Journal of Next-generation Convergence Information Services Technology Vol.5, No.1, June (2016), pp. 45-58
차세대컨버전스정보서비스기술논문지 *http://dx.doi.org/10.29056/jncist.2016.06.06*

A Research Analysis on the Convergence of Information and Operational Technologies in Business

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Abstract

Each technological system has its own capability to do a certain task. As time passes by, each piece of technology has the tendency to evolve. One result might be the bridging of gap between two systems so that they can operate as one. This paper discusses the linking of information technology and operational technology which are typically found in business systems. A brief introduction about the functions of the typical division of a business entity was made. Then this article has then enumerated the different IT and OT applications and have managed to make models on how these two areas can be connected. Lastly, this paper also talked about the technical and organizational challenges of adapting this technological convergence.

Keyword : Information Technology, Operational Technology

1. Introduction

Generally, businesses whether for-profit or not-for-profit, are being established to achieve certain goals. To attain these goals, proper management must be done. This includes the appropriate facilitation of functions such as planning, organizing, leading and controlling of resources and activities. Each division of an entity must also do their share for the welfare of the organization. [Fig. 1] shows the typical departmental division of a business organization which generally includes operations, finance, marketing and human resource. The Operations section plays a vital role for it is where the main activities can be found, this department deals with the day-to-day business activities. People in this section is concerned with the products and services being offered, sales and profitability[1]. On the other hand, the finance section deals with the controllership and treasury. This includes budgeting, forecasting, bookkeeping and reporting furthermore this section also deals with investment, financial, dividend and liquidity decision making[2][3]. Another section which is the marketing department is in charge of the strategic promotion of products or services which are being offered by the entity. In addition they are also concerned with

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Received(March 09, 2016), Review(March 31, 2016), Accepted(June 03, 2016), Published(June 30, 2016)

ISSN: 2384-101X JNCIST

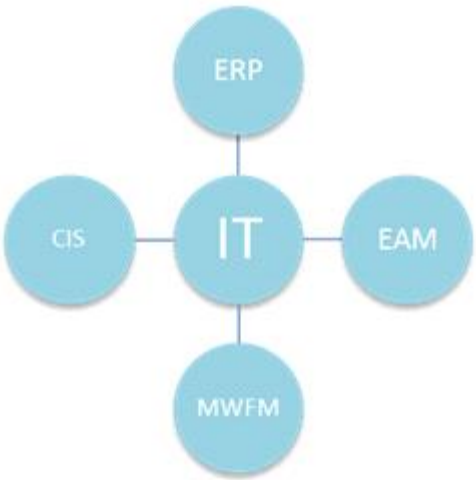
research, product development, communications and sales support[4]. Lastly, human resource section deals with manpower, recruitment, workplace safety, employee relations, compensation, benefits, trainings and professional developments of the employees[5].

Technology, ranging from simple to complex ones has always been a partner of most business entities in conducting their activities mentioned lately in each of the respective divisions. Generally, these advancements used in business may be classified as an Information Technology (IT) or the Operation Technology (OT). Years ago, these two technologies are completely separate. IT traditionally aims to ensure confidentiality, integrity and availability of relevant data in the system so this generally includes data management to support business transactions[6]. On the other hand, OT are those advancements which deals with the hardware and software systems that deals with automation, monitoring and controlling of physical assets as well as the supporting, producing and delivering goods and services[6][7]. As the needs of information in the operations increase, these two technologies must seem to be linked with each other to make business processes simpler. It may be a challenge for these two systems to meet but this can be a key to effective and efficient business management. However, we could not deny the fact that this also has hard times due to the challenges that it faces. There may still be many rooms for improvement.

[Fig. 1] Typical Business Functions

2. Information Technology Applications

Information Technology is quite a broad term but it can simply be defined as the use of advancements especially the computers, internet, storage and other devices for the purpose of creating, storing, retrieving and manipulating data as well as communicating information[8]. Most of the time, Information Technologies are composed of software applications which are for commercial purposes. These applications can help in business planning and decision making, business processes management and economic resource allocation. [Fig. 2] shows the common types of this application include the Enterprise Resource Planning, Enterprise Asset Management, Mobile Workforce Management and Customer Information Systems[9].



