Lappeenranta University of Technology
School of Business and Management
Degree Program in Computer Science

Islam, Fahad Rezwanul (G0406380)

SYSTEMATIC MAPPING STUDY ON INTEGRATION OF B2B CUSTOMERS IN ERP

Master's Thesis

Examiners: Professor Kari Smolander
M.Sc Tommi Kähkönen

Supervisor: Professor Kari Smolander

Abstract

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Business-to-business terminology is relatively new as a business concept, so is the enterprise resource planning system in information technology. Research, implementation and integration of these two concept has been observed for last two decades in this paper. One of the major success point for growth in business-to-business environment is the availability of internal and partner data. Enterprise resource planning system facilitates storing, analysis of such data and enables different business process automation, forecasting and numerous value creating activity. In order to achieve such functionality for B2B customers, integrating them within ERP is very useful. This paper aims at understanding and suggesting such integration through investigating related documentation of similar integration scenarios, infrastructure, models and architectures. The investigation of the topic of this paper has been made using systematic mapping study of related papers and listing and suggesting necessary ingredients that enables such integration. Furthermore, this paper also suggests possibilities to overcome challenges integration experts might face during the integration phase and opens doors to future research scope in the related fields.

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Fahad Rezwanul Islam

Lapeenranta, 25 January 2016

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ABBREVIATIONS

AIS	Artificial Intelligence System
ANSI	American National Standards Institute
B2B	Business-to-Business
BOV	Business Operation View
BPEL	Business Process Execution Language
CAS	Customer Account System
CIDX	Chemical Industry Data Exchange
COBRA	Common Object Request Broker Architecture
COTS	Commercial-Off-The-Shelf Products
CRM	Customer Relationship Management System
CSR	Corporate Social Responsibility
DCOM	Distributed Common Object Model
e-	Electronic
EDI	Electronic Data Interchange
EJB	Enterprise Java Beans
EPC	Event-driven Process Chain
ERP	Enterprise Resource Planning system
FSV	Function Service View
GL	General Ledger
GMS	Global (supply-chain) Management System
GUI	Graphical User Interface
HL7	Health Level 7
HRM	Human Resource System
ICS	Inventory Control System
ICT	Information and Communication Technology
IEC	International Electrotechnical Commission
IS	Information Systems
ISO	International Organization for Standardization
ISP	Internet Service Provider
IT	Information Technology
KMS	Knowledge Management System
LADS	Logistic And Delivery System
MCF	Multi-Channel Framework
OAG	Open Application Group
ODETTE	Organization For Data Exchange By Tele Transmission In Europe
OMG	Object Management Group
OTA	Open Travel Alliance
PIDX	Petroleum Industry Data Exchange

PIP	Pipeline Interface Process
R&D	Research and Development
RFID	Radio Frequency Identification
RNIF	RosettaNet Implementation Framework
SCM	Supply Chain Management System
SOA	Service Oriented Architecture
SOAP	Simple Object Access Protocol
SRM	Service Resource Module
TP	Transaction Processing System
UDDI	Universal Description, Discovery and Integration
UI	User Interface
UML	Unified Modelling Language
UN/EDIFACT	United Nations Electronic Data Interchange for Administration, Commerce and Transport.
UMM	Unified Modeling Methodology
VMI	Vendor Management Inventory
WSC	Web Services Choreography
WSDL	Web Services Description Language
WSO	Web Services Orchestration
X12	Electronic Data Interchange Standard
XML	Extensible Markup Language
XSLT	Extensible Stylesheet Language Transformations

1. INTRODUCTION

In big business enterprises, Enterprise Resource Planning system (ERP) already has a big share of IT investment. Recently mid-sized vendors are also adopting ERPs, the annual IT budget reached from USD 500,000 to USD 50 billion in Europe (van Everdingen, van Hillegersberg and Waarts, 2000). Economic globalization and specialization have led companies to rethink and adjust their scope and boundaries (Jacobides, 2005) (Santos and Eisenhardt, 2005). Inter-organizational electronic interfaces play an important role in coordinating and streamlining their distributed supply chains (Segars and Watson, 2006), as these supply chain partners are the core for their competencies. These electronic interfaces are enabled through the ERP systems which introduces primarily the internal information integration into the company by providing cross-functional data integration and process support and secondarily external information integration with their suppliers, customers and service providers (Schubert and Legner, 2011). This leads to the concept of business-to-business (B2B) customer's integration to ERP.

