

PLM implementation: case study of a success

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Abstract. The Design, Production & Operation Single Environment connects the PLM universe. The 3D model supports similar design and production roles: drawings, count hours, end-treatments, BOMs, drive robots, non-Engineering consumable forecasting (paint, blasting, welding, etc.), human resource requirements (manhours, special skills, inspections, etc.). Non-engineering Data & information contributes to the product model: lead time, availability, problem areas, etc. The 3D model is the visual representation of different types of data & information generated and required by different Departments, exploited with today's EnterprisePlatform-ShipConstructor, AutoCAD, Navisworks, etc. by Autodesk/SSI.

Keywords. EnterprisePlatform, ShipConstructor, PLM, ERP

1. Introduction

In 35+ years of international professional activity, the authors have witnessed time and again the sheer losses caused by the chronic disarray which data and information seem to lie in across the marine industries, despite genuine efforts by many (Figure 1). Already in the late 1980s, the Product Models signed the dawn of Digital Prototyping, and Single Data models have long been advocated [Danese, 2010] and worked on, but a variety of misconceptions invariably impeded the successful outcome of the efforts.

The Single Data model paradigm evolved into the Model Based Enterprise and, almost concurrently, a Holistic Definition approach was coined. Ephemeral standards and ineffective data conversion routines eventually proved their limitations and inadequacy, and Single Environment Models ensued. However, even the latter, most modern and IT-cognizant strategy suffers a high probability of failure due to subjective misconceptions introduced by the ineluctable presence of the human factor.

In contrast with so many notable and sometime epic failures, this paper discusses a success story: the implementation of the SSI EnterprisePlatform and ARAS PLM to bind and integrate the combined SSI ShipConstructor, Autodesk and MARS ERP environment at Huntington Ingall Industries, USA, a large, multi-product shipyard.

In particular, it will be discussed how carefully planning an incremental strategy of existing, commercial IT technology constitutes the solid foundation to achieving success and significant short-term ROI (Return on Investment).

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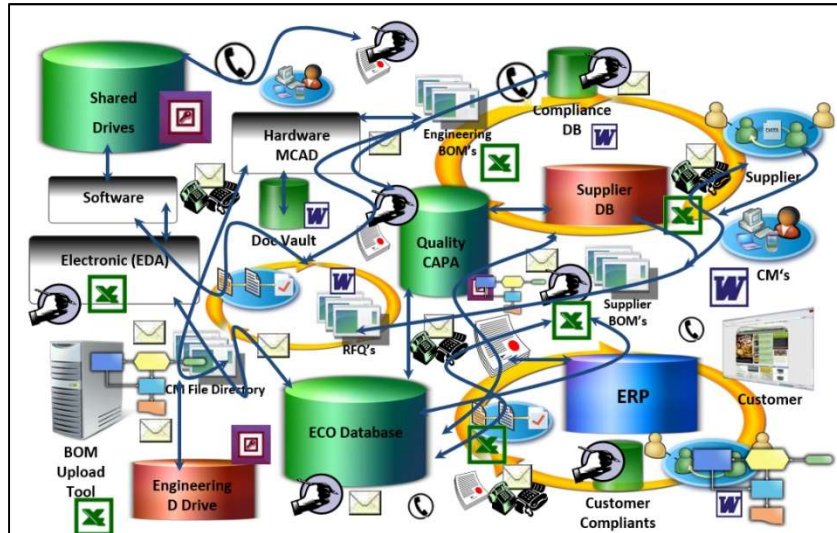


Figure 1. Schematic representation of legacy enterprise processes.

2. Misconceptions

Many misconceptions have marred the best efforts time after time, such as:

- Some data and information dependencies are not important
- All data and information must be collected together and be in the same format
- Data and information must be checked and approved when ready for release, not before, and must be managed by the respective managers
- Must plan for a “total” solution which must cost little and be completed quickly
- New software systems are required, everything “old” is bad and does not work
- The goals are well known, it is enough to improve here and there, an overall approach is “too much”
- Only managers should be involved

Admittedly, some of the “misconceptions” described above do not seem to be one but they do become one when hampering a smooth, timely, data and information flow, which is almost always. Some of the above statements are reviewed hereafter.

