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Study on a collaborative platform for product development using cloud computing

L Popa[1] and V Popa[2]
[1]Department of Automation and Information Technologies, Transilvania University, Mihai Viteazul, No.5, 500036, Brasov, Romania
[2]Department of Defense Resources Management Studies, National Defence University, Mihai Viteazul, No. 160, 500183, Brasov, Romania

E-mail: mluminita2001@yahoo.com

Abstract. In a more digital-oriented world, companies need to be present on all customer communication channels, including collaborative social media platforms, and provide them with quick information and responses.The companies should provide unitary work experiences by integrating collaborative applications into existing systems and processes.The ability to connect employees, partners, vendors and customers to deliver real-time information is the basis for differentiation in the competitive environment. The main purpose of our work is to study a cloud collaborative platform that comes to support the companies and generates results through predefined work patterns and processes that connect employees and the necessary business decision-making data. In our case, the secret is the technology that leads to the existence of applications that can be accessed "from the clouds". Thanks to cloud computing, even small or medium-sized businesses that did not allow an investment in IT infrastructure or expensive software can have the most important technology in the world, just like multinational companies, but now at an insignificant cost.The medium and long-term challenge is related to integration between modules, and detailed integration with the production enterprise's internal information systems, as well as presence and integration with social media networks to create products distribution opportunities, staff recruitment, and collaboration on the ideas development and sharing of shared resources in the enterprise.Due to the diversified services offered on demand as well as to the Cloud Computing multi-tenant aspects (multi-tenant is a principle in the software architecture in which a single program running on a server simultaneously serves multiple client organizations), the traditional forms of audit and evaluation are not applicable or can have incomplete results. In the context of migration to cloud, within our research, we have sought to underline the importance of interoperability principle in the context of the current production environment which allows a rapid migration from one configuration to another using a cloud computing method. The main results of collaborative platforms 3DEXPERIENCE on CLOUD are as following: reduction by almost 10% the time needed to conclude new contracts, with about 15% the time needed to access information in the interest of the service, and with about 15% the costs of training programs for new employees. The most important consequence of the paper is the use of a 3DEXPERIENCE on CLOUD platform, providing new ideas for innovative business..

1. Introduction

In a more digital-oriented world, companies need to be present on all customer communication channels, including collaborative social media platforms, and provide them with quick information

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and responses.The companies should provide unitary work experiences by integrating collaborative applications into existing systems and processes.The ability to connect employees, partners, vendors and customers to deliver real-time information is the basis for differentiation in the competitive environment.Considering the fact that in recent years, organizations are increasingly using the digital version, there have been important changes in their adaptation to the Internet. The combination of these technologies quickly, cheaply and accessible to the evolution and integration of the four trends: cloud computing, portability, social collaboration, and data analysis. International competition and increased product complexity force the manufacturing departments of all industries to optimize their entire product development process to save time, reduce costs, and increase quality. Collaboration is one of the most important values (practices) within an organization. Teamwork for product development requires a collaborative approach.

2. Cloud computing

Cloud computing is a new paradigm in the world of IT services. This paradigm is geared towards low IT usage costs, "pay as much as you need", and the abstraction of certain components. Thus, on this principle, companies that offer cloud services have developed very well. These services are organized in the form of a stack and according to what they offer they are classified in:

- Software as a Service (SaaS);
- Platform as a Service (PaaS);
- Infrastructure as a service (Infrastructure as a Service) (IaaS).

The services offered in this way have as their main features the availability and scalability.

3. General description of the hardware and software structures involved in cloud computing

Computing Terminology refers to a computing system in which tasks are assigned to a network through a combination of connections, services, and software. This collection of connections is known as Cloud. Cloud computing is a natural evolution from computing-oriented architectures and utility computing. The details are not visible to consumers, who no longer need experience to work in the system, nor do they have control over the technological infrastructure of the "cloud" they are working on. This domain is a secundary product and also a consequence of the ease of remote access to computing sites offered on the Internet.These sites often take the form of web tools or applications that users can access and use through a web browser as if the programs had been installed locally on the personal computer. The National Institute of Standards and Technology (NIST) offers an objective definition. The term "cloud" is used as an Internet metaphor based on a scheme used in the past to represent the telephone network, and later to describe the Internet in computer network diagrams, abstracted from basic infrastructure. Generally, cloud computing providers provide customized online business applications that are accessed by another Web service or web browser, while software and data are stored on servers. Most cloud computing infrastructures consist of server-based services and provided over the Internet. "Clouds" often appear as unique access points for consumers. The core feature of Cloud Computing is the provision of IT infrastructure and applications as a service in a scalable way [1]. Commercial offers must meet a certain quality and customer requirements. ICT is the driving force of the virtual enterprise, providing easy communication and collaboration among business partners and, in addition, allowing small organizations to participate in a major national / international project. Due to its virtual nature, the enterprise benefits from great flexibility in adapting to changes in the business opportunity to which it is addressed. The cloud infrastructure is owned by an organization selling cloud services to the general public or to a large industry group [2]. Industry revival is a process that is already underway and will gradually change the paradigm of an "analogue" factory to a new "digital" production system: this change, exploiting new generating technologies, can take place due to the introduction of a system governed by information and collected data of company's expanded enterprise, which will enable more accurate, real-time decisions to optimize production and logistics processes-figure 1.

