An Advanced Platform for Collaborative and Mobile Enterprise 2.0

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Abstract: Recently, a new model of Enterprise 2.0, which interacts actively with customers using web 2.0 tools (chat, forum, blog, wiki, social network) to improve and develop new products/services and to satisfy market requirements, is affirming. The company to communicate with all stakeholders of the supply chain and to exploit all business services of the Information System can use smart and mobile devices. The new model of business, provided of technological tools, is a mobile and collaborative enterprise that interact, exchange and share information with the internal and external social environment. In this paper we describe, in detail, an advanced platform that integrates various tools and applications and supports the new model of business. In this way the enterprise can implement a corporate strategy to reach competitive advantages.

Key-Words: web 2.0, enterprise 2.0, mobile enterprise, collaborative software, web services, SOA.

1. Introduction

In recent years, in the business sector, a new and advanced Enterprise 2.0 model is developing. This model represents an open enterprise that exchanges information with commercial partners and in particular with customers by web 2.0 tools (chat, forum, blog, wiki, social media) to improve the product/service. Web 2.0 tools, before, were used only in a private sphere and not for business goals. Nowadays many websites of companies have their pages on Facebook, videos on YouTube and use business communities to exchange and share information with customers. Even mobile devices enhance the new business model of Enterprise 2.0, focused on collaboration and information sharing. Within the company it feels the need to integrate these mobile devices to use services and corporate information assets. The internal IT department must adopt the most effective strategy to preserve benefits and advantages also in a mobility context.

The corporate ICT plan must consider all aspects affecting the mobility, the introduction of new devices and new business applications, their integration with the existing components, the security, the connectivity and the user support. The mobility [1] redefines the context of the company, to experiment with new technologies and solutions and to assign them a greater importance as business tools. These devices transform business networks in global networks and change the work environment in a virtual space [2]. By these new and advanced mobile devices an efficiency organization will be possible.

In the paper we describe a collaborative and mobile platform that integrates legacy systems with new web-based tools and business applications [3]. For the success of the implementation of the Enterprise 2.0 model, it is also necessary that the top management and employees have a global vision of the change.

The paper presents the following structure: the next section focuses on the new Enterprise 2.0 model. In the third section we analyze the new ICT consumerization phenomenon. In the fourth section we describe an advanced platform to implement a mobile and collaborative Enterprise 2.0. The fifth
and sixth sections focus on technical features and benefits/limits of the platform. Finally some conclusions is drawn.

2. Enterprise 2.0 model

The new model of Enterprise 2.0 (Figure 1) is an open enterprise that, for business goals, exchanges and shares information with all stakeholders (customers, suppliers, sponsors, partners).

Enterprise 2.0 [4] is the use of emergent social software platforms within companies, or between companies and their partners or customers.

Figure 1. Enterprise 2.0 model. Source: own.

The Enterprise 2.0 introduces strong impacts in the organization and in Information Systems. This enterprise uses intensely web 2.0 tools (that before were generally used only in a private manner and not for business goals. In the web 2.0 [5] we can take in consideration two aspects: technological and social. The social aspect is relative to people that interact and exchange information and the technological aspect is relative to digital tools used.

The Web 2.0 is a network of people and not of machines. The technology surely is the trigger but the people are the real core of this evolution. Every day, people exchange and share experiences, opinions, photos and video. There are a lot of websites that collect and make available customer reviews: epinions.com, ciao.it, complaints.com, planetfeedback.com, ecomplaints.com, dooyoo.it, cnet.com. [6]. To capitalize customers opinions is very important for an enterprise, both for the improvement of products and for the reinforcement of the customer loyalty [7]. The customer will be motivated to be loyal if the enterprise shows a strong attention to his/her needs and identity.

The knowledge sharing, the collaboration and the development of social networks, inside and outside the company, are very important factors for the success of the enterprise. In fact the key features of an enterprise 2.0 are: sharing, collaboration, interactivity and agility.

An Enterprise 2.0 presents an architecture bottom up and uses a peer-to-peer communication while in a traditional enterprise (Enterprise 1.0) the architecture is top-down and the communication is hierarchical.

