy in the conversion of raw materials and/or parts into products. Manufacturing operations management includes activities that may be performed by physical equipment, human effort, and information systems. (ISA 2005)

Since this standard is developed to be the optima it can be difficult for a manufacturing company to implement it exactly as the way it is, following every model. This leads to the problem of knowing to what extent it follows the standard and uses MOM in an efficient way. In other words knowing where you are in the process and where to go. And particularly, how to communicate this to others. These are some of the reasons of why to investigate how the maturity level of a MOM implementation can be estimated. The Manufacturing Enterprise Solution Association (MESA) has recently developed a document regarding this topic. We will summarize this document in the report and also discuss it with a MOM vendor. In conclusion we will present some of our own opinions about the subject.

2 Manufacturing Operations Management Capability Maturity Level

2.1 ISA-95 – Enterprise-Control System Integration

MESA's model for MOM capability maturity is built on the foundations of the ISA 95 standard. In that standard, the International Society of Automation provides definitions of terminology and concepts important to the integration of the high level Enterprise system and the more basal control systems. The intermediate level between the Enterprise systems and the control systems is called Manufacturing Operations Management.

The ISA 95 standard sets up models and defines necessary terminology for its purpose to facilitate the integration of the longer term business planning and logistics and the actual production in a plant. In order to execute such an integration successfully, it is necessary to know how a company works and how different systems are used. Therefore, the ISA 95 standard sets out to create a model for the running of an enterprise, which is naturally very wide, to encompass a wide array of different types of companies that in some way produce things. ISA 95 defines a Functional Model of an enterprise, classifying the systems used in an enterprise, formulating a hierarchy that assembles the different activities of an enterprise, and their relation to one another. This hierarchy can be seen in Fig. 1. It should be noted, however, that this hierarchy does not necessarily describe the organization of a company, but rather the relation between its activities. Furthermore, the standard sets up a model of what one has in an enterprise, i.e. an Equipment Model. It also—perhaps the foremost part for the purposes of the MESA MOM Capability Maturity

Model—defines what type of information that needs to be exchanged between the Enterprise system and the Control systems, and the activities of the Manufacturing Operations system needed to abridge the gap between these two levels. (Brandl, C. Johnsson and Unger 2006)

The activities in an enterprise that coordinates personnel, equipment, material, and energy in the production are joined in the notion of Manufacturing Operations Management. That is, the activities that translates the long term business plans to actual production. The hierarchy in Fig. 1 shows the different levels of activities in a company. The levels below level 4, i.e. levels 0–3, contains activities that directly relate to the manufacturing process. Activities belonging to these levels must also be critical to either

- plant safety,
- plant reliability,
- plant efficiency,
- product quality, or
- maintaining regulatory compliance.

Levels 0, 1, and 2 are about the actual production, they define the physical processes, the sensing and manipulating of the physical processes, and the control thereof, respectively. Level 4 defines the longer term, business-related management of a manufacturing organization. Here one finds e.g. the plant scheduling, the determining of inventory levels, and the handling of materials—that the material is at the right place at the right time. Level 3 is the interface between levels 2 and 4, wherein the work flow of the production is defined. Activities include keeping records and coordinating the processes. (ISA 2005) Obviously, the activities at the fourth level hinges on the functions in the third. The importance of effective integration between the enterprise level and the control level is thereby rendered evident.