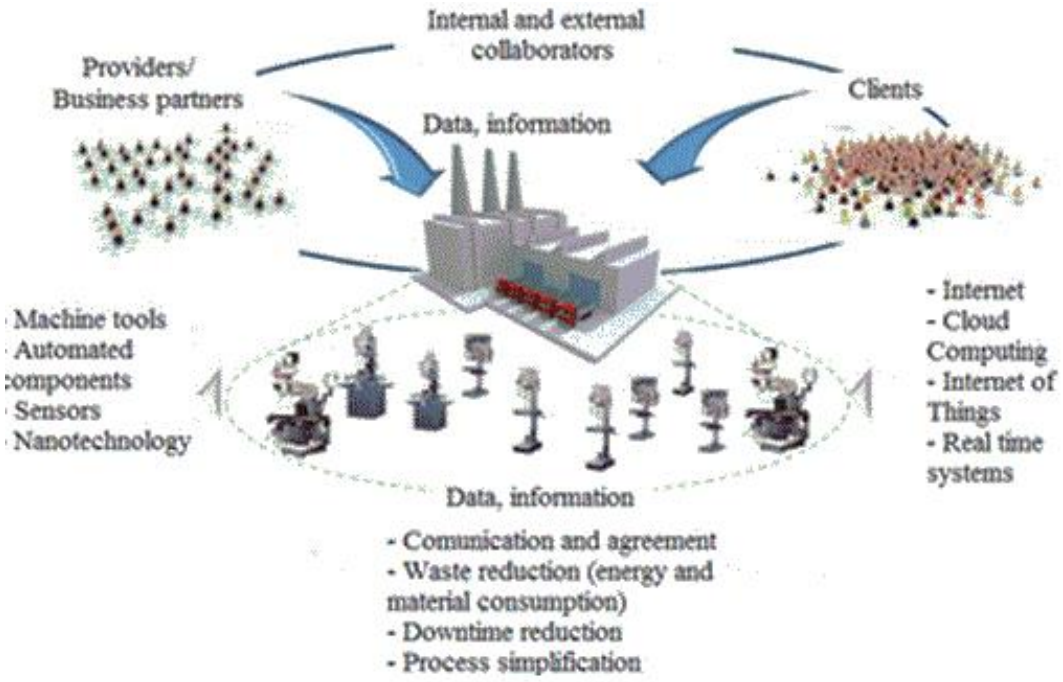

Figure 1. Virtual Enterprise.

4. The major technological megatrends

Summarizing, there are 5 major technological megatrends that are modifying the traditional production system:

1) Cloud computing: allows companies of all sizes to take advantage of the computational power and computation necessary to exploit Big Data, or the huge amount of information coming from sensors, components connected to the network and any instrument with an internet connection, in order to identify waste, simplify processes and make production more efficient.

The new processing possibilities offered by these systems would also enable companies to exploit information from different destructured sources such as customers, suppliers, logistics systems and social networks, in order to obtain real time or at least with relatively short time spans (real near time) indications necessary to improve production.The Cloud, reducing initial investments, also enables smaller companies to benefit from technological innovation and information management by exploiting "as-a-service" infrastructures;

2) The IoT and the robotics applied to the factory allow to increase the automation of the processes allowing however a flexible management thanks to the platforms that can manage events triggered by data and information in real (near) time;

3) The 3D printing technologies, which are now approachable thanks to the numerous services that are increasingly affecting the market and which allow companies (especially small businesses) not to initially tackle the cost purchasing. As we will see, these technologies will modify part of the supply chain, especially as far as the prototyping, production and logistics phases are concerned;

4) The use of augmented reality, for example for the maintenance of critical factories through the intervention of technical figures and the support of documentation relating to the product to be supervised, the certifications, the location of the components, the taking of photographs before and after the intervention, as in the case of gas pipelines, chemical platforms, tanks, large plants;

5) Integrated Enterprise Ecosystem: The new systems will also allow greater collaboration between the different sections of the factory (where often design and realization travel on separate channels) with consequent reduction of waste in the prototyping phase.