[Fig. 2] Information Technology Applications

2.1 Enterprise Resource Planning (ERP)

Enterprise resource planning is one of the most commonly used business systems. This has the capability to assist the flow of data throughout the enterprise and it can also coordinate all the resources and activities within the business entity. The ERP system supports business roles which include product manufacturing, inventory management, statistics and logistics, product distribution, sales invoicing, and

financial accounting. Stated the other way, this can also support the typical business activities such as operations management, financial management, marketing and human resource management. For this reason, it is well suited to be adapted by small and medium enterprises. On the other hand, connection with stockholders is also important in the corporate world, with this, type of system, the business management can be assisted when it comes to stockholder communication. Aside from the fact that this usually relies on a common computing platform, this type of system also has the characteristic of having a centralized database. This furthermore provides a unified and consistent user environment[10].

2.2. Enterprise Asset Management (EAM)

From the name itself this system, deals with the strategic optimal method for managing the entity's controlled resources. Furthermore, EAM is applied in supply chain, inventory and work management with the aim to maximize the value of the firm. This system also includes design, construction and maintenance of facilities and equipment[11]. This system enables the business to manage almost all types of assets within a single repository[12]. EAM can be broken down into five components which include the EAM strategy, Maintenance, Repair and Operations processes, EAM technologies, Engineering Data Content and the People[13].

2.3. Mobile Workforce Management (MWFM)

MWFM solutions enable companies to deliver superior field service, mapping, scheduling and optimization of work. In this system, there is an efficient exchange of timely, accurate and detailed information to manage front-line workforce and their work activities anytime and anywhere. Technology is not the sole player here. In order to achieve its objectives, the people engaged must have clear vision and understanding of the things that are going on. This technology has greater visibility, consistency and control, has improved labor management, and increased productivity[14]. These applications run on a variety of device types, including mobile phones, tablets, smartphones, and other improved devices. Specific features and capabilities include data capture, wireless time cards, GPS and properly designed reports[15].

2.4. Customer Information Systems (CIS)

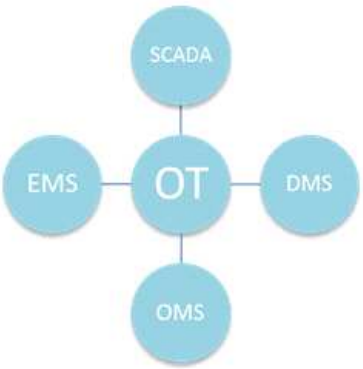
CIS is usually used in handling customer data. This system is capable of managing accounts, data consumption and invoicing. This aims at fulfilling customer satisfaction though a single solution of all transactions[16]. An effective CIS is the one which can be able to automate repetitive transactions and improve the revenue streams while maintaining exceptional customer service.

2.5 Others

Other types of IT applications may include the Energy Portfolio Management (EPM), Demand Response Management (DRM) and Advance Metering Infrastructure (AMI)[9]. EPM usually deals with activities related to commercial power. This may include the planning, organizing and trade risk reduction in commercial energy management. The DRM is usually applied in virtual power plants. Lastly, the AMI deals with remote reading of interval and non-interval data.

3. Operational Technology Applications

Operation Technology is a category of technology which deals with the application and operational control of physical devises and assets in the electronic network in real time. Usually, there is a very little human interaction and supervision between devices in an OT system. These things were primarily used in industrial systems to monitor and control the manufacturing and facilitation of technological utilities. Furthermore these types of systems support value creation during the processes involved in providing goods and services[17].



[Fig. 3] Operational Technology Applications

Operational Technology applications as shown in [Fig. 3] may include the Supervisory Control and Data Acquisition, Distribution Management Systems, Isolation and Restoration and Energy Management Systems.