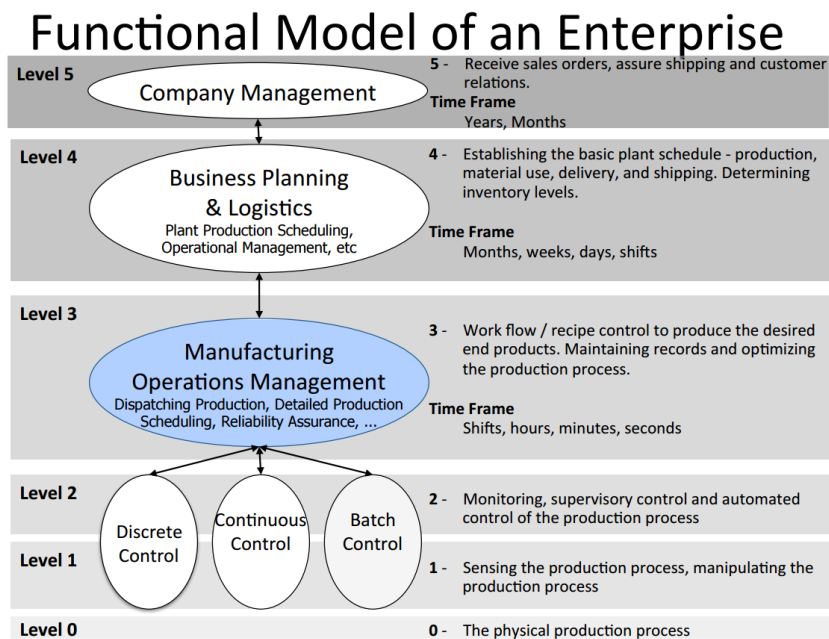


Figure 1: Overview of the levels in the functional model of an enterprise, as defined in ISA 95. Image from Charlotta Johnsson 2016.

There are four categories of activities in Manufacturing Operations Management:

Production operations management: The focus of the activities herein contained is the direct production of the desired products or services.

Quality operations management: Here one finds activities centered on quality testing and inspection.

Inventory operations management: This category contains activities that focus on the movement of material (not related to production), shipping, and storage.

Maintenance operations management: The operation of the equipment must also be ensured, and activities related to that is contained in this category.

(Brandl 2016) Hereinafter, only the first category *Production operations management* is treated.

Production operations management is a category consisting of activities are directly related to manufacturing, but that do not actually execute the production. That is, it consists of activities that coordinate, direct, manage and track the execution of the production, considering the costs, quality, quantities, and schedules, whilst ensuring safety. Activities in this category include the collection and maintaining of data on the various parts of production. It is necessary to collect data for e.g quality analysis and to handle the personnel, making sure that there are good schedules for the work force, managing personnel qualifications and possible in-house training.

An important part of production operations management is—as may be noted—scheduling, including detailed production schedules that take into account the conditions of the specific area, such as maintenance and transports. Schedules may also need to be modified to compensate for interruptions to plant production. Another important part of production operations management is the handling of costs. Whilst still abiding by the overall production schedule set up by higher level functions, one must optimize the costs for individual production areas. (ISA 2005)

The activities connected to production operations management, is formalized in an activity model, detailing the activities necessary for plant operation, and how they ought to relate to one another, and to the activities of adjacent levels. The activities, their interdependence and connection to level 2 and 4 is shown in Fig. 2. It should be noted that this model does not necessarily show organizational structures—that is up to each organization to specify—but rather the activities to be executed.

Beginning by looking at the relations of production operations management with other levels, namely level 4, and levels 1–2, one may identify categories of information that need to be exchanged. There are four such categories in the interface between level 3 and 4, namely:

- product definition
- production capability
- production schedule
- production performance

(ISA 2005) Comprehensive definitions of the product must be communicated from the high-level business system to production operations, so that it is known what should be done. Likewise, an overall schedule, established at level 4, must be passed down to production operations, which can then concretize the schedule in further detail.

Information must also be passed from production operations to the business system at level 4. The capabilities of the plant is naturally essential to know at level 4, in order to efficiently determine long-term plans for the production. Similarly, it is of importance to level 4 to know how actual production

