ERP and Big Data: The Inept Couple

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Abstract

The world is witnessing an unprecedented interest in big data. Big data is data that is big in size (volume), big in variety (structured; semi-structured; unstructured), and big in speed of change (velocity). It was reported that almost 90% of the data worldwide was just created in the past 2 years. Therefore, this paper is an attempt to align ERP systems with big data. The objective is to suggest a future research agenda to bring together big data and ERP. While almost everyone is talking about big data at the product or tool level, relationship with social media, relationship with Internet of things, etc. no one has tried to integrate big data and ERP. A research agenda is discussed and introduced in this paper.

Keywords: ERP; Big Data; Research Agenda

1. Introduction

Enterprise resource planning (ERP) systems integrate the data and processes of organizations into single system and single database. This database functions as a hub that stores, shares, and circulates data from within the different departments and business functions. ERP systems are one of the most adopted IT systems by organizations [1]. Mostly, organizations adopt ERP systems to manage the everyday large volume of operations and information, which are created from within the organization. ERP systems are “tightly coupled”, in contrast to the legacy systems that usually reside in organizations prior to the ERP adoption [2]. Besides the potential cost savings, one of the main drivers for an ERP adoption would be the technical and operation integration of business functions to harmonize the information stream with the material flow of goods or services [3]. This will happen through integrating the internal value chain of the firm [4], and providing a seamless business processes streamlining, which could potentially sustain the firm’s market competitiveness and responsiveness [5]; [6]. According to [3], enterprise competitiveness
could be achieved through the use of ERP systems, as they can provide reporting capabilities to management with cost and operational information needed to aid in strategic decisions related to the enterprise’s competitive position. On the other hand, in order for the management and employees to utilize the use of the competitive capabilities of ERP systems, they must have a basic understanding of the principles of ERP, so that it can be used to the maximum potential. In addition, acquisitions, mergers, and joint ventures could be drivers of organizations to adopt ERP systems, in order to unify, utilize and manage the huge information and work flow among them.

Because of their scale and substantial resources consumption, it is not surprising that ERP systems have been a center of focus by both researchers and practitioners. Moreover, ERP systems require many organizational changes which could impose high risks if the implementations are not thoroughly planned, executed, and managed, as statistics from literature and practice show high rates of implementation failures [7]; [8]; [9]. Through the years, many communication technologies and infrastructural changes have evolved and been introduced to ERP systems, like web enablement, service oriented architecture (SOA), cloud computing, etc.

For decades, ERP mainstream research focused on implementation critical success factors, (CSF), ERP upgrade, project management practices, etc. Future research is needed to explore the potentials of ERP systems to be linked to new technology like big data. Since big data has been the hottest word in the ICT industry nowadays, we are trying in this research to explore the relationship between this inept couple in order to draft a new research agenda to be used by researchers and practitioners in the years to come.

2. Related work

At the time of writing this paper, there has been no single peer-reviewed published article found in the below sources:
- Google scholar
- IEEE Explore
- ACM Digital Library

The keywords used for search was: “Big Data and ERP” or “ERP and Big Data”. Indeed the search results brought some papers but while reading abstracts it was confirmed that none of the papers really matched the search keywords.

The results indicated that big data and ERP have been divorced in the literature and therefore the objective of this paper is to draft a research agenda for future research, which combines both ERP and big data. In the below paragraphs, we are going to discuss what is big data and how it can bring value to organizations.

[10] predicts that the worldwide demands for big data related roles will reach 4.4M by 2015, whereby at least two-thirds of those positions are not fulfilled i.e., excessive demand. Big data is data that is characterized by the so-called three, or sometimes five V’s. That is; volume, variety, velocity, veracity, and value. See figure 1.
Volume
According to a Fortune magazine [11], we created 5 Exabyte’s of data in recorded time till 2003. In 2011, the same amount of data was created in two days! Few years ago, organizations used to have gigabyte to terabyte of storage. Now, organizations have petabytes or storage, in addition to cloud storage. The volume of data is on the increase with all the consequences on storage and processing.

Variety
Big data comes in different formats including structured data e.g., ERP data, semi-structured e.g., emails and tweets as well as unstructured data e.g., audio and video.

Velocity
Velocity represents the speed of change in data. Big data is characterized as being high in velocity. That is, nowadays the analytics is increasingly being embedded in business processes using data-in-motion with reduced ever latency time.

Veracity
Most of the big data comes from external sources, which lack the required governance and homogeneity. Veracity is concerned with the credibility and correctness of the data sources as well as the suitability of the data for the purpose of use. Managing as well as extracting value from data has become the crucial competitive advantage that all organizations are striving to achieve.