ERP system usually combines other sub-systems such as general ledger(GL) system, transaction processing system (TP), human resource management (HRM) system and customer relationship management (CRM) system, business intelligence (BI), electronic procurement (eProcurement) system and supply chain management (SCM) system (Huiping, 2009) (Chou, Bindu Tripuramallu and Chou, 2005) (Kim, Umanath and Kim, 2006) (Subramaniam and Shaw, 2002). Hence the integration of enterprise applications or systems of the supply chain partners enables the ERP integration in the B2B scenario (Lee, Siau and Hong, 2003). The aim of ERP is to integrate a company's information systems and to make the company's business processes more efficient. However, ERP systems are commercial-off-the-shelf products (COTS) that seldom totally fit into the company's existing business processes (Vilpola and Väänänen-Vainio-Mattila, 2005).

Generally, ERP enables organization to reduce inefficiencies and streamline business process by allowing information access by various parts of the organization. Furthermore, research also shows that, in on average, firms using ERP systems secure greater savings through B2B procurement than that of the firms without ERP (Bendoly and Schoenherr, 2005), despite high implementation cost ERP is considered to be a productive investment (Hitt, Wu and Zhou, 2002) (Bock et al.,

2009). ERP's are becoming rapidly indispensable for large and medium sized organizations to run their operations.

Therefore, management needs to know the factors that drive successful ERP integration with B2B customers, a process of the continuous interaction between the business partners in a B2B scenario (Basu and Lederer, 2004). Moreover, integration is usually a complex process and there are several aspects such as, technology, investments and time needs to be considered in the process. In this paper, different technological aspect related to such integration will be discussed and a systematic mapping study will be conducted towards identifying different models and architectures that can be used to enable the process. Furthermore, different challenges related to this integration will be discussed towards identifying possibility lies in such process.

1.1 Motivation

Numerous reports have been published covering the ERP or ERP sub-systems implementation and integration in the context of business information technology. However, B2B customer integration into ERP carries enormous profitability potential if successfully achieved, also, supply chains and customers in the context of B2B will enjoy more advantageous e-commerce systems in the long run. Currently researcher and business tends to provide more focus on procurement system rather than the ERP integration, although, procurement is significantly important functions for any business-to-business transaction, but transaction relies upon myriad numbers of functions and requires involvement of various channels (Bendoly and Schoenherr, 2005). One-system solution to this schema not only minimizes transaction time and options, also enables numerous reporting and calculation possibility that in the long run positively influence profitability. Hence, study on this possibility of integrating B2B customers in the ERP could be a starting point of such unification.

In the context of today's B2B environment, due to globalization, and enhancement of widely accepted global communication platform the possibility has been arisen to bring all the supply chains and business partners in one window (Madlberger, 2006). B2B as a system holds information about the product's features, price, availability, relevant market and business intelligence (White, 2000). From buyer-seller relationship point of view, electronic information sharing and transactions within a business network or industry are possible through online

information platform and online intermediaries (Baida et al., 2008) (Hirnle and Hess, 2007). Hence, integrating the business-to-business customers in the ERP is a possibility, that is not only the standalone sub-system instead the whole enterprise resource planning system. Presence of ERP system provides greater levels of transaction efficiency to the B2B systems and exchange of data within the systems (Bendoly and Kaefer, 2004).

Nevertheless, this might be difficult to entirely unify the customer's systems in one ERP but study is required to understand the extent to which this integration may be possible. Furthermore, this might be possible to understand how this integration might take place. Besides, such study might open the doors to the new area of ERP integration into B2B customers and ease the information integration for business globalization.

1.2 Research questions

This paper will aim to investigate and answer the following questions related to integrating B2B customers and ERP,

1 Which models can be used to obtain integration requirements?
2 What kind of architectural solutions for integration can be found related to the models?
3 What are the challenges and future research possibilities in such integration?

In business information technology, business system integration consists of integration of several processes, such as business, strategy, database, system, platform, and other communication modules and functions. The research question 1 aims at identifying the existence of models for each of these processes to understand the requirements to initiate integration. Then based on the models identified, this paper will investigate if related research framework or architecture can be found and objective of research question 2 will be fulfilled. After that this paper aims at discussing the challenges lies in such integration and will try to identify the possibilities to overcome those challenges.

2. Background of B2B-ERP Integration

According to "Gale Encyclopedia of E-Commerce", Integration refers to the activity of combining various computer systems and databases within the company (internal integration), or with the partner's system or databases on the outside (external integration) to achieve seamlessness in business operations (Encyclopedia.com, 2016). In B2B-ERP integration both external and internal integration comes in the picture as ERP is usually a company's own system and business to business refers to partner based supply chain unit. In order to achieve such integration, ERP of different partners and also internal ERP is required to be integrated to support seamlessness of system's internal operations. In this chapter, different elements of B2B-ERP integration will be discussed based on the past studies on those elements.