In the Enterprise 2.0, the customer is a central figure and he/she is involved in all processes: conception, design, development, testing, marketing, buying and so on. A customer more involved in the production process helps the company to find and eliminate errors/defects for improving the final product/service.

The Enterprise 2.0 model can be interpreted as a new way of doing business, a participative business where the company and the customer work together (co-operate, co-create, co-produce) [8] to improve the final product/service.

A collaboration between companies and customers, in a context of co-creation and co-production, stimulates the realization of the figure of the prosumer (producer and consumer at the same time) [9]. The consumer is becoming a co-creator of value [10] while in the past he/she was a passive responder to market supply.

Nowadays, the customer, really, has an active role as prosumer. In IKEA, the customer participates in the logistical and productive processes by transporting and mounting, individually, the furniture at home. The Mulino Bianco is available to listen any proposal of new biscuits. Ideas can be proposed and voted; the best one will be realized. In the website "Fiat 500" (500 Wants You - www.fiat500.com) any consumer contributed creatively to the design of the new car. In the case of the canadian manufacturer John Fluevog, customers...
participate actively and creatively designing new models of shoes.

The Web 2.0 also leads to a revolution in the content generation. Until few years ago, users read only, in a passive modality while now they can create contents and movies, express opinions and give advices becoming User-Generated Content [11] or Consumer Generated Content [12].

In the web, the contents’ production is no longer the prerogative of media centers and press but everyone, by web 2.0 tools, can participate in the discussion and produce contents by simple platforms like Flickr, YouTube, Second Life, Facebook, Wikipedia. In the era of Web 2.0 there is no clear boundary between who produces and who consumes contents; everything is indefinite, "everything is miscellaneous" [13].

To emphasize the role of users [14] in Time magazine affirmed that “Person of the year are you: For seizing the reins of the global media, for founding and framing the new digital democracy, for working for nothing and beating the pros at their own game”.

The primary goal of the enterprise is not to sell directly but to gain more brand-reputation and brand-engagement, following a continuous and fruitful relationship with customers. The brand engagement describes the process of attachment (emotional and rational) between people and the brand [15]. The reputation and customer loyalty are useful to create brand affinity toward an enterprise [16] but these require not only investment but mainly time to build a lasting relationship.

The main differences between an Enterprise 2.0 and an Enterprise 1.0 (traditional enterprise) are summarized in Table 1.

<table>
<thead>
<tr>
<th>Contents reading</th>
<th>Contents generation</th>
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<tbody>
<tr>
<td>Structured</td>
<td>Unstructured</td>
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<td>Sharing</td>
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<td>Competition</td>
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<td>Technology-driven</td>
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<td>Top Down</td>
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<td>Content publishing</td>
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<td>Contacts</td>
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<td>Copyright</td>
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<td>Product-oriented</td>
<td>Customer-oriented</td>
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3. Enterprise 2.0 and IT consumerization

The orientation towards the principles of the organization 2.0 stimulates the introduction and application of new interactive tools 2.0. These tools contribute significantly to strengthen and promote innovative organizational behaviors that are based mainly on participation, collaboration and sharing of information. The collaborative and adaptive decision making stimulates the development of an Information System 2.0 configurable and flexible around people and digital devices used in everyday life.

The logic of governance of the Enterprise 2.0 [17] must be bottom up and not based on traditional hierarchical top-down mechanisms. The building blocks of Governance 2.0, must be based on a coherent and communicative leadership that spreads enthusiasm.

All employees must have the access to corporate information, the possibility to develop social relationships for a positive comparison and mutual influence that lead to the realization of new practices. Furthermore, people are urged to share top-level decisions and take responsibility for their own initiatives.

In the private life, daily, it grows the desire to communicate and collaborate. The market always pushes towards the
consumerization of IT tools (smartphone and social networks). We must bring, in the company, tools and applications that are used in the private sphere. People feel the need to use in the work what they use in the private life regarding technological and social aspects. Companies must understand that allowing to employees to use their mobile devices (tablets, smartphones, laptops, etc.) [1] for business purposes, it increases the productivity and improves the results. This consideration outlines a framework of integration from below, from the desire of employees to work in a more easy and convenient modality. In the future there will be a cultural change, a long wave [18] which involves not only senior managers but also employees, who can use their devices to manage corporate information assets in a context of mobile enterprise [19][20].

