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# Digital Engineering Model Maturity

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## ABSTRACT

*The Digital Engineering Environment is new and rapidly changing. It is a complex system with many tools, databases and views. Organizations struggle with how to access their maturity in a new environment. This paper discusses the different aspects of determination of the maturity of architecture model within a Digital Engineering Environment. The intended audience is all levels of system engineers. It will address the characteristics of maturity from content, size and usefulness of architecture models. The goal of this paper is to provide system architecture with tools, process and insight into gaining more productivity and value from architecture models.*

## INTRODUCTION

The purpose of a model is really two fold. One is to inform. Merriam-Webster defines inform as to impart information or knowledge. The model provides data, structure and relationships to show the reader the known information or the collective knowledge of the system.

The other purpose of the model is extract to draw out something hidden or latent. The model provides a number of ways to extract addition information based on the relationships of the system.

### Model Maturity

For the purposes of this paper, I will define model maturity in the "state of being fully developed" [2]. The model is not a static model. It is a model that continues to grow in size, complexity and has many different views or viewpoints. A model is not a perfect representation of the system. The goal of the model is to be accurate and have the appropriate levels of rigor. The size of the model is not a guarantee of maturity. Size is a measurement of the amount of work put into the model. The value of the model is more than the data that is input into it. Maturity is what happens after growth. The model should be used for sound decision making.

### Maturity Considerations

The maturity of a model as well as the time and resources it take depends on the source and the scope of the model.

One source of the model could be fresh, blank model. This indicate a very immature approach to building a model. It indicates that there is no historical or heuristic experience going into the model development. This approach relies on the skill and experience of the modeling resource.

Another source would be reusing an existing model. This may or may not be better that starting with a blank model. Although you have immediate growth, it is usually overwhelming and has many unneeded artifacts and relies on changing many definitions and block characteristics.

The best source would be the deliberate reuse of models/libraries/profiles that have been reviewed and accepted in a similar environment. These artifacts may have already addressed questions that your project needs.

## Tools Maturity

Model maturity is linked to the tools used to build the model. New modeling tools normally are undergoing huge changes and frequent application releases. Model migration and model stability are natural concerns. The architectural model needs to have the ability to be hosted on different computing platforms and interface with other engineering applications. The tools must be able to support necessary Industry Standards.

## Model Size

As stated earlier, model maturity is achieved after model growth. This growth should follow a pattern of development that supports the purpose of the model. This pattern should start with the decision support that the model needs for analysis. The model should identify the inputs and output artifacts needed for analysis. The artifacts should use consistent definitions, block types and value properties across all views. The total number of elements is not the goal, but rather are the elements used in the analysis. The elements should be fully and uniquely defined.

## External Connections

The system being modeled is not independent of its surrounding environment and interactions. The identity of all relevant external connections is important for model maturity. These connections must be of consistent types and the ability to transport the necessary information flow. However, no environment is without change. The mature model will be able to grow, modify or adapt as internal or external conditions change.

## Model Definition

Model maturity is indicated by a well formed model definition. This will include scope, purpose, part definition, interface definition, information flow, performance and all positive indications of maturity. However, it is reasonable that the model will address the conditions and solutions necessary in the event of a negative outcome.

## Maturity Descriptors

The model should provide aids or descriptors that status key performances of the model. Such items would be completeness of definitions, consistency across the model and the ability to have customized reporting the metrics.

## Number of Diagrams

The mature model will not try to model everything exhaustively. It is not necessary that the model provide every detail. It is important that critical aspects are modeled thoroughly to obtain the necessary analysis support for decision making. The model is not just about creating analysis diagrams. It is focused on structuring the data in a manner that can be easily queried and reported.

## Problems

The lack of maturity has several root causes. These are forced fast growth, lack of tools, lack of methodology, lack of commitment and inexperience. The timing of technology turns affects the model maturity. A certain amount of the maturity of a model assumes that initial assumptions are valid during the course of analysis.

## Maturity Aspects

Model maturity is applicable is many areas supported by systems engineering. System engineering supports Acquisition, Program/Project Management, Analysis, Simulations, Verification & Validation, Test, Build and Deployment. There is a different set of decisions that the model supports. Each of these phase needs a different level of maturity. We would indicate that the degree that the mode is mature in each of the phases.

## Goals for Maturity

It is the goal of professional modelers/architects to have the most mature model give the constraints of the program. One of the goals is to be able to maximize the reuse of as much of the model as possible. This implies that there will be repeatable processes, tools, resource training and development.

## How Do You Know That You Are Done

The dilemma that modelers face is "How do you know that you are done?" If you are working against a time deadline or a budgetary limit, the answer is obvious. You are out of time or money. The model must reflect that you spent your time, resources and money doing the correct analysis. Before starting the model, it is best to determine what are the decisions (or questions) that will need analysis support. The model should focus on the factors that are important for decision making.

The model is a living analysis that is meant to grow and provide answers or decision making. You are done, for now, when the model has answers for the questions of your analysis. It is likely that during the analysis, other questions (unknown when started) are identified. These may be answered by the model or another form of analysis.

## Conclusion

Maturity is a continually changing state in system analysis and architecture models. The purpose of models is to answers system questions and aid in the decision making process during design and specification. The maturity of a model is an indication of sound and informed decision making. As the model progresses through different stages, the maturity needs to change as well.

## REFERENCES

[1]Merriam-Webster

[2]Collins English Dictionary