3.1. Supervisory Control and Data Acquisition (SCADA)

SCADA is the most common type of operational technology. This is a computer-based structure that operates using coded signals for real-time data monitoring and control of industrial processes[18]. These are highly distributed systems that can be able to control far-distant physically dispersed facilities and equipment[19]. SCADA has a centralized monitoring and controlling center which can detect alarms and process a status of the specific facility.

3.2. Distribution Management Systems (DMS)

DMS is also a type of industrial system which can have an integrated electrical system structure to be used for the security, optimization, management and control of distribution networks. Its function may include analysis of network connectivity, schedule and safety management, volt/var optimization, system fault and restoration management[20]. This became useful when electricity became a necessity in the lives of the people as well as businesses, each having variations and specifications of demands. With the real-time network, proper work flows must be present in this type of system.

3.3. Outage Management Systems (OMS)

As mentioned earlier, power is very important in our daily lives and business operations. When the supply of power is not delivered due to a technical problem, the entity may not be able resume their activities which require power so its restoration must be a priority. This is the reason why OMS was built in order to enable electric utility employees for better management and effective response to customers' power outages[21]. Its functions include the area prediction of where the problem can be found as well as the addressing resolution of its concerns. This can also make calculations as to the duration of outage, estimated number of restoration and the number of crew required for the restoration[22]. Thus, they can have a more effective, efficient and orderly solutions at the shortest time

possible.

3.4. Energy Management Systems (EMS)

EMS usually deals with the management and control of transmission systems. This is very useful for business enterprises for effective resource management and can lead to thirsting of costs. EMS can be a combination of separate networks including floor level. Building level and management level systems. Its basic benefits include remote system access and alarm notification. In addition, this also involves the monitoring or surveillance, demand limiting, maintenance and record generation[23].

4. IT-OT Analysis and Discussion

4.1 IT vs OT

Historically, operational technology as well information technology have been managed and maintained separately from each other. As businesses begin to make processes easier for users, employees and managers, IT begins to connect with OT via Internet[17].

Information Technology is traditionally linked with back-office information systems. In field of business, IT systems are usually used in accounting and finance which includes accounts receivable and accounts payable management. IT systems can be also used in the recording human resource activities such as attendance monitoring. IT systems are also used as a tool to make repositories of and customer data[24].

On the other hand, Operational Technology is typically linked with field-based facilities, equipment and devises that are used to monitor and control a certain business operational activity. This is sometimes linked directly to industrial control systems as mentioned in one of the discussion above, which deals with the communication between devices with minimal human supervision[24]. Thus this is usually found in manufacturing businesses.

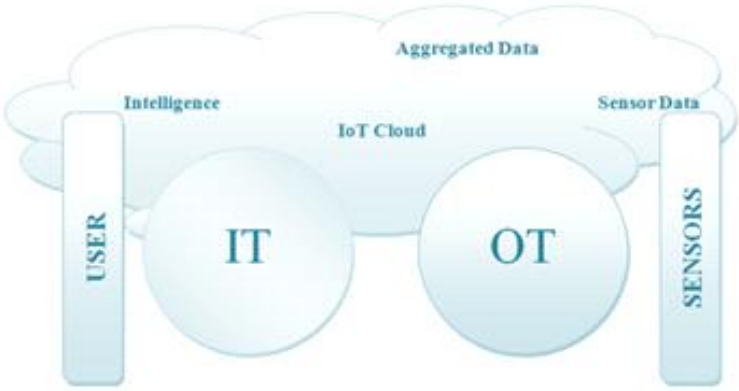
Furthermore [Table 1] shows a comparison of information technology and operational technology [25][26].