2.1. Some data and information dependencies are not important

Chaos theory is famous for saying “*the flutter of a butterfly's wing can cause a typhoon halfway around the world*”. In other words: a single event, no matter how insignificant, can change the course of the universe forever (Fractal Foundation, *What is Chaos Theory ?*) - let alone the destiny of a shipyard ! Such examples are many, and even more numerous contingency and emergency plans have been drawn up over time. Sadly, history shows that most have failed.

In fact, the amount of intertwined data and information present in the marine industry is uniquely large, its very mass and complexity presenting a challenge even for advanced big-data analysis and processing algorithms.

Complexity and multiplication of components introduce fragility in any mechanism and, given a chain, it is naïve to ignore any one of the many links in it. The most ignored and perhaps crucial of all dependencies, hence the weak link, is the human factor.

2.2. All data and information must be collected together and be in the same format

One of the important aspects of what is referred to as “Cloud Technology” resides in the ability of knowing where data and information are stored, and the format which they are stored in. Not all storage formats are recognizable by IT tools - for example how to read emotions from a picture - but much progress has been achieved in recent years so that today most data and information immediately relevant to industrial processes exists in machine readable formats.

It then remains to keep track of which data and information is stored where, to map dependencies, identify stakeholders and have *them* define the datasets of relevance to the processes they participate in, so that *they* can carry out the tasks *they* have been assigned.

2.3. Old systems, new systems, dangerous habits and absolutes

Not all old systems are “bad” and many new systems are not “good”, but habits and absolute certainties are very dangerous. A sensible Business Process Analysis invariably uncovers subjective inefficiencies, bottlenecks and process failures.

Attempting a process optimization of the current *overall* environment with existing processes and tools - including third parties such as suppliers and subcontractors - invariably leads to quickly identifying many underlying issues.

2.4. Goals, Scope, Cost and Duration of the PLM implementation process

Goals and Scope generally have an exponential effect on Cost and Duration. Inevitably, unclear goals and excessive scope lead to total loss of control, let alone predictability, of cost and duration.

On the other hand, one must not confuse or equate Goals and Scope. It would be naïve to limit scope without a strong justification: ROI is compounded significantly by relatively modest goals being pursued across a wide scope. An immediate analogy is to make everyone in the enterprise 5% more productive versus making 5% of the people 100 % (or more) more productive.

2.5. Remedies

The above sections highlight fundamental challenges to be tackled from the onset:

- Objectives: every step must produce measurable progress and gains
- Logistics: allow for changes of direction and goals
- Planning: establish targets and expected ROI
- Flexibility: maintain an alert, critical view of the overall Enterprise ecosystem and strive to anticipate changes

- Cultural shift: by automating data and information availability, responsibilities move upstream in the work chain
- Business Process Analysis: identify objective and, especially, subjective inefficiencies, bottlenecks and process failures
- Goals: accept that goals change before they can be reached and will never be fully achieved
- Success: to always be as close as possible to the goal

One key, and perhaps *the* key to unlock all remedies is to make data and information available to *all* stakeholders, custom formatted for their consumption.

3. The Business Process Assessment (BPA)

A BPA is probably the single most important component of a PLM implementation process and yet it is almost always ignored in favor of the inevitably doomed “*let us begin and see how it goes*” mermaid song.

On the other hand, many BPAs are misdirected and their potential benefits missed completely. In fact, rather than just analyzing distinct processes and finding discrete faults here and there, the main goal of a healthy BPA is to ascertain the harmony or dissonance within the enterprise’s *overall* ecosystem, to include third parties and external factors such as suppliers, subcontractors, customers, culture and cultural differences, climate, environment, laws and regulations, special situations of specific people, sales patterns, geo-political factors, industrial evolutions, newly confirmed IT tools, etc.