A concept that will lead to the reduction of consumption and the realization of the finished product from the first moment with a consequent contraction of related costs and the bill of materials, as well as a greater understanding of the changes and tracking in real time of the product throughout the phase of the production cycle.
Not within the 5 MegaTrends but nevertheless of significant importance we want to place the concept of sustainability, transversal and which involves an optimal use of the energies and resources available, with contingent risk reduction. In the future, this concept will be fully integrated into the development plans of all the industrial realities and not only of the larger and multinational companies.

5. Cloud collaborative platforms

In Romania, research and design and information systems have made significant progress over the past years in developing collaborative platforms using PLM solutions and synchronous collaboration tools based on the latest technologies. The main activity that leads to the realization of a product is the conception activity, which can be defined as a collaborative activity that requires a specific commitment to participate in product development. This refers to: factors related to the general context of the project (geographic distribution of resources, means of communication), organizational factors (organizational proximity, business integration, information exchange), factors related to the conception process (nature of the problem, approach, restrictions) and factors related to the members of the research team (work group optimization, communication, geographical positioning).

When two or more members of a project team from different geographical locations cooperate to define product design solutions, these solutions generate different parameters or information that needed to create a common understanding of design intent.Due to problems such as the large time zone gap, it is difficult to plan simultaneous cooperation between engineers, so only asynchronous cooperation is possible.In the PLM platform, software applications are implemented, especially applications for conceptual design, virtual design, virtual prototyping, virtual manufacturing, product design and manufacturing, factory layout, production flow, testing, simulation and product optimization.

These include software applications for managing data and documents related to open projects within the platform, as well as means of communication between project team members.

A number of interoperability, security, connectivity issues need to be considered within a Cloud collaborative platform. Such a platform can be used by distributed project teams in any geographic location without the need for graphical stations or large system resources to access and use it.
Through Cloud collaborative conception platforms, users can access all existing resources for collaborative product design and project data management, both through the Intranet, when project team members are in the same location, and through the Internet, if some nodes are running on real physical hardware, and some nodes are running on the Cloud server, which they have access to and partners from outside the site.PLM / PDM collaborative platforms combine all of these into a single computer program linked to a common database so interdepartmental communication is much easier.
Dassault Systèmes helped the industry to optimize design and product development through 3D and digital mock-ups. Initially used for complex projects, these technologies were then applied to each industrial sector. Today, the company allows complete anticipation of industrial processes through solutions that offer a three-dimensional vision of the product lifecycle, from design and manufacturing to maintenance and recycling. Software architecture has been created that has opened the possibility of creating digital models for any product. Enterprise architecture function within enterprise IT has evolved to manage the complexities of an ever-changing technical environment [3]. CATIA has soon allowed a reduction in the number of physical prototypes, cost savings and development time, as well as design and engineering within non-geographic collaborative teams.

6. Aplication of 3D Experience Platform

The platform is accessible via a web interface by accessing a link. To access the platform, we need a username and a password (figure 2). The first thing a user sees when accessing a dashboard platform

(figure 3). A user may have different dashboards to view different information. The project manager has a dashboard to monitor the status and the current phase of ongoing projects. Within the platform there is a 3D Space News/Common Space Content that returns various information about what's new as content in the workspace where the connected user is a member. Here is also displayed the 3Ddrive-Personal Works screen where the user can load different objects in the private space within the platform.

Figure 2. The access to platform.

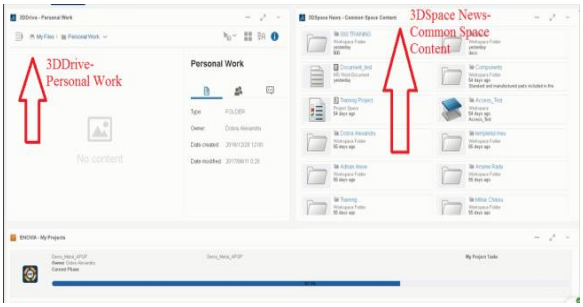

Figure 3. Accessing a dashboard platform.

