



<sup>1</sup> Emilija RISTOVA, <sup>2</sup> Valentina GECEVSKA

## PLM AND BUSINESS PERSPECTIVES OF THE NEW PARADIGMES IN INFORMATION TECHNOLOGY

<sup>1</sup> "GOCE DELCEV" UNIVERSITY STIP, FACULTY OF MECHANICAL ENGINEERING, VINICA, MACEDONIA

<sup>2</sup> FACULTY OF MECHANICAL ENGINEERING SKOPJE, "SS. CYRIL AND METHODIUS" UNIVERSITY, SKOPJE, MACEDONIA

**ABSTRACT:** Small to medium-sized enterprises (SME's) are significant part of the world economy but a tiny one of the PLM marketplace. The usual approach of the product lifecycle management (PLM) industry to this sector is to try to sell "PLM Light" product, in the belief that smaller companies simply need a stripped-down version of what works for large corporations. In this paper, the comparative study of conventional PLM model and Cloud PLM is given. For SME's more than any other group, costs, flexibility and performance are the key requirements when considering a Cloud computing solution as an IT infrastructure optimization alternative.

**KEYWORDS:** PLM, Cloud Computing, SME's, Business perspective

### INTRODUCTION

In industry, Product Lifecycle Management (PLM) is the process of managing the entire lifecycle of a product from its conception, through design and manufacture, to service and disposal. PLM integrates people, data, processes and business systems and provides a product information backbone for companies and their extended enterprise.

The last decade was the period of initial introducing of PLM concepts on the market. Initial came in early 2000s as a transformation of Engineering Data Management (EDM) and Product Data Management (PDM), thus PLM emerged as integrated information oriented approach to manage a product lifecycle. Nowadays, PLM is considered as a complex, expensive, service - depended software initiative.

A PLM system is designed to manage the full gamut of engineering information in a single location through the many stages of a design. The enterprise server manufacturer used the PLM system to manage the lifecycle and all revisions of their Bill of Materials (a listing of components used in a product), provide revision control of engineering documents (such as assembly drawings, schematics, and datasheets), electronically route approvals for New Part Requests (NPRs), manage and automate their Engineering Change Orders (ECOs), and control Approved Manufacturer's List (AML) changes. More importantly, the PLM helped bridge the gap between engineering and manufacturing [2,3,1].

Product Lifecycle Management is one of the four cornerstones of a company's information technology structure. All companies need to manage communications and information with their customers (CRM - Customer Relationship Management), their suppliers (SCM - Supply Chain Management), their resources within the enterprise (ERP - Enterprise Resource Planning) and their planning (SDLC - Systems Development Life Cycle). In addition, manufacturing engineering companies must also develop, describe, manage and communicate information about their products. By providing direct data sharing with the ERP system, any changes made in the PLM system are automatically uploaded to ERP so that engineering and manufacturing are always in synch [2].

### PLM FOR THE SME'S

PLM is the strategic business approach that applies a consistent set of business solutions in support of the collaborative creation, management, dissemination, and use of product definition information across the extended enterprise from concept to end of life - is now clearly recognized by many companies as fundamental to the product innovation process, and a businesses' top and bottom line performance. The most recent market research figures that the worldwide PLM market achieved overall growth of 4% during an economically tough 2003, and the investments in both new and expanded PLM solutions continue to grow at a solid pace over the next five years and exceed to \$20 billion by 2008 [14].

Historically, Product Data Management (PDM) and more recently PLM solutions were only practical for large enterprises, which had the extensive resources required to deploy and maintain them. The latest PLM solutions are designed not only for large companies, but also for SME's in multiple industrial sectors. Some PLM solutions now deliver pre-packaged functionality that is easy to acquire, implement and support at a reasonable price point for mid-size enterprises. Unfortunately, because these systems are typically built on their legacy foundations, their heredity does not allow them to

adapt easily to the evolving needs of the smaller enterprises. Moreover, these systems still require lengthy (and costly) implementation phases [4,3].