To conduct a fruitful BPA is not difficult, but attention, common sense and time are required to accurately map the DNA of the enterprise, identifying and documenting fundamental aspects of the overall enterprise process:

- major obstacles at the macroscopic level and at the individual level
- easy to correct situations
- crucial contrasts within the enterprise’s and within its ecosystem

An effective BPA will employ a two-sided, convergent approach - *top-down* and *bottom-up* - and will identify links between macro- and micro- components of the ecosystem. Much is discovered very quickly by listing:

- all actions that are repeated the most and/or that require the most steps
- all processes that require many (small) steps and involve different people at every step
- all processes that employ different tools, software and not, or data conversions in order to achieve a small number of steps
- all actions and processes which require a long time to complete
- all actions and processes that involve several intermediate steps to complete

To automate the availability of data and information to *all* stakeholders, custom formatted for their consumption, is key to a successful BPA.

4. The Vision

A well-executed BPA will always bring benefit and ROI to the enterprise, but a vision is vital to a successful implementation. To have a vision is simply to pursue the overall objective of *optimizing the symbiosis between the enterprise, its mission statement and its ecosystem*: no one cannot exist independently of the others, and the mission statement is the very reason why the enterprise exists.

Just like the implementation per-se must be a dynamically changing process in order to be successful, the vision must be realistic and idealistic at once. This can be compared to walking a tightrope whose height and tightness are determined by the quality of the overall enterprise process elevated to the power of the mission's ambitions.

5. Case Study

The present case study refers to a large, military ship design and ship building enterprise with a complex overall process distributed over two distinct shipyards. The two-site operate somewhat autonomously and have different IT environments, one builds essentially very large aircraft carriers and nuclear-powered submarines, the other concurrently builds a variety of surface vessels ranging from mid-size aircraft carriers to highly specialized and high performance large ships.

The PLM Implementation discussed here continues in the latter, where SSI's ShipConstructor software solution was already present.

5.1. Compelling event

The compelling event that created the requirement for the deep process review that led to the planning and carrying out the implementation of a PLM environment was a fundamental change in the contract structure applied to new building, maintenance, repair and upgrading of Navy ships, which passed from a cost+ model to a fixed price model. The immediate consequence of adopting a standard commercial contract was the vital need to predict, manage and control costs across the enterprise's entire ecosystem.

5.2. The Status-Quo

The MARS ERP system, SSI's ShipConstructor, Autodesk's Navisworks and ms-Office suite constituted the IT backbone, supporting a relatively smooth existing process. Some objective conditions were easily and immediately identified:

- Multiple, disconnected instances of same data with visible and subjective inconsistencies, distributed over an unmanaged number of spreadsheets
- Limited sharing of data and information
- Less than ideal use of resources with downstream compound effects

5.3. Vital constraints

The initiative would be successful if and only if significant, time-lasting goals were to be achieved in a short time, across the enterprise's ecosystem.

Time was identified as the main constraint influencing the choice of the goals to be pursued. Some discriminating parameters applied in the selection of goals are:

- Easy to identify and document
- Realistic chance of success
- Simple implementation procedure
- Achieves goals, wins gains and ROI across a wide sector of the ecosystem

5.4. The Team

In order to support the best possible outcome, a dedicated team is to be tasked to identify and document objective and subjective constraints. The team is expanded to grow into a task force that includes representatives from vital components of the enterprise's ecosystem. This included people from HII, SSI and ARAS. A little later, ARCOS joined the effort, its role being to drive the integration of engineering and management data, information and processes into the overall PLM environment.

Vitally, the team must make abstraction of the status-quo, be open to change and vet options in an objective, neutral fashion: the mission and how to accomplish it are mutually dependent variables.

5.5. The Tools

ARAS PLM and SSI's EnterprisePlatform (Figure 2) were added to ShipConstructor (a software product of SSI, Canada), MARS ERP and ms-Office.

ARAS PLM was chosen because of its flexibility in configuration and its ability to support the very unique ship design and ship building processes as well as their management. The core engine of ARAS PLM was further developed to this end.