Activity Model

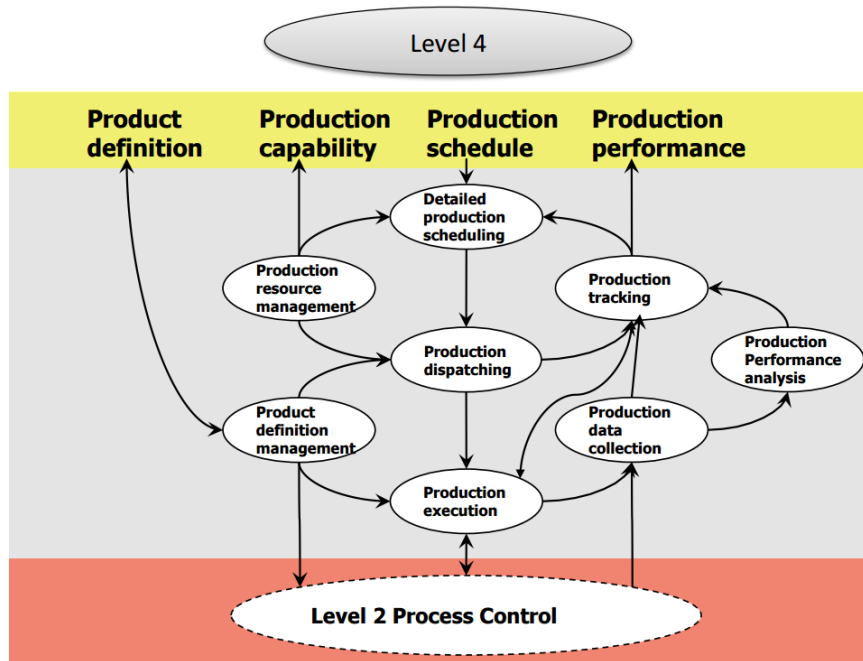


Figure 2: Overview of the activities of production operations management, as defined in ISA 95. Image from Charlotta Johnsson 2016.

performs, rendering necessary the passing of information about production performance from production operations to business systems.

In a similar fashion, information must be exchanged between production operations and the more basal control functions of the production process. Production operations must send down rules for e.g. production and equipment, as well as commands pertaining to what should be done. In return, the control level responds to commands and allows production operations to collect data on the process and equipment from monitoring level 2.

ISA95 defines eight activities within production operations:

- Product definition management
- Production resource management
- Detailed production scheduling
- Production dispatching
- Production execution management
- Production data collection
- Production tracking
- Production performance analysis

Naturally, there must be information about the product in order to manufacture it. The information required to manufacture a product, consisting of production rules, bill of material and bill of resources, are managed in the first activity, *product definition management*. The information here is more specified than in the business system. Production rules are the rules used to instruct the manufacturing operation on how the product is to be produced. This may be e.g. master recipes or assembly steps, depending on the method of production. The product definition management activity provides this information as needed to the lower-level activities or personnel. Changes are also handled here, as are any local production rules, e.g. rules pertaining to start-up and shut-down.

It is also necessary to manage resources needed for production. *Production resource management* contains activities that handle required resources, such as machines, labour, material and energy. Herein planning and information about the current and future statuses of the resources is handled, it does not exercise direct control over the resources.

The business system sets a comprehensive production schedule, but this must be adapted and concretized to local conditions. In *Detailed production scheduling*, the best use of the specific resources available locally, considering local capacities, is determined to meet the demands of the overall production schedule. This adaption to local conditions is necessary at level 3, as the level 4 planning systems for the entire enterprise do not have the detailed information needed to control the manufacturing at the required level of precision. In detailed production scheduling at level 3, there is also the possibility to compare the plans with actual results, which are seldom treated at level 4. Orders may also be merged or splitted to better suit local capabilities.

The management of actual production flows is contained in *production dispatching*. Herein production is dispatched to personnel and equipment. This may include issuing work orders and, depending on the method of production, scheduling the start of batches, production runs, etc., as indicated by the production schedule. Here one may also handle conditions and local resources that were not planned for in the detailed production schedule. The status of work orders—and possible unanticipated conditions—are also maintained in production dispatching.

Production execution management is the activities that direct the production in level 2, with basis in the list elements obtained from production dispatching. This activity issues operational commands and receives the operational responses, ensuring that the correct resources are used. Here one also has access to information from previous runs, which may be used to locally optimize the production.

It is important to have and save data about the execution of production. In *Production data collection* data on the work processes or specific production requests are gathered and compiled. The collected data may be sensor readings, actuator statuses, event states, etc. That is, data that allow the company to track how production have been executed, and have pertinent statistics on production.

Information about how production has gone should be passed on to level 4 for the business systems to be able to update scheduling to better conform to the current situation, and the preparation of this production response is done in *production tracking*. Here, summarized information about actual usage of personnel, equipment, and material in production, as well as actual material produced. Other data, e.g. costs, pertaining to the production is also summarized and reported. The data reported here is also used to improve the detailed production scheduling.