Since 2010, the Gartner report (www.gartner.com) announced that the consumerization of IT in the company would have been the trend for the next 10 years. Recognising the benefits, companies are investing in adopting the BYOD (Bring Your Own Device) policy, with the aim to meet the needs of employees and others. This action increases the productivity, employees are happy, and the access to information and the internal collaboration will improve. The Cisco report's "Connected World" (www.cisco.com) of 2010, already showed the dissatisfaction of the employees of obsolete access policies: the 63% of Italian employees suggested updated policies, finding a compromise between the use of devices, social media, mobile and the working flexibility; the 22% of people declared to be ready for violating the rules of business just to satisfy the growing demands of communication and to work better. Companies need to switch to a type of "security as a service". Using rules that everyone could not follow it is dangerous. It is much better to create a sort of white list of approved applications to provide employees with secure tools. For employees working remotely, it is necessary to use a strong authentication process, valid independently of the device. The Apple model (www.apple.com) suggests to keep users free within an operating area.

Users applying the model of Consumerization IT operate, in an implicit way, for the best security (being their own terminals), with a self-awareness that, in standard working conditions, it is more difficult to have. However, this spreading of a real time collaboration requires specific tools and applications [3][21] to support the business in this area in a full security context [22][23][24]. Inside the companies, people should be able to use their devices to manage corporate information assets to have the mobile access to a series of business processes.

The implementation of a mobile Enterprise 2.0 [25][26] brings to company advantages such as the increased staff productivity, best performances, effectiveness of processes, a greater control of products movement and a greater customer loyalty. For all these goals it is important to use an integrated platform that enhances the collaborative and mobile aspects of the Enterprise 2.0. [27].

4. A platform for a Collaborative and Mobile Enterprise 2.0

At the moment the adoption of web 2.0 tools (chat, forums, blogs) and mobile devices inside the company, presents a relatively low impact on business Information Systems with some problems of integration. In this section, we describe an advanced platform (Figure 2) to integrate, inside the company, new web 2.0 tools, smart mobile devices with legacy software (ERP, SCM, CRM, CAD/CAM).
4.1. The logic infrastructure of the Enterprise 2.0

The logic infrastructure of the Enterprise 2.0 is shown in Figure 3 [17].

The application layer is a set of software applications that supports different functions and business processes. All applications could be transformed in services.

The collaborative layer includes the software that interacts with the external environment and in particular with all stakeholders: customers, suppliers, partners.

The Service Oriented Architecture (SOA) [28] allows to switch from monolithic systems to systems based on different components able to provide single services that can be used from more applications. A service could be an online order or the monitoring/traceability of a product from the magazine to the final customer.

Services can be executed at interactive (controlled by users) or batch (controlled by process) level. Services can be published thanks to remote Web Services (WS) [1] [17] in a cloud modality according the paradigm of software-as-a-service (SaaS). The service can be invoked by browser using Rich Internet Application (RIA) interfaces [29]. Services can be reused, modified or combined (mash-up) to create new ones for satisfying workload changes and the applications trend.

The service provided by Web Services is described with a Web Services Description Language (WSDL) document and published into an Universal Description Discovery and Integration (UDDI) repository. For example a business process requires a service (Service Request) to Web Services. The Web Service, found the service in the UDDI register responds and activates a Service Delivery [30].

4.2. Security service

This module contains the applications that control the access to different services of the platform. The security policies protect the confidentiality, integrity and availability of information [31]. These procedures authenticate users to safeguard the legal exchange of information.
All applications must comply with common security requirements and service levels necessary for the proper functioning of business processes. The security service includes different tasks:

- definition of users and groups to structure hierarchically all users of the platform;
- definition of roles and privileges to define, in detail, hierarchical permissions on contents;
- management of the Single Sign-On (SoS) [32], an unique identification for allowing to users to authenticate once and gain access to all permitted information resources.