Implementation time and costs are critical factors for the SME's to consider when selecting a PLM system. SME's cannot afford to reassign their valuable resources to long PLM implementation projects. Most software designed for the large enterprises have considerably lengthy implementation processes of more than six months. Alternatively, striped down software designed for the SME's has a quicker implementation process and can have the company up and running within days or weeks, depending upon the vendor and level of integration with other systems [4]. At the same time, smaller enterprises are also accepting the need to improve their management of intellectual assets, and are more clear of their need to become better integrated with customers and suppliers address cost, quality, and delivery [14,8].

Life is going to be different in the next ten years in everything that related to business models. PLM will not be able to continue existing business model with mostly direct sales, heavy reliance on the service offering by partners and marathon of new product releases with new features, or expect always that SME's will accept "PLM Light" products. So, new approaches should be searching for.

Majority of PLM systems was created based on previously available EDM/PDM and CAD products. Some of the products related to ERP offering inherited lots of ERP technologies. However, nature of PLM products drives Product Lifecycle Management into areas where Internet technologies demonstrated clear differentiation – scale of data management, integration, collaboration, information sharing. PLM needs to stand in front of complicated decisions about how to adopt various internet technologies to keep technological leadership.

#### ABOUT THE CLOUD COMPUTING PARADIGM

The evolution of Cloud Computing over the past few years is potentially one of the major advances in the history of computing. Cloud Computing might be one of the alternatives for strategic investments in information technology and infrastructure due to the PLM software adoption having in mind the following: companies have to increase innovation and flexibility in meeting the requirements of the market/customers (so they should focus on innovation, not solving problems associated with the infrastructure implementation and its maintenance), „start-up“ companies as well as small and medium enterprises cannot afford large investments in information technology and infrastructure, greater flexibility and speed up launching new products on the market offering the opportunity to access and use of already defined data, etc. [11,9,12].

Cloud Computing is transfer of information infrastructure in the network, in order to optimize the load in terms of storage space and connection to the different number of users and reduce costs for managing these resources (hardware, software, networking). Resources are virtually interrelated and have a dynamic provisioning (under so called Service Level Agreement contracts (SLA) concluded between users and providers) to ensure uniformity [5,13].

Three basic categories of Cloud Computing services are identified [12]: Software as a Service (SaaS), Platform as a Service (PaaS) and Infrastructure as a Service (IaaS). Software as a service (SaaS) means software deployed as a hosted service and accessed over the Internet. Platform as a service (PaaS) means platforms that can be used to deploy applications provided by customers or partners of the PaaS provider. Infrastructure as a service (IaaS) means computing infrastructure, such as servers, storage, and network, delivered as a cloud service, typically through virtualization.

Some advantages of Cloud Computing concept are: basically cost savings; scalability; „pay-per-use“ model; independence from devices and location; efficiency; providing space for storage and control; probability and transparency of the processes; optimal utilization of resources, etc. [5,7].

Below are given some of its disadvantages: currently undefined standards between Cloud Computing providers, not techno-economic analysis of costs that will arise in case the company discontinued the use of web based services; the security of data is still not guaranteed by providers with certain regulations/standards, users become dependent of providers, or lose control over the management of information resources and services, etc. [5,7].

Cloud computing is a paradigm appropriate in all economic situations. When the economy picks up, the flexibility it provides can help in coping with growth, complexity and globalization; in a recession, costs are lowered, liquidity created and flexibility rose [6]. Cloud computing is a topic of discussion even in the traditionally conservative Product Lifecycle Management (PLM) segment. CIOs and business managers also see possibilities here for reducing costs significantly and greatly speeding up the usually slow processes connected with the introduction and maintenance of PLM solutions. Companies are less and less willing to tie up developer resources in PLM projects for months on end – their employees are simply too valuable. Developers should, after all, be concentrating on product development and IT employees on creating an efficient work environment in order to get the most out of business processes [6,15].