There are intelligent elements within the platform, the compass is one of them (figure 4). Depending on which part of the compass we activate, we notice that the list of applications will change.If we access the compass's 3D part, we have access to various applications called Catia V5 workbenches (figure 5).If we access the northern part of the compass we have access to the Enovia applications (figure 6).

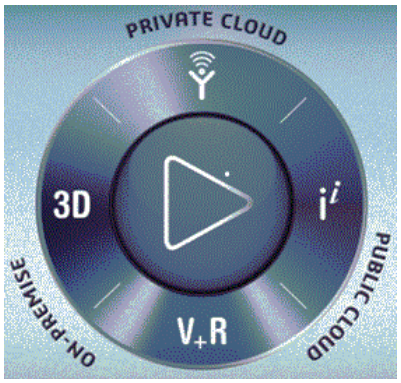

Figure 4. The compass.

Figure 5. Access Catia V5 workbenches.

Figure 6. Access to the Enovia application.

Each user has the ability to create a list of the most commonly used applications, and this can be done through *Drag & Drop apps* from that list. The number of applications depends on the role of the users in the project (figure 7). Depending on the role of the user in the project, we can update the application list.

Within the Collaborative Platform we can view on-line the ongoing projects (figure 8)

Figure 7. The role of the users in the project.

Figure 8. The ongoing projects.

Within the 3DExp Platform, there is also the Projec Management module where you can see information about ongoing projects with the help of an Intelligent Dashboard that returns various project information: how many tasks are already exceeded as time to work (figure 9 and 10) or if there are critical tasks that may affect project performance.

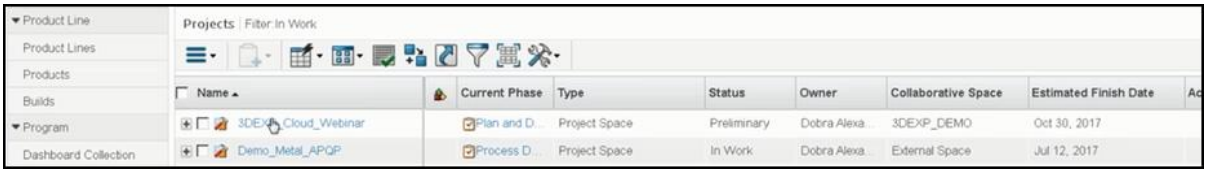

Figure 9. The tasks that already exceeded time to work.

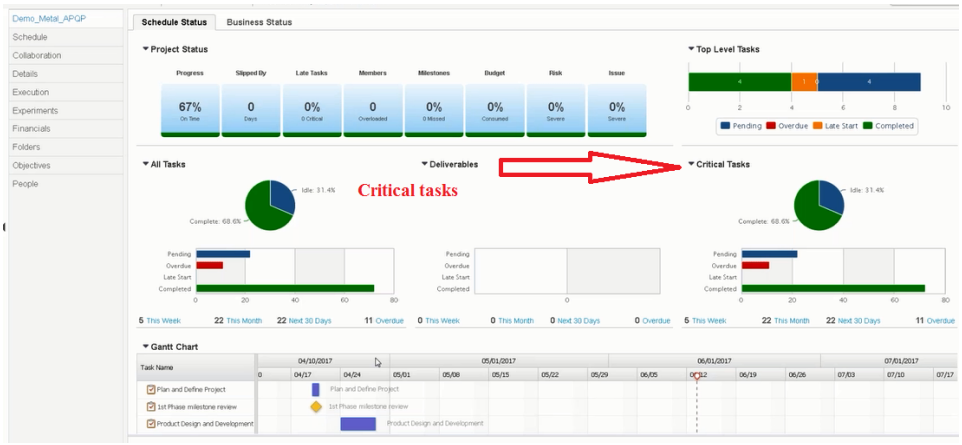

Figure 10. Dashboard with Critical tasks.

We can access Schedules and Phase Gate (figure 11 and 12) view of the project where we have access to all components of the project.