First released in 2012, SSI's EnterprisePlatform is a fully focused, management-oriented software environment, specialized in and dedicated to creating a pro-actively sharing data and information environment that spans the ecosystem, combined with (and not limited) to ShipConstructor.

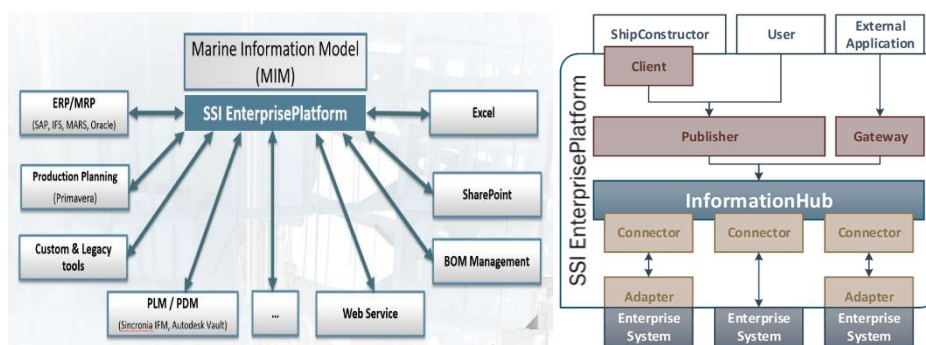


Figure 2. Schematic representation of SSI's EnterprisePlatform environment and Architecture

The combination of ShipConstructor and ARAS PLM within the EnterprisePlatform environment created the framework on top of which the enterprise-wide system and process integration, to include ERP, could take place.

5.6. Implementation

The vital paradigm shift hinged on the evolution from drawings being the source of data and information to just being one of many representations of a purpose-formatted collection of data and information.

The initial effort, intended to be a pilot and a benchmark to define the template of future work, combined elements of BPA, easy wins and definition of the major data structuring building blocks, the premise being that data availability must be automated. The legacy model of data being just accessible, which requires knowing that the data or information really exists, where it is, whether it is valid, etc., is abandoned.

During the initial implementation effort, data and information instances were identified as:

- Source: who generates it, how, where and when
- Storage: where is the data stored and in which format (ideally the source format)
- Stakeholders & Consumers: who needs which data and information, when, in which format (subject to change as a function of finding during the BPA)

Successive implementation cycles are mapped and defined along the way.

5.7. The Plan

As noted already, PLM implementation is an open-ended initiative that, for it to be successful, must rest on a solid foundation of automatically available, valid data and information, but also be highly adaptive to changes to the overall ecosystem. Thanks to having reduced the instances of each data and information to just one, and knowing its storage format and where they reside, the “availability” mechanism can be put in place.

The somewhat iterative process would see a first pilot and benchmark cycle, followed by flexibly defined, further cycles to be reviewed and mapped during the preceding cycle, and finally defined only after completion of the preceding cycle.

5.8. Success

The immediate goals of enhancing efficiency in the exploitation of resources in general (i.e. reduce “waste”) proved correct and valuable and were maintained during the initial effort. Functional deliverables came on-line within 8 months, on time, and used across the enterprise. Achieved goals included:

- Reduction of manual work and manual workflows
- Quasi-elimination of multiple instances of data and information
- Measurably improved overall efficiency and tangible ROI

5.9. Next

While successful, an 8-month cycle is long and vulnerable, even when dealing with multi-year projects. Shorter, 3-month cycles follow, each set to complete with overall measurable gains and ROI.

Following the rationalization of data and information generation, storage and automation of its availability, change-management is being progressively spliced into the PLM process.

In terms of IT, “platformization” and open architecture begin to be viable supports to the distributed, single environment, ecosystem digital model and are increasingly used.

6. Conclusion

While all enterprises and ecosystems are different, the concept of rationally assessing the relative roles of data and information sources, distribution of their storage, objective formatting and automated availability can be applied to all and will generate the strongest ROI in the shortest time within the scope of an incremental, open ended, closed cycle strategy. The case study discussed is one such example of continuous success and many specific, several aspects of which are discussed in detail in the Waveform Blog (Morais, 2012-2018).

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