### TAKING PLM TO THE CLOUDS

SME's often have a competitive advantage over their larger competitors when it comes to customer support and responsiveness. SME's can react quicker to the evolving needs of their customers and target market, with intimate support and new or enhanced products. This should also be an important consideration for the SME when choosing a PLM system. SME's should consider such purchases to be a "partnership" with the vendor. For the SME's, their PLM system needs to be easy to use, have a low total cost of ownership (TCO), and be from a vendor who is dedicated to the success of that SME [4]. Not constantly small-to-medium enterprises need stripped-down versions that work for large corporations. What when the SME's wants a robust solution quickly, something that is not normally associated with PLM? When it's about smaller business, with big aspirations, which has need of implementation PLM to streamline the product development process between engineering, manufacturing, sales and quality assurance departments [14,8].

Hence, Cloud computing might be one of the alternatives for strategic investments in information technology and infrastructure and there is a high importance of the comparative study of conventional PLM models and Cloud PLM.

What market research says about Cloud computing? According to the latest Forrester research, increasing customer demand for software-as-a-service (SaaS) applications has already convinced 50% of software vendors to deploy some of their business applications via SaaS. The approach is turning out to be major technology challenge, as it re-opens the fundamental platform discussion. A new set of functionality in the form of platform-as-a-service (PaaS) offerings is leading to a new software product and services category. Worldwide cloud services revenue is on pace to surpass \$56.3 billion in 2009, a 21,3% increase from 2008 revenue of \$46,4 billion, according to Gartner, Inc. [11,9].

In this paper an approach has been made, all essential points about conventional model and Clouds model as strategic investment solutions in IT infrastructure regarding PLM systems adoption are going to be summarized.

### PLM AS SOFTWARE-AS-A-SERVICE (SaaS) VICE VERSA PLM CONVENTIONAL MODEL

When considering PLM SaaS, then we are talking about software application in the Clouds that is delivered as a service, renting out and paying monthly subscription, as easy as login and logout, as it shown on Figure 1 (PLM Users in interactions with the Cloud services).

PLM data are heavy and complex. Those can run remotely on Cloud servers and to be delivered over the Internet. The usage is in the same way that would be if they were installed on the conventional system. Thus, PLM SaaS allows focus on the product innovation, not implementation and infrastructure issues characteristics for conventional PLM models.

The comparison between Conventional PLM model and SaaS PLM shows that the "old - fashioned model" in-house PLM software requires company to spend on servers, networks and software licenses and to run the PLM applications, but at the SaaS PLM model there is no software or hardware to buy, install, maintain, or upgrade. Hence, the benefits of using SaaS PLM are the following: no software licenses to be purchased, no middleware, database or hardware to buy, fast and easy automatic upgrades, no customization and re-customization, instant access (anytime and anywhere), pay-by-the-meter, etc.

The current situation regarding usage of Clouds into the market is that, vendors like Arena Solutions, PTC PLM On Demand, PLM+, Autodesk Labs Project Twitch already made some attempts in that way, offering on-demand advantages.

### PLM AS PLATFORM-AS-A-SERVICE (PaaS) VICE VERSA PLM CONVENTIONAL MODEL

When considering PLM PaaS, then we are talking about the platform resides in the Clouds. As it shown on Figure 2, renting programming tools, subscribing and building apps and uploading in the Clouds, as well as a database, security, workflow, user interface and other are tools that step through the process of building powerful business applications.