Some guidelines to create secure web applications are:

- divide applications in components and each component must be armoured;
- control privileges allowed to users for the access to different functions of single components;
- management of user session, maintenance, opening and closing to protect the id session and the simultaneous presence of the same user in different multiple sessions;
- management of the log file for tracking sessions, user behavior and the communication between components.

### 4.3. Basis Service

The platform should contain interactive tools for the login, profile customization, context menu, search engines. The main components of the basis service are the followings:

- management of the own profile to customize personal home page as a container for widgets and RSS feeds
- dashboard to monitor personal activities;
- tools to support multichannel audio, video, mobile devices;
- calendar and agenda shared with other users of the platform with the possibility to create and share events, meetings and planned activities;
- contact management to manage internal and external contacts
- context discussions for sharing comments and consultations on specific contents;
- ratings and comments to allow additional modalities of participation around specific contributions;
- search engine to find useful information;
- tagging to facilitate the classification of information (content, documents, articles, etc..).
- reporting to monitor the use of services.

### 4.4. Collaborative – Mobile – Contents (CMC) services

This multiple-service can be split in 3 services.

#### 4.4.1 Collaborative service

A collaborative service contains Web 2.0 tools for the communication and collaboration [33] among internal and external subjects, for sharing know-how and user-experience. The main components are the followings:

- Wiki: to collaborate and share knowledge;
- Blog: to publish contents on the web space;
- Chat: for instant interactions among system users;
- Forum: to exchange views on topics and discussions;
- Social Network: for information exchange with profiled users and groups;
- Tagging: for the knowledge classification;
- FAQ: to classify the answers to specific questions;
- Polls: to consult the opinions of users
- Votes and Comments: to evaluate work and reviews;
- Syndication: to subscribe and update some news..

#### 4.4.2 Mobile service

In setting a mobile strategy [34] it is important to think about the mobility solutions to implement and therefore to
the management of these activities (mobility management). 
In terms of mobility management [35] [36], we must consider the following steps [37]:
- Management of the infrastructure: laptop, tablet, smartphones and industrial terminals;
- Management of mobile applications: middleware, mobile applications (apps) and delivery;
- Management of enterprise mobility: management of people, resources, processes and connectivity (gprs, cdma, wifi, rfid, wimax).

Carriers that offer connectivity are mobile operators and wireless internet service provider (WISP).

An important factor to consider in the mobility management is how mobile applications (apps) impact on business organization and information systems [37] (Figure 4).

How we can see from the Figure 4, Business Intelligence (BI) and apps 2.0 have a strong impact both on organization and Information System (IS).

Unified Communication (UC), analog and digital communication over IP, has a low impact on Information System and high in the organization; inside a company the communication is very important.
The applications of Customer Relationship Management (CRM) and Supply Chain Management (SCM) have a strong impact in IS and not in organization and, at the end, the Sales Force Automation (SFA) has a low impact both in IS and organization.

In the globalized economy and increasingly mobile society, companies must increase their capacity to develop and optimize the mobility [38] to operate, collaborate and decide more quickly with all partners of the value chain. In a scenario in continuous and rapid technological evolution it is important the development of the Infomobility.

In the future, regarding the connectivity wireless, QR code and RFID technologies [39] seem destined to pervade the entire value chain of any organization.

The Wireless Fidelity (Wi-Fi) [40] uses the IEEE Standard 802.11 and by a router, it is possible to connect the devices to an ISP network.

The Worldwide Interoperability for Microwave Access (WiMax) is a technology that enables a wireless access to a broadband communication network like the Broadband Wireless Access (BWA). Code Division Multiple Access (CDMA) is a protocol for a multiple access in wireless networks.

The Radio Frequency IDentification (RFID) is a technology based on radio frequency. The data transmission of RF code, in wireless modality, occurs when a tag (microchip), attached on product and connected to its own antenna, is synchronized and coupled with the frequency of an electromagnetic field generated by an electronic device (reader). RFID technology is very important to speed up loading-unloading, goods delivery and to localize vehicles and drivers. The data is transmitted according to the standard Electronic Product Code (EPC) and processed by a centralized information system. From the operations center, via the Internet Protocol (IP), it is possible to know all movements of mobile units and associate data to transported goods.