Value
Big data has brought together lots of both technical challenges as well as opportunities. Bringing business value to the organization is a big data challenge as well as opportunity at the same time. This aspect puts the business prospective of big data next to the technical aspects. Viewing the value of big data aligned with organizational objectives has become a key aspect. [12] explained how can big data create value-added to organizations:

- Making information transparent and usable at a higher frequency;
- As organizations create and store more and more transactional data in a digital form, they can collect more accurate and detailed performance information on everything from product inventories to sick days;
- It allows a fine-grained segmentation of customers and therefore much more precisely tailored products or services to meet their needs and requirements;
- Sophisticated analytics can substantially improve decision making quality; &
- Big data can also be used to improve the development of the next generation of products and services.

[13] focused on how agile big data projects should be. Accordingly, agile big data is a development methodology, which goes inline with the unpredictable realities of creating analytics applications from data at a large scale.

3. ERP and Big Data: A Research Agenda

Over the past three years, many organizations have tried to reshape their strategies and agendas in order to include big data within. In this section, and below subsections, we will try to discuss and shed some lights on some areas, which are supposed to change due to the emergence of big data. That will help introduce a future research agenda that includes both big data as well as ERP systems. Figure 2 includes the dimensions of the research agenda:

![Figure 2: Dimensions of the ERP and Big Data Research Agenda](image)

3.1 Best Practices:

ERP systems have been recently implemented with the concept of best practices in mind. That is, leading vendors such as SAP and Oracle have incorporated their past experience of implementing their ERP systems into the so called “best practices”. To illustrate, SAP has formerly implemented their ERP at Mercedes, BMW, VW, etc. so they have acquired all the necessary knowledge and have productized such knowledge into ERP with “Best Practices” in Automotive. Therefore, implementation time with a new automotive customer will be shorter as their will implant their best practices into the new customer business processes.
On the other hand, big data technology and tools are able to bring industry best practices from all over the Internet and make sense out of it. With the advances in data capturing, data analysis, and data storage, big data is able to bring best practices quickly to organizations.

Now, definitely the integration between ERP and big data should enable organizations to have a better and wider-in-scope best practices. The impact on the organization will be profound as they will be able to have a faster and higher quality implementation.

3.2 Infrastructure:

ERP systems used to run on basic infrastructure, which is needed to have the ERP system up and running fulfilling the needs of organizations. For example, by ERP systems require database tier, application tier, and user tier forming the so-called n-tier architecture. More recently, organizations have opted to have their ERP on the cloud and hence migrating sometimes both the database as well as the application tier to the cloud. Next-generation computing and communication systems are becoming both pervasive and increasingly data as well as service centered.

Business Intelligence (BI) tools and techniques used to come on top of the ERP systems in order to help decision makers making quality decisions. Indeed, BI can go deeper to find hidden patterns and unknown facts when using data mining techniques.

Now, the situation with big data has become radically different. That is, organizations are supposed to be able to and make sense of data and transactions that do take place inside as well as outside the organization. That requires a different type of infrastructure.

In a nutshell, certainly the emergence of big data has put new types of demands on the way organizations layout and deploys their IT infrastructure. As a matter of fact, as well, ERP vendors must be ready for the era whereby third parties -based on information and models provided by other (several) parties- will build various applications that should be integrated and value adding out of the box.

3.3 Data Privacy:

ERP systems have been used for decades with little track record of data privacy violation. Only when the implantation entails sensors arises the data privacy problem e.g., use of RFID in retail stores.

However, the situation with big data is different. The data privacy of big data is a serious problem that is causing the regulators around the globe to enact laws to protect privacy of data and people. As an example, the US Federal Trade Commission has settled a case with Facebook, which requires them to undertake regular audits. Facebook agreed to US government audits of its privacy practices every other year for the next two decades.

Indeed bringing together data from the ERP as well as big data will pose unique privacy restrictions and limitations, which requires deep investigation before implementation in order to avoid problems or exposing data to the outside.

3.4 MDM:

Over the past years, there has been a rise in the use of Master Data Management (MDM) for various objectives across the enterprise by ERP systems e.g., customer, product, vendor, etc.

Then analytics applications used by big data have also consumed master data in order to create mappings across multiple hierarchies. MDM then graduated to transactional applications with much of the focus on business solutions e.g., customer relationship management (CRM).

Now big data could be used to build comprehensive view of the customer based on external data. This poses a new challenge as well as opportunity for ERP systems.

3.5 Data Discovery:

For decades, ERP systems have relied on their internal data to produce reports and intelligence. Additionally, business intelligence has been primarily focused on structured data. With the increasing availability of semi as well as unstructured data, efforts need to be done to bring value from such “data at rest” to ERP systems.
In big data, statistical techniques have been used and built to search for unstructured data e.g., audio and video. Not only that, as more and more devices become networkable and individually addressable, the amount of information and connectivity exponentially upsurge.