PLM data are rich and deep in term of size, proprietary file formats and etc. The cost of rendering is high in the sense every time we work with the data we need to download the whole file. Rest based API's can provide access to partial contents so we can download and work on relevant pieces. PLM PaaS allows working between PLM tools. With software oriented architecture (SOA), companies can wave together various PLM tools like CAD, CAM, CAE and PDM and make them more interoperable. And

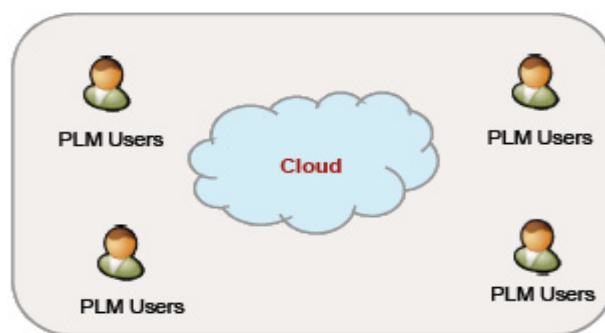


Figure 1: Software as a Service [10]



again, the most important, PLM PaaS allows focus on the product innovation, not implementation and infrastructure issues.

The comparison between Conventional PLM model and PaaS PLM shows that the “old - fashioned model” requires too many moving parts to be bought, installed, configured and maintained, then the PaaS PLM model allows application development and all application to be run entirely on the web. Hence, the benefits of using PaaS PLM model are the following: custom application development possible without the pain and expense of buying, configuring and managing development stack, developing, parcelling and instantly deploying of applications without any infrastructure, no need of hardware procurement, etc.

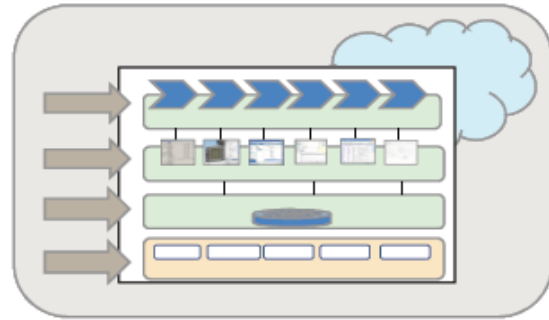


Figure 2: Platform as a Service [10]

What’s the current situation on the market regarding PaaS advantages usage – still no PLM vendors players, none so far; just few of them, which are non PLM vendors already offer on demand platform advantages, like Force.com IDE, Google App Engine SDK, Windows Azure SDK, etc.

**PLM IN AN INFRASTRUCTURE-AS-A-SERVICE (IaaS) VICE VERSA PLM CONVENTIONAL MODEL**

When consider PLM IaaS, and then we are talking about renting computing hardware resources, as it shown on Figure 3. With subscription, it’s allowed configuring the computer resources.

Elastic nature of cloud platforms makes it possible to scale up when needed. This can be greatly used by simulation, visualization and computation products. Refresh and rendering time of 3D images are very time and space consuming. Advanced technologies on the Cloud, such as non-relational databases and MapReduce parallel processing capabilities can ease out such of complex rendering of product data.

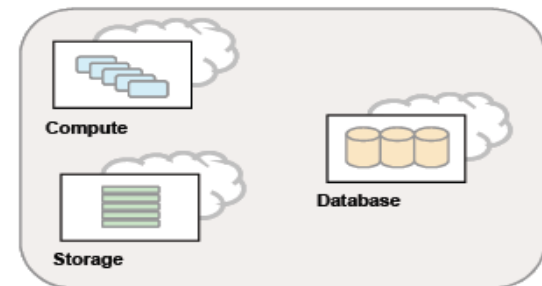


Figure 3: Infrastructure as a Service [10]

The comparison between Conventional PLM model and IaaS PLM model shows that the new approach allows configuring and controlling the leased hardware in provider’s data centre then the “old - fashioned model” where is necessary company to buy own hardware and manage its own data centre. Hence, the benefits of using IaaS PLM model are the following: no hardware to be bought, scalability (massive compute capacity on the fly), reliability (always on and self healing infrastructure), pays and go, meaning no more, no less, acquire resources on demand, release resources when no longer needed, etc.