Even in the traditional Enterprise 1.0, there were mobile activities: the movement of the inventory, outbound logistics, remote maintenance and direct supervision of customers.

In terms of business processes an important and strategic mobility activity is the delivery of products to various customers and the tracking of this service which allows, at any moment, to
see the current position of the product and if it was delivered [30].

All products and means of transport are provided with RFID/GIS tags [41]. The service requests and their deliveries are implemented via web services. This model is supported by a web-based Information System that provides, in real-time, information on products. To implement the planning of distribution routes a Geographic Information System (GIS) can be used. In this way we can provide the best routing plan and new scenarios depending on the timing, cost, locations, etc... The system manages all means of transport, combinations of locations and deliveries. The control of the logistic fleet can be executed also with other technologies [40]: Wi-Fi, Global Positioning System (GPS) and General Packet Radio Service (GPRS). The efficient management of fleets is also useful to reduce consumption, emissions, minimize operating costs and to increase the sustainability.

The Information System coordinates all stakeholders and uses web collaborative tools to enable the interactive exchange of information, the planning and the execution of activities in the supply chain. The sensor network that monitors the operations in real time, plays a crucial role to improve processes, infrastructure and information flows.

4.4.3 Contents service

This service is used to manage, publish, distribute and search information and contents in the whole platform. Main components are:

- Content Management System (CMS) [42]: for managing unstructured contents as web pages
- Document Management System (DMS): for managing and sharing files among users of the platform
- Contents Search: for searching all contents available in the platform
- Opinion mining: to extract the polarity of opinions: negative, positive, neutral. For the the Opinion mining process we can use statistical or semantic algorithms.

4.5. Integration service

The platform must be able to integrate digital interactive systems with legacy ones. A level of integration it becomes essential to ensure uniformity and harmonization of different services. The integration will be among different heterogeneous information sources. We remember that main legacy systems are:

- Enterprise Resource Planning (ERP)
- Supply Chain Management (SCM)
- Customer Relationship Management (CRM)
- Computer Aided Design (CAD), Computer Aided Manufacturing (CAM), Computer Aided Engineering (CAE)
- Product Lifecycle Management (PLM)

To integrate and link together legacy and collaborative systems it is necessary an interface named Collaborative Contents Software & Legacy System Integration (CCS&LSI). This integration is designed to share information and documents among different applications. In this way, the available knowledge, inside the organization, will increase and therefore will be possible to discover new business opportunities.

Companies that decide to transfer on the web (part of) their applications and transactions must transform software applications in services. Actually, many companies convert their legacy systems and develop applications to share with different stakeholders a part of the business process. In this way the full development of standardized and reusable components is implemented. To transform a legacy application in a web service, it is necessary to use appropriate wrappers [43] which add useful information to the old code in order to expose it as a service, easily accessible by browser.

4.6. Database Service

Data of the platform is stored in an Integrated DataWarehouse. This database contains exchanged data by legacy and collaborative systems and
therefore both structured and unstructured information. All different components and services (e.g. security, collaborative, contents,...) of the platform save and read data from this database.

**5. Technical features of the platform 2.0**

The main goals of the platform are: implementing interactive channels among managers, employees and external actors to improve business processes, the integration between legacy and new interactive tools and the management of smart mobile devices. Technically it is important that the platform meets the following basic requirements:

- **multi-database**: to implement the platform on a database like Oracle, MySQL, SQL Server, PostgreSQL, DB2, Firebird, Sybase databases
- **multi-platform**: the solution should preferably be installed on Microsoft, Linux, MacOSX, Windows Mobile, Palm OS, Symbian, Android
- **scalability**: to distribute the platform load
- **caching**: to improve performances of web applications
- **multiserver**: implementation in web servers like Apache/Tomcat, IIS, WebSphere Application

The platform presents also the following technological components:

- **Software Development Kit (SDK)**, an API-based access to the platform in Java, .Net, etc...
- **An Integrated Development Environment (IDE)** to develop software applications
- **Directory Services**, for the interface with systems such as Open LDAP and Active Directory enabling the sharing of users, groups, roles and permissions
- **Mail server**, to interface with the most common e-mail protocols: SMTP, POP3, IMAP, EMS, MMS, WAP.