Models, techniques, and frameworks are needed in order to explore the potentials of unstructured data and how to analyze it in a way that would further enrich the data stored in ERP systems.

3.6 The Knowledge Hub:

ERP systems have the potential to keep organizational data into one single integrated database. This has enabled ERP systems to act as the knowledge hub of the organization for years. Nevertheless, ERP systems can only provide such hub functionality based on internal data. But, what about external data?

Big data, on the contract, focus on analytics of all types of data including structured (mostly found internally e.g., ERP systems); semi-structured; and unstructured data.

If we are able to integrate the outcome of big data into ERP systems, that would enable ERP systems to act as the knowledge hub, breaking the barrier of internal data only.

3.7 Data Quality:

The data in the ERP system follows certain quality constraints and abide by the organization internal quality measures and procedures. However, when marrying this data to the external sources we might face biases, inconsistencies, etc.

In big data, data comes from variety of sources with different levels of data quality. This poses a challenge when being integrated with ERP data.

This data needs harmonization and as we harmonize the data, we must establish confidence levels on raw data as well as aggregations.

3.8 Functionality:

One of the key strength of an ERP system is its functionality. This refers to its ability to enable, manage and monitor key business functionalities. Functionality of ERP systems has attracted lots of organizations, over the years, to adopt them. Now, with the introduction of big data, we believe that ERP functionality will never be the same again.

For example, the HR’s recruitment must be different in light of the marriage between big data and ERP systems. By which, organizations will be able to recruit from their Facebook group/fan page, or announce via employees’ social networks. Additionally, probably part of the evaluation could be constructed via professional social networks like LinkedIn. The integration between ERP systems and LinkedIn, as example, could facilitate plenty of HR recruitment issues; with all privacy and integration concerns. Too little studies focused on the future functionality of ERP system. As example, [14] explained the need for ERP systems to be integrated and linked to social networks.

3.9 Lifecycle:

There are many ERP systems lifecycle models. [15] provided a comprehensive lifecycle model, which consists of six phases that represent different stages through which an ERP system goes through during its lifecycle in organizations. Those phases are: adoption, acquisition, implementation, use and maintenance, evolution, and retirement [16].

We believe that the integration between ERP systems and big data has the potential to change the ERP lifecycle phases, or activities within. For instance, in the adoption phase organizations might use semi-structured as well as unstructured data, from social networks, to evaluate ERP alternatives. Additionally, and during the retirement phase, ERP systems could retire if they fail to accommodate the way new-generation use social networks as an integrated part of their day-to-day life style.
4. Conclusion

We believe strongly that the future of ERP systems will definitely incorporate big data. Accordingly, a lot of research needs to be undertaken in order to establish cross-fertilizations between the two areas. Below is a suggested research, which combines both ERP and big data together forming a capable, and powerful technology platform:

- The integration between ERP and big data should enable organizations to have a better and wider-in-scope best practices. So research needs to be done in order to explore the impact on the organization;
- Organizations need the study the impact of big data on their regular IT infrastructure, with regards to the infrastructure supporting ERP systems;
- New techniques need to be studied and tested in order to preserve the data. In this context different data masking, encryption, etc. need to be tested for appropriateness;
- Big data could be used to build comprehensive view of different MDM elements e.g., customer. This poses a new challenge as well as opportunity for ERP systems, which requires further research and exploration of impact on database, security, performance, etc.;
- There is a need for the development of models and frameworks in order to explore the potentials of unstructured data and how they could be analyzed in a way that would further enrich the data stored in ERP systems;
- Integrating the outcome of big data into ERP systems would enable ERP systems to act as the knowledge hub, breaking the barrier of internal data only. But, that is easier said than done. Processing, storage and analytics remain as challenges which require further explorations;
- Marrying ERP data with big data requires where confidence level must be established at raw as well as aggregation levels. This requires further investigation to the harmonization techniques and confidence measurements;
- One of the key strength of an ERP system is its functionality; it is the ability to enable, manage and monitor key business functionalities. Functionality of ERP systems has attracted lots of organizations, over the years, to adopt them. Now, with the introduction of big data, we believe that ERP functionality will never be the same again;
- The integration between ERP systems and big data has the potential to change the ERP lifecycle phases, or activities within e.g., during ERP selection organizations might rely on semi-structured as well as unstructured data, from social networks, to evaluate ERP alternatives.

5. Future Perspectives

Future research should also address questions like: which ERP functionalities might get the most out of big data analytics?; what new functionalities need to be added to ERP systems?; what is the impact of big data on the ERP lifecycle?; etc."

References