[Table 1] IT vs OT

	IT	OT
Area of focus	Transaction Systems, Business Systems, Information Systems	Control Systems, Physical Processes, Facilities and Equipment
Architecture	Enterprise-wide infrastructure and applications	Event-drive, real-time, embedded hardware and software
System Approach	Interconnected Applications	Standalone Applications
Interfaces	Operating systems and applications, Graphical User Interface, Unix, Web browser, terminal and keyboard	Electromechanical, sensors, Windows, actuators, coded displays
Ownership and Control	Chief Information Officer, Chief Financial Officer or Controller, Administrative Departments	Chief Operating Officer, Engineers, technicians, machine operators
Connectivity	Corporate network, Internet, IP-based	Control networks, hard wired twisted pair and IP-based
Function	Supports business applications and office personnel	Support controls processes and plant personal safety

4.2 Converging IT and OT

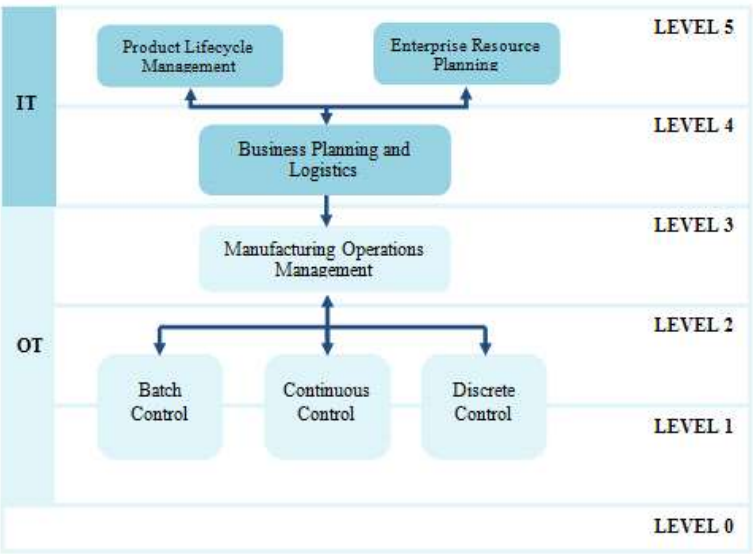
Currently, to furthermore improve business transaction these two areas are being linked with each other through the Internet. [Fig. 4] shows the fundamental model of the current situation wherein IT and OT processes are being connected through the Internet. Data from both IT and OT are accessible through the cloud.



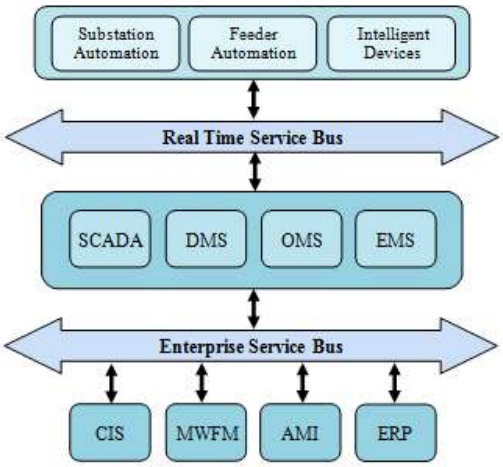
[Fig. 4] Bridging the Gap between IT and OT

In addition, to dig deeper about how IT and OT can connect, another graphical presentation is shown on [Fig. 5]. This is called as the ISA 95 and this is the international standard for the integration of enterprise and control systems where enterprise systems refer to IT while control systems refer to OT [17]. Level 0 is the product process where there is no presence of IT and OT yet. Level 1-3 is where Operational Technology processes occur while Level 4 and 5 is where Information Technology processes can be found. Level 1 is the sensing and manipulating of the production process. Level 2 is the monitoring, supervisor control and automatic control of the production process. Level 3 involves maintaining of records and optimizing the production process while managing the workflow to produce the desired end products. Level 4 is the establishment of the basic plant schedule production, material use, delivery and shipment and determination inventory levels. Level 5 involves the management of commercial activities as well as product development.

Furthermore, another representation is shown in [Fig. 6]. In this one, the different IT and OT application which were discussed a while ago will be incorporated in the diagram in order to show how they are converging with each other.