Regarding business performances it is important that the platform is also able to process information for Knowledge Management, Business Intelligence and Business Process Management. The Business Intelligence is important for decision support systems and therefore to analyse collected data for forecasting future events. To this end it is important the Knowledge Acquisition and the representation of structured knowledge in specific ontologies that describes data and relationships for a correct knowledge representation. The extraction of useful information can be done by extraction techniques that use specific wrappers and intelligent software agents.

**6. Benefits and limits of the platform 2.0**

Enterprise 2.0 technologies improve the collaboration and cooperation with all stakeholders and stimulate the productivity enabling people to participate in business processes. Firstly, inside the company, Information Systems were more oriented to the processes than people; now employees use productivity tools more individual-oriented.

The platform 2.0 improves also the user experience. The user, inside the organization, assumes a central role with his/her ability to cooperate, create and generate value through relationships in social networks. All interactions among users are important as contents and the user experience becomes more rich and complete. Internal systems and services match with the needs of the business productivity and the habits, relationships and interactions among employees.

Appreciating the experience that the user can live with business tools it means to design an enterprise system that takes in account the continuity of user experience. Designing the user experience in Enterprise 2.0 means provide to users the facility of exploiting all necessary resources and tools in relation to their needs and experiences like smartphones, tablets and social networks.

The wrong decisions are often caused from a poor use of employees'skills and missed innovation opportunities for incorrect policies of communication. The
collaboration between employees in the right working environment is fundamental to the business success. The use of collaboration and mobile tools in a social context can improve the time to market and the positioning of the enterprise regarding competitors. In this way the company becomes more agile in answering to market requirements [44]. Inside the company, there is a fear for data privacy and internal security [24]. The Security Officer should certainly reduce the risk that the social network is used improperly; internal rules on the use of the Web are necessary [45]. Firstly it is important to create clear rules that clearly indicate which behaviors are tolerated, those to avoid and the required checks. Posting sensitive contents on social networks, such as technical information, potentially can cause problems to the reputation and the intellectual property.

Being alert to malware intrusion like contents, hyperlinks, files or applications that link to malicious contents that, once executed can compromise the security of the entire network. Data owned of the company should only be treated in a controlled environment according to defined policies. Other limitations are due to the entrepreneurs/managers who not use the platform 2.0 because they are afraid of the customer opinions and suggestions and of the word of mouth (WOM) [46] which may affect the company's online reputation. Furthermore, some managers is afraid to stimulate a peer-to-peer and non-hierarchical communication because in this way, they lose the power in the corporate management.

### 7. Conclusions

Nowadays, in the knowledge era, by the new business model of Enterprise 2.0, the company can acquire competitive advantages. The company interacting with customers can improve the product/service. The bidirectional communication, enterprise-customers, is supported by web 2.0 tools and by smart and mobile devices. Inside the company, it is important the implementation of a technological collaborative and mobile platform that integrates new and legacy systems. In this way the Enterprise Information System is more complete and can process both structured and unstructured data coming from online contents. The platform 2.0 works in a SOA environment where all functions that support the business can be used as services. These services reside on web servers and can be read, used and combined to support new processes. In this context the enterprise becomes more agile in answering to market requirements and in improving the customer satisfaction.

The Enterprise 2.0 is a social and participative model based on collaboration and participation of web 2.0 tools. These interactive tools have facilitated a great revolution in the information sharing among users. The future web 3.0 will be useful to understand the semantics, that is the meaning of words. The semantic algorithms allow the exchange of information and data among computers. Enterprise 2.0 is the open company of people who work in the supply chain while the Enterprise 3.0 will be the technological company of the machines where it will be easier to find useful documents and to support the automated reasoning of computers in the decision making.

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