Finally, we arrive at *production performance analysis*, wherein activities that analyze the performance, for reporting to level 4. Here one compare production runs, identifying exceptional runs and poor ones, and analyze them to establish what makes a run stand out, and how that knowledge may be used to improve the production in its entirety. These analyses may also be used for Key performance indicators (KPIs). (ISA 2005)

Similar activities are defined for quality, inventory, and maintenance operations management. However, they are not treated in this report. There are of course other activities in an enterprise that affect manufacturing. For example, security management, and the management of regulatory compliance both have the potential to greatly affect the basis for production, but also lie outside the scope of this report.

2.2 MOM Capability Maturity

The standard described in the previous section is naturally quite idealized, and many companies do not adhere very stringently to the provisions set out in it. Furthermore, it can be difficult for a company to know to what extent it follows the standard and uses MOM in an efficient way. The rather abstract clauses of the standard can also be difficult to implement in an organization. Manufacturing Enterprise Solutions Association (MESA) has identified a need for evaluation of a company's adherence to ISA 95 and the maturity, robustness and repeatability of its manufacturing operations management.

MESA has therefore produced a report presenting a model for the MOM capability maturity of an organization. This model sets up several structured levels describing how well the practices and processes of a company yields efficient manufacturing. The idea is that high maturity implies an efficient organization, with few systemic problems in its operations and where few mistakes and errors are made.

The model does not only serve to evaluate the operations of a company, but it also serves as a benchmark for comparison. One may use, with basis in a thorough evaluation of the current state of the company's work with MOM systems, the levels defined in the model as a guide to what improvements to make, striving to advance through the levels. This given course of action may help a company proceed with its development of an efficient MOM-system, as well as help a company track its progress by knowing the current level and comparing with the state from whence it came.

The report (Brandl 2016), laying out the model rests on the groundwork of the ISA 95, Part 3 standard, using the activities therein defined as a base for which a set of characteristics is set up for each level of maturity and each major activity.

In evaluating the MOM maturity level it is necessary to consider three elements, or areas of interest:

Policies and procedures: It is important to consider the formal—and perhaps a tad bureaucratic—aspects of MOM work. At high maturity, policies—overall, high-level plans for work with MOM—and procedures—a sequence of actions set up to implement a policy—are often formal documents, rather than unspoken 'general knowledge', or, in the case of procedures, already implemented in tools, e.g. software.

People: Plans and procedures are of course not very effective if there is no one to use them in real life. It is therefore very important to consider the level of training in company policies and procedures given to personnel. Formalized training, with records being kept, and formalized updated training are signs of high maturity, with respect to personnel.

Tools: It is often advantageous to not only rely on manual implementation of aforementioned policies and procedures, but to have tools, e.g. software, for the purpose. These tools are used to formalize and support the implementation of procedures, and may may enforce adherence to the procedures with varying zeal—from mere support, to encouragement and finally actual enforcing. Tools that match the policies and procedures of the company and encourage adherence thereto, as well as personnel trained in their use, are characteristics of high maturity in the company's work with MOM. With increasing maturity, and increasing reliance on these tools, comes an increased importance of sophistication of and control over the tools, ensuring them being efficient and preventing their obsolescence.

It is important to note that an organization may have different levels of maturity in the aforementioned areas; a company may, for example, have highly developed policies and procedures, but fail to properly train its personnel in their uses. A company may also have different levels of maturity in its various areas of resource handling. Personnel, equipment, material, and physical assets may all be handled at different levels of maturity. It may furthermore be noted that it is necessary in these evaluations to present objective evidence of possessing the characteristics needed for a certain level.