What’s the current situation on the market regarding IaaS advantages usage – very similar to PaaS, none PLM vendors’ players so far? Amazon AWS and Force.com on AWS are the only one non PLM Players that offer IaaS on demand advantages.

**COST’S COMPARISON ABOUT CONVENTIONAL PLM MODEL AND CLOUD PLM**

As it shown in the Table 1, there are significant advantages in using Cloud PLM model despite the conventional PLM model. Perpetual App Licences and large upfront investments characteristically for conventional model are reduced and thus replaced with subscription level at the Cloud PLM model. Costs savings are on the side of the Cloud PLM model also for the maintenance and support/upgrade costs.

Table 1: Cost’s comparison about conventional PLM model and Cloud PLM

Costs	Conventional PLM Model	Cloud PLM Model
Software cost	<input type="checkbox"/> Perpetual App License <input type="checkbox"/> Large upfront investment	<input type="checkbox"/> Subscription service <input type="checkbox"/> Low upfront investment
Maintenance cost	<input type="checkbox"/> Annual fee for the license	<input type="checkbox"/> None, included in the subscription
Support/Upgrades costs	<input type="checkbox"/> Unpredictable, hidden costs	<input type="checkbox"/> None
IT Infrastructure/HW	<input type="checkbox"/> Large upfront investment	<input type="checkbox"/> Pay-per-use
Facility expense and maintenance	<input type="checkbox"/> Comes with the infrastructure cost	<input type="checkbox"/> None

**CONCLUSIONS**

When it comes to Product Lifecycle Management, in today’s complex business environment companies are beginning to focus more and more on the individual productivity, application productivity and IT productivity. These three factors must be balanced and optimized – at moderate cost. This is particularly challenging for small- and medium-sized companies who don’t want to tie up their investment resources in major IT systems.

As product designs become more and more complex, businesses require a high-performance Product Lifecycle Management solution. Implementation, integration, rollout and operation of a PLM platform is a significant source of cost and risk, setting a tough challenge to the cost oriented business. While large enterprises have the resources to invest in leading-edge solutions, smaller companies may miss out on the opportunity to unleash the potential of PLM by settling for second-best. In general, companies are facing the challenges given in Table 1 when they operate a PLM system.

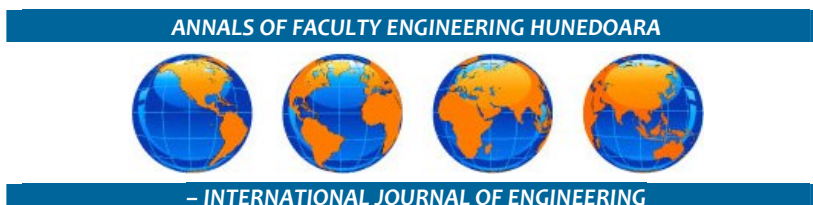
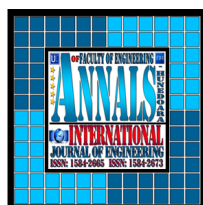
The benefits of using on demand PLM solutions for SME's means:

- Improved cost efficiency, lower TCO (by using standardized applications, the costs of rollout, service and operation, user training and ordering and billing processes can be reduced significantly. This is the basis for ensuring a much lower „time to value“ and total cost of ownership, TCO, [6])
- Flexibility through the pay-per-use model
- Improved service quality through standardization
- Faster implementation (on average less than three months following kick-off in a typical user environment)
- No implementation risks
- Higher reliability thanks to the limited need for fine-tuning
- Advantages of best-practice standards

Here are of course some disadvantages too. The cloud computing services needed to deliver the majority of IT services needed by customers do not yet exist. There are still problems and constraints with application offerings, service-level agreements, more importantly security issues. All of the cloud providers do not have the same capability for their technological levels. The fundamental shift is going towards to the collaborative environment of the future – new devices, real time, and social environment.

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