2.1 ERP system

Understanding of organizations own ERP system before proceeding with an integration should be one of the primary objectives in the process. According to the definition, ERP systems are basically software packages that organizes the enterprise business data into an integrated database which facilitate the organization with useful information generated from the transformation of those business data (Norris et al., 2002) (Hsu, 2013b). It is also a tool for effectively managing and planning all the resources within the organization by integrating different business functions (Koh, Gunasekaran and Goodman, 2011).

In the process of streamlining and integrating information of the business entities and organizations ERP has significant role, which leads to enhanced profitability, superior market capitalization, improved customer management and improved service quality apart from those internal financial and management functionality advancement. However, in many cases not only the ERP but also the integration of other systems such as CRM, HRM, SCM has made such improvement possible in the context of systems integration (van Everdingen, van Hillegersberg and Waarts, 2000) (Schubert and Legner, 2011) (Kim, Umanath and Kim, 2006).

2.2 B2B-ERP integration

In terms of B2B, integration to ERP refers to the enterprise integration or the capability of integrating different ERP applications that enables the transformation of the business functionalities (Lee, Siau and Hong, 2003) (Lam and Shankararaman, 2004). However, this integration process should occur in two steps to obtain full integration. First, integration of the applications within the organization to automate business functionality within the enterprise and then, integrating the enterprise in a platform where the functionality can be extended electronically to the partners. Hence, the terms EAI and EI come in the picture.

- **EAI (enterprise application integration)** – refers to the technology that consolidates the enterprise applications, especially different ERP packages, to share data and functionality (Gleghorn, 2005) (Erasala, Yen and Rajkumar, 2003). EAI is essential in B2B-EPR integration as it provides the necessary foundation to extend the company's ERP functionality to automate and support external collaboration or data sharing (Erasala, Yen and Rajkumar, 2003).

- **EI (enterprise integration)** – a process that integrates business functionalities in the enterprise. EI is also is referred to as "webification", since, it transforms organizations business process, products and services to an integrated system that can be accessible via internet. This enables organizations and their business partners to obtain an efficient collaborative value chain (Lam and Shankararaman, 2004).

2.3 B2B data exchange

Backtracking the process of exchanging data between the organizations, numerous standards has been identified that enables exchange of data in integrated system. Electronic data interchange (EDI) based systems could be found from the 1960's (Schubert and Legner, 2011) and during that period business was carried out using proprietary purchasing system and e-mail (Sung Ho Ha and Sang Chan Park, 2001). Based on EDI, as an electronic exchange of business documents UN/EDIFACT came as one of the first worldwide standards (Reimers, 2001), in 70's and 80's industry associations developed several other standards which subsequently has given rise to the global cross industry standards such as ANSI X.12 and EDIFACT (Schubert and Legner, 2011).

After the emergence of internet in 90's integration was much cheaper and flexible through the advancement of internet as a global communication medium (Schubert and Legner, 2011) (Teo, Ranganathan and Dhaliwal, 2006), which also raised the concept of e-business, e-commerce and recent technologies such as, web services and service-oriented architecture (Schubert and Legner, 2011) enabling integration to be carried out and benefitted by these technologies (Lee, Siau and Hong, 2003). New standards have arisen supporting the newly emerged web architecture specially the e-business framework (Nurmilaakso and Kotinurmi, 2004) such as XML. Although XML provided with universal exchange capabilities but security was a problem in the data exchange. In year 2000, based on XML, new framework was introduced called Rosettanet which eventually solved the problem of security (Shim et al., 2000).

Nonetheless, there are many other interoperability standards have been discussed over the time and still being used by different enterprises and industries such as, common object request broker architecture (COBRA) promoted by object management group (OMG), distributed common object model (DCOM) by Microsoft, enterprise java beans (EJB) by Java, BizTalk, open application group (OAG), organization for data exchange by tele transmission in Europe (ODETTE), petroleum industry data exchange (PIDX), chemical industry data exchange (CIDX), textile industry data standards - health level 7 (HL7), travel agency data standard and open travel alliance (OTA) (Kajan, 2011) (Shim et al., 2000) .

However, from different paper published over the past years' discussion regarding EDI, XML and in recent years RosettaNet has more focus regarding integration of B2B, hence, this paper aims at discovering the use of these three standards in models and architectures related to B2B-ERP integration. According to definition these three standards can be elaborated as follow:

- **Electronic Data Interchange (EDI) -** According to this standard, data transferred between two trading partners follows certain structure, first, the data document is converted into standard message format, then the data is transferred between a shared proprietary network (Erasala, Yen and Rajkumar, 2003) and finally on the recipient side this formatted data message is translated back to the actual data. After the discovery of internet, EDI obtained internet based imitative called as EDIINT – EDI over the internet.