This type of maturity evaluation can be carried out with varying scope. Any organizational unit may be assessed, from single teams, up to entire sites or even divisions of the company. Furthermore, a company may have e.g. teams with high maturity, whilst still having a low overall company maturity, if there are other teams with low maturity. To encourage all subgroups in an assessed company to strive for improvement of their maturity, and to bring all subgroups to the same level, the overall maturity of a company—or site, or other organizational unit encompassing multiple subgroups—is defined as the lowest maturity level of any subgroup. (Brandl 2016)

2.3 Maturity Levels

2.3.1 Aspects of Maturity

The maturity model put forth by MESA sets up five levels of maturity, plus one additional 'zeroth' level, signifying a deliberate decision not to evaluate the maturity:

0. No evaluation
1. Initial
2. Managed
3. Defined
4. Quantitatively Managed
5. Optimizing

At each of the maturity levels, the organization at hand is evaluated with regards to seven aspects of maturity, some of which have been previously touched upon. (Brandl 2016)

As previously mentioned, one must evaluate the *policies and procedures* for performing the necessary activities that are in place at the organization. Here one considers the degree to which the policies and procedures are properly documented. Clear documentation is necessary to prevent confusion and misunderstandings regarding the manner of performing the activities at hand.

Although not actually a criterion for high maturity, the use of *technology and tools* in operations significantly simplifies maintaining a high maturity level. This aspect is thus considered.

It is also important to consider that personnel need to be *trained* in the use of the existing policies and procedures in order for them to be effective; unused documents serve little purpose. Proper training thereby indicate a higher maturity.

In evaluating, one should also take into consideration the clarity with which *roles and responsibilities* are defined. A company with a mature work with manufacturing operations management will have clearly defined roles for its personnel, so that one's responsibilities are known when one assumes them, thereby reducing uncertainty.

The company's management of manufacturing operations, or parts thereof, should neither stand and fall by a single individual, or group of individuals. Naturally, it is good to have plans for any future contingencies, such as the primary person responsible for an area of operations management being unavailable. Thus a mature company ought to ascertain that there are *succession plans and back-ups* for e.g. when people leave or are otherwise unavailable, so that no one is irreplaceable.

There must furthermore not be impenetrable bulkheads between organizational parts performing different activities; they all depend on information from other activities. In order to reduce errors, omissions, and similar problems, one needs to ensure a good flow of information between different parts of the organization, that is effective *information integration*. Mature practices in this field include the formal definition of the information, the manner in which it should be shared in the organization, as well as putting into place technological tools facilitating the aforementioned information sharing.

Finally, one also considers the use of *key performance indicators* (KPIs), whence—although the use thereof does not say anything about the maturity level of the organization—aspects of the company's maturity level may be inferred. One may e.g. evaluate how the organization analyses the values, and to what extent corrective measures are taken with basis in the KPIs. The use of KPIs to improve operation, proper management of KPI definitions, and their regular reviewing and updating would indicate a high maturity. (Brandl 2016)

2.3.2 Capability Maturity Levels

There is a set of levels for all of the eight production activities defined in ISA 95, with each level being defined by between three and eight criteria and characteristics. Similarly defined levels exist for maintenance, quality, and inventory operations management, but they are outside the scope of this report. The fulfillment of all the criteria of a level and possession of the characteristics indicates the maturity level of the organization being at said level. Naturally, fulfillment of the criteria of previous levels are also required—which obviously do not necessarily apply to all characteristics, a low-level organization may be characterized by poor practices that naturally should not be carried over to later levels.

Though separate levels, with different criteria, exist for every activity defined in ISA 95, their definition share many basic similarities, and are built on the same idea. We shall therefore herein present the common characteristics. For the exact maturity level definitions for specific activities, the reader is deferred to MESA's full report, Brandl 2016.

The first level corresponds to initial work with MOM, to some extent characterized by chaos and instability. Processes are generally not formally managed, and often changing, lacking control. Organizations at this level tend to depend greatly on the effort of individuals, whereto success is often attributable, thereby rendering them potentially vulnerable to problems if these individuals should become unavailable. This is not to say, of course, that these organizations are somehow dysfunctional. On the contrary, they often succeed in performing their activities to an acceptable degree. However, due to the lack of coherent control, activities are often performed with great variations in performance and/or cost. Generally, software tools are not used to facilitate and support the processes. If software is used, it is, in line with the aforementioned lack of formal management, often used inconsistently and without proper training. Activities also tend to be fairly separate, lacking a concrete and formalized system for exchange of information. This potential lack of information may cause errors and omissions, which naturally need to be kept at a minimum.