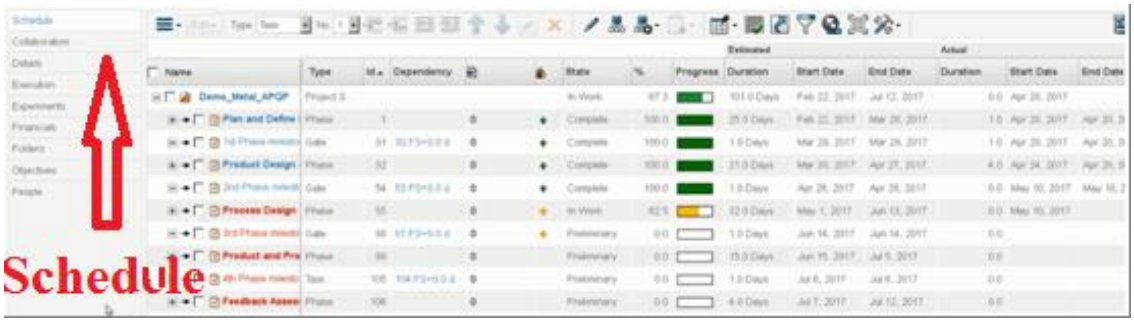

Figure 11. Schedule view.

Figure 12. Phase Gate View.

After each phase you can create decisions so that each document can be used in the Audit Phase (and you can see why a particular member of the team made a decision in the design of a project phase).
The virtual project uses tasks and subtasks. In the Gantt diagram we can enter into detail for each phase of the project (figure 13).

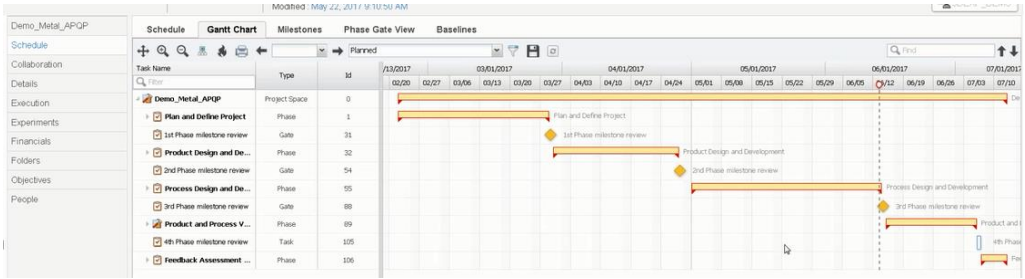

Figure 13. The Gantt diagram.

In the collaborative part, we insist on discussing the Industry 4.0 concept where there is total collaboration between department, machine and user, and massive data collection.
Within the platform decisions can be made, discussions can be held between the members of the project or meetings can be held. There is bidirectional integration with the OutLook module for sessions (figure 14)

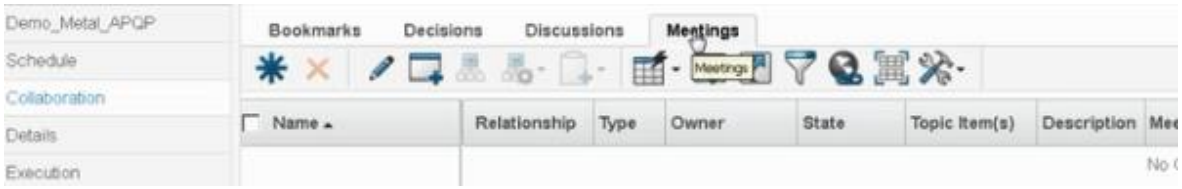

Figure 14. Bidirectional integration with the OutLook module.

In the Enovia module of the 3DExperience platform, through the *Folders* structure, we can attach the relevant project documents, for which we can edit them, create revisions and manage the document management part and the revision part of the project. Besides the technical documentation, we can also attach the geometry part of the project. A designer can arrange different parts in this document structure.

In the *Resource Plan* section we can see the part of the resources needed for the project (figure 15). The system administrator can define department-specific resources, and if a project or task manager needs more resources, he (she) can request these resources for the department manager, and the latter will allocate this resource to the project.

Figure 15. Resources needed for the project.

We have the option to make a revision to a document with the Revisions tab of the document life cycle is in work. If we want to access the platform from the perspective of a compiler designer we can access a module of my choice. The platform sends an *Enovia Folder* command to access a local application and we will see how can be managed the CAD structures around this project-level folder structure (figure 16).

An example of the toolbox structure (through which we can manage different components) within the design software, without changing different windows and software is shown in figure 17.

Several complex assemblies can be managed and we can also access those documents (figure 18).