[Fig. 5] Enterprise-Control System Integration

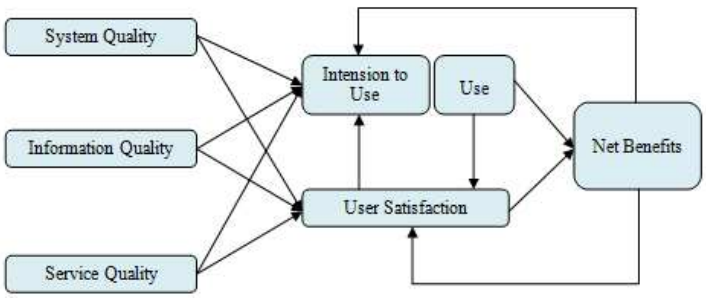


[Fig. 6] Unified Technology Management Architecture

4.3 Drivers, Benefits and IS Success Model

Aside from the potential technological advancements, drivers of IT-OT convergence may include economic and societal pressures. Another thing is the competitive advantage of the business adapting this new system. Each type of industry may have varying benefits gained if such technological convergence would be adapted but the most common benefits are enhanced monitoring, control and decision making, enhanced performance, flexibility and operational excellence.

For smaller industries, in adapting this new technological convergence, we can use DeLone and McLean Model for IS Success to see if this can be good in the business entity[17]. Aside from this, we must also not forget to reflect that costs must not outweigh the benefits.



[Fig. 7] Model for IS Success

4.4. Challenges in IT-OT Convergence

With all the advancements in technology, many convergences are already present. One of this is the IT-OT convergence, but why is it that the norm in business is still not up to it? There may be many reasons that could answer this question. One is that there might be hard challenges to consider before fully adapting this new system. In this part, the different challenges in adapting IT-OT convergence will be discussed.

4.4.1. Technical Challenges

Technical challenges deals with obstacles which are related to the physical, practical and mechanical issues with regards to the adaptation of IT-OT unified system. These concerns include things regarding the physical environment, compatibility, skills shortage and security.

As these two large technological advancements are joined, devices are also needed to be set-up in necessary places or in enterprise resource centers. Of course, factors to be considered in choosing the right place is its cleanliness and temperature. These technological devices must stay out of intense dust and must be kept in a humid-controlled environment. Its set-up, monitoring and maintenance costs must be also considered.

The next challenge is about the compatibility of the technologies being merged or joined. Operational technologies are designed to function within specified communication parameters. Of course, you can definitely find many tools to be used in an operational space without crashing the system. However, it would still depend on its functionality as designed by the third party vendor which may include device code, server applications and protocol stacks[7].

Though technology might be well prepared, one of the problems there would be the scarcity of people who has skills with such technology. Introducing new technology requires training of people who will be engaged with it and this mere fact also leads to the fact that there are no other people more experienced in this one. Except if many functionalities were adapted from the classical technologies which were long been used by such technology personnel.

Since this technology can still be considered on its early childhood development, security can also be one of the concerns. This new technology is also exposed to various risks and of course trouble

shooting might again be a problem if no experienced personnel are available.

4.4.2. Organizational Challenges

We cannot deny the fact that operational technology and information technology was conceived and developed on different scenarios and history itself states that these two has been traditionally separated. So until now, there may be technological convergences that still emphasize the difference and independency of both systems.

Now let's talk about the business silos. Collaboration in a business culture with silos among teams or departments will be limited for member of a different group is hesitant to share ideas. Unless otherwise that a certain collaboration benefits the members of each of the groups. Though people having bright mentality and thinks about the future of the business would not do such acts, however this truth still remains in our work ecosystems up to date.

Merging some activities in a business can somehow improve its operations. However, these things might not happen especially in the introductory phase of this new technology implementation. This because there might still be culture clashes against the two groups that merged in an activity.

Another problem with mergers of some tasks is the impact on the corporate reputation. This is because merging two activities into one process might expose delicate business information to a person who is not supposed to do so. There might be data integrity issues that will happen.

5. Conclusion

The convergence of Information Technology and Operational Technology has a great potential on business processes specifically in finance, operations, marketing and human resource. It can result to effective and efficient utilization of company resources while having exemplary customer satisfaction but unfortunately, there is no simple way to overcome the technical and organizational challenges of IT-OT convergence. In addition, adapting such technology requires much study in consideration of your business resources, income, expenses and technological adaptability.

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