Progressing to the next level is characterized by a more managed approach to the matter. Work has started with addressing the problems present at the initial level, but work is far from complete. Organizations at the second level have at least some processes that are repeatable, and possibly even yielding consistent

results. However, there still remain processes that are not adequately documented. There may also be variations in the processes used by different groups within the organization, even for similar tasks. At this level, dependence on individual efforts are reduced; software tools are used, albeit they may be used inconsistently and without adequate training. There are also at least partially defined lines of succession, which further decrease dependence on what the report refers to as “heroic individual efforts”. Information is exchanged properly between different activities under normal circumstances, but may under stress fail to reach the necessary recipients.

At the third level, all activities have defined and documented standard processes. Processes do not vary significantly between different organizational groups. The organization-wide standard processes may however be adapted to specific conditions in different subgroups, whilst still keeping the connection with the organization-wide standard. Lines of succession are defined, and software tools are used with at least some training. The integration of information between activities are further improved compared to the previous levels, with errors rarely occurring, even under stress.

Quantitative management is an indicator of level 4. Here, all the good practices of level 3 are implemented, and furthermore, processes are managed using effective metrics that cover all organizational groups. Software tools are used to a great extent and training in them are readily available. Information integration between activities is effective and monitored so as to ensure accuracy. Regularly occurring exceptions are handled as a part of normal processes.

Finally, the fifth level is characterized by optimization. The organization strives to continually improve processes in different ways, e.g. through technological innovation. One also use statistics to improve process performance. Furthermore, in addition to the criteria of level 4 being fulfilled, Software tools are used and are regularly updated to handle changes. KPIs are used to find problem areas and are routinely reviewed to ensure their appropriateness to the processes at hand.

3 MOM-system in practice – an interview with a MOM-vendor.

The work with this report includes information from an interview with Hans Nilsson, business developer on Rockwell Automation, Sweden. Rockwell Automation is an American company partly working with offering others companies an investigation of what to improve relating to manufacture operation management, as well as the software to facilitate introduction of the new system. Even though Hans Nilsson is not yet familiar with the new MESA report, he has been working with MOM-systems for several years and is very acquainted with the practical implementation of the systems.

The final purpose of implementing and working with a MOM-system is to achieve cheaper and faster production. A production company normally has limited communication and information exchange between the four interfaces connection level 2 and 4, as well as between the eight activities within production operations. As long as everything works correctly – an order is placed and the product comes out in the other end in perfect condition every time, the business works as expected. However, as soon as something unexpected occurs, there is a requirement to localize the cause for the problem and try to prevent it from happening again. This is where MOM-systems are introduced. Some companies, especially larger ones, are often familiar with MOM-systems and already has an ongoing work with them, while other companies only knows that something should be done in order to improve the production, but not necessarily what. Therefore it is common for both large and small companies to hire a specialist in MOM-system, for example a company like Rockwell Automation. It is also hard for the companies to know how far their work with these models has come. The MOM Capability Maturity report can, according to Hans, be a good instrument for analyzing the already existing systems in a company and the ongoing work with

development of new ones. For the companies to be successful, the work with MOM is a continuously ongoing process rather than a time-limited project. Since the ISA 95 standard was introduced a lot of companies have been working according to it's model, and thus contributed to a lot of questions on how to evaluate the progress. Hans explained that one of the reasons why MESA's model for MOM capability maturity has been constructed is probably due to this demand from the companies to understand how well they are performing in their work with manufacturing operation management systems.

According to Nilsson, companies are often interested in focusing on a few points, rather than all. It may not be profitable to be at the top level in all activities and sometimes it is not even worth working with all activities. It all depends on how much the company can gain from the improvement and how much it will cost. Rockwell Automation together with the customer sets a goal for what should be achieved and a plan on how to get there.