The motorcycle fork design is shown in figure 19. In figure 20 we present the access to the material list of the EBOM project. The project helps us t0 access to the material list of the EBOM project (figure 20)

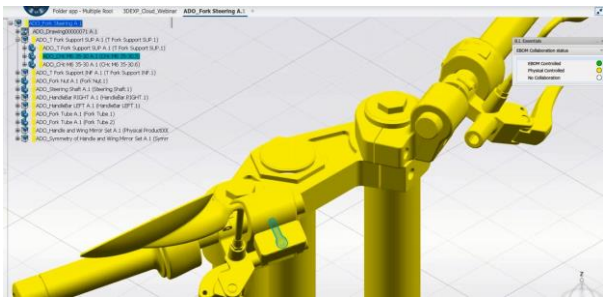

Figure 16. CAD structures around this project.

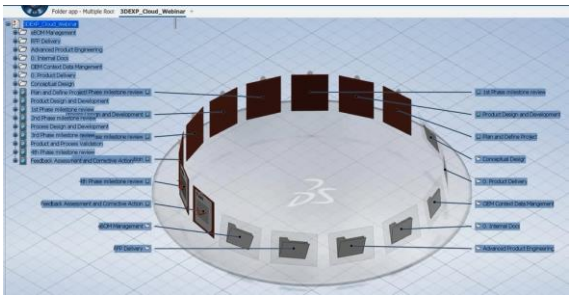

Figure 17. An example of the toolbox structure.

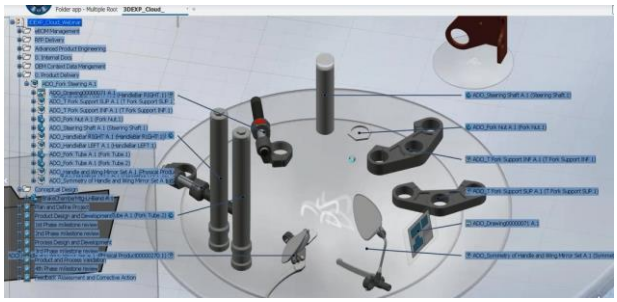

Figure 18. Several complex assemblies which can be managed.

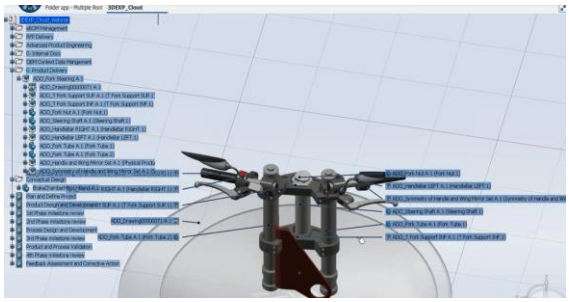

Figure 19. Product Assamblies.

Figure 20. Access to the material list of the EBOM project.

Figure 21. The final project.

There are also integrations at Excel and PPT level.

7. Conclusions

Collaborative Pltforme 3D experience covers as many domains as other PLM softwares that only cover CAD data. It therefore covers as many roles as possible within the company and makes management of nonCAD data much easier.Cloud solutions will certainly be the next step. They will allow users to work at any time, from anywhere in the world, through a simple internet connection.

Such expensive application packages, including several office software, and cloud solutions can be purchased as packages. The major difference between traditional software programs and cloud services is that online solutions can be integrated so they work together without having to ask for the computer's processor. Collaboration is possible from anywhere, anytime, directly from your computer, smartphone or tablet. In addition to ease of use and the convenience of being intuitive, cloud solutions allow flexibility.

Cloud allows you to choose exactly the solutions your individual employee needs. Many people agree that cloud-computing is the next phase of business and personal computing [4]

Customized solution packages can also be created for each company.

This eliminates unnecessary spending and costs are constantly under control.

This means for a company that it becomes more competitive on the market and its products are delivered much faster.

The emergence of virtual organizations and their interconnection into electronic data networks have led to the development of virtual teams. The complete information is centralized into a database that allows access to and modification of any of the departments involved. Software companies will adopt cloud services and build solutions on platforms as service (PaaS), due to the agility and size of these types of services.

The market evolved through efficient solutions for enterprises built with data center, security, unified communications, ERP and CRM technologies [5]. Many companies will keep their activities

unique, and will outsource cloud services instead of developing internal departments. Collaboration is possible anywhere, anytime, directly from your computer, smartphone or tablet. Besides of ease of use and the advantage of being intuitive, cloud solutions allow flexibility. The Cloud allows you to choose exactly the solutions your individual employee need.

Designing open and linear form architecture by integrating software applications is the most relevant concept of the digital factory. In this context, a collaborative and flexible development environment is needed to manage the entire product development process. In order to reduce costs and production time but also to increase product development efficiency, the degree of digitization of computer assisted technologies is in a dynamic and continuous progression.

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