Hans Nilsson explained that for most companies it is important to focus on traceability, i.e. production tracking. If the company knows what is done in every step in the production line, it is easier to localize any production faults. For the company, this may amount to the difference between recanting thousands of products or just a few, when a production error is discovered in a single product. Thus working with production tracking can save a lot of money for the company. Hans believes that the MOM Capability Maturity model will be used by the companies to understand on what level they are performing in their MOM-systems and how to make improvements to move further up in the levels. However, Hans thinks that the declaration of the different levels in the model are a bit too complex for most companies to understand and to work after, and thus it is good to hire a MOM-vendor who is an expert on this matter. It should be noted though, that since the report is newly published, it is impossible for Hans or anyone else to know exactly how the model will be received and implemented on the market. (Nilsson 2016)

4 Discussion

As mentioned in the report there are several positive aspects of creating a standard way on how to measure the maturity level of a MOM implementation. It gives the manufacturing firms advice on how and what they can develop regarding their MOM systems and it also provides a useful tool for communication. For example if a company wants to improve its production tracking it is vital to know how to do this. This process could be simplified if you know that you are on a certain level and therefore easily can see where to go next.

But how should we measure the maturity level? What kind of model should one use? In the MESA MOM Capability Maturity Model they have chosen the ISA 95 standard and more specific, part 3. We think that this is a good idea since it is a well known standard which is used throughout a large degree of manufacturing firms. This makes it easier to interpret for all those who works with the standard. Since the goal is to determine the capacity of an organization of having repeatable, developed and powerful manufacturing operations we could in theory construct a whole new system on what to look at and which areas to improve. This would however, most likely extend the implementation period of the model for organizations. Furthermore, the ISA 95 is proven to be a good standard, so why reinvent the wheel. It would supposedly also inspire organizations to work according to the ISA 95 in a larger extent which could be seen as positive, since the standards are well thought through and you don't have to come up with everything by yourself.

Since the ISA 95 is a standard and invented to be as general as possible, it can be used by any industry. Since the MESA model is based on ISA 95, it is also generalized and should thus be useful for all industries. The obvious advantage is that the more organizations using the same standard the more they

can communicate. In addition it will probably also be applicable over a longer time period, since standards often takes time to implement and accept this is important. But there is a negative aspect to making the model generic, it can be hard to concretize the different levels for an individual firm.

Taking a look on the specific levels, we can first note that in the MESA model there are five different levels and in addition a zero level. Reaching the fifth level would mean reaching the optimum. In many cases this could be quite costly and therefore not profitable. This could be an argument for not having a fifth level if it is too idealized so therefore there are very few organizations that will reach the highest level. But in the model there is no requirement of reaching this level, that is not the purpose of the model. Some firms might not benefit from getting there whilst others may. From this argument we do agree that there can be an idealized level even though it most likely won't be beneficial in many cases. Furthermore it is a model that explains on what levels a manufacturing firm can be in it's work of MOM implementation so it is quite natural that the highest level is when you follow the standard as it is.

Moreover we've been discussing possible future usage of a model measuring the maturity level of a MOM implementation. First of all we've mentioned several times that a model like this can lead to better communication. But why is this so important? Narrowing it down to future usage we can see trends in the manufacturing industry where producing products can be more of a cooperation between different factories. For example if someone would like to order something customized, the product may have to be partially manufactured at a factory that is specialized at this. This kind of industry requires thoroughly thought through information systems. We also think that it is a possibility for the levels to be used as a kind of certificate. But since it isn't quite likely that the buyers of the products understand the MOM-system it could be hard to benefit from this. Though if a firm develops its tracking methods, i.e. moves up a level, it can be easier to, as an example, find out how much environmental impact the product has which in turn can lead to greener ways of producing with common certificates.

All in all we think the MESA model is good. It may take a long time to implement and the process may be costly but looking at how the industry will develop, requiring more information systems, it will likely be profitable investing in ways to measure the maturity of a MOM implementation.

References

- Brandl, D. (2016). *MESA MOM Capability Maturity Level*. White paper. Version 1.0. Manufacturing Enterprise Solutions Association.
- Brandl, D., C. Johnsson and K. Unger (2006). *ISA 95 for Beginners*. White paper. WBF.
- ISA (2005). *Enterprise-Control System Integration – Part 3: Activity Models of Manufacturing Operations Management*. ANSI/ISA-95.00.03-2005. American National Standard. International Society of Automation.
- Johnsson, Charlotta (2016). *Lecture 4: Manufacturing Operation Management (MOM)*. FRTN20 – Market-Driven Systems. Lecture slides.
- Nilsson, Hans (2016). *Interwiev with MOM-vendor Hans Nilsson on Rockwell Automation, Sweden*. Interview.