- **Extensible Markup Language (XML) –** a widely-used standard which is programming model independent and it is a universal internet format thus support a large number of software vendors (Shim et al., 2000). Similar to the hypertext markup language (HTML), XML provides meaningful information or meta-data about a data set using tags (Zhao, Zhao and Hou, 2010). Since the web services techniques came into the picture electronic business XML (ebXML), commerce XML (cXML) came into picture to support specification of the technology of e-business and e-commerce (Kajan, 2011).

- **Rosettanet –** is an organization set up by leading information technology companies to define and implement a common set of standards for e-business (Rosettanet-Corporation, 2000). It improved the security feature of data exchange through SSL with HTTP, digital certificates and digital signatures (Shim et al., 2000). Looking at the architecture, RosettaNet has three main parts, Dictionaries, RosettaNet implementation framework (RNIF) (Rosettanet-Corporation, 2002) and pipeline interface process (PIP). It uses industry standard dictionaries in order to coordinate semantics. The RNIF core specification provides exchange protocols that enables implementation of its standards (Liu et al., 2007). It relies on XML to exchange data, it uses pipeline interface process (PIP) to define the communication (Brewer, 2013). The PIP standardizes business documents alternatively it standardizes the business process and sends these business documents to the defined business services. RosettaNet introduces cost reduction for integration (Damodaran, 2004).

2.4 e-commerce, e-business and SOA

The evolution of data exchange standard is correlated with the evolvement of internet technology; introduction of new web technology has enabled implementation of new data exchange standard. As far as B2B is concerned, e-commerce is a web-based inter-organizational system that connects two or more firms (Teo, Ranganathan and Dhaliwal, 2006) (Hope et al., 2001). E-business also have been considered as a distinct form of e-commerce, accelerated the supply chain integration through adoption of internet (Møller, 2005).

After the era of e-business and e-commerce, business integration is moving towards more compact service oriented architecture (SOA) through web services – the technology to implement SOA. SOA is expected to be fast and inexpensive to implement changes of internet technology in B2B scenario through its' top-down approach. This means the business requirements drive the technology (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010).

In SOA, a service is a deployable unit of executable code performing a particular task and services can be composed together to perform more complicated business function (Reimers, 2001). Data exchange of web-services occurs when servers listens to and replies with a communication protocol, called simple object access protocol (SOAP), generally via HTTP carrying XML-based data content and web services description language (WSDL) expresses the service descriptions of the web-services (Papazoglou, 2003) (W3.org, 2016) (Liu and Roussev, 2006). Implementation of these technologies will be investigated in this paper in the light of different models and architectures studied in related papers.

2.5 Integration scope

Based on the discussion in this chapter it can be perceived, there are quite a lot of options available in terms of technology and standards to enable B2B-ERP integration. Standards and compatibility of the technology should have intense focus when thinking about such integration. If the system lacks compatibility it can end in an implementation failure which in turn can cause losing integration sponsorship (Zeng, Wen and Yen, 2003)**.** However, in order to select a particular way towards a successful integration, it is essential to understand the business requirements of the supply chain partners of the B2B circle. Many of these requirements might be obscured inside huge company specific documentation and company executives might not be always open towards disclosing many business requirements. Therefore, the demand of identifying appropriate models to obtain these requirements and related frameworks or architecture to design a map for such integration is necessary. Furthermore, an accurately designed data-integration system eliminates the need of extensive programming (Gleghorn, 2005). This paper aims at, recognizing appropriate models and architectures towards such integration from existing studies and discussing possible challenges and scopes for further investigation in this area.

3. RESEARCH METHOD

In software engineering, systematic mapping study (SMS) is a distinct method to build a structural outline of a software engineering field of interest. The analysis focuses on frequency of publications and results within it. Thus, it covers the general idea and concentration within the study area. Different aspects of the structure can also be bind together to answer more specific structure. The main objective of a SMS is to deliver an overview of a research area to identify the quantity and type of research and results available within it (Petersen et al., 2008).

Systematic Mapping Studies or Scoping Studies are intended to establish if research evidence exists on a topic and provide an indication of the quantity of the evidence; therefore, it provides a wide overview of a research area (Kitchenham and Charters, 2007). So, the aim of this research will be to run a query on scientific journal's databases to find existing studies on this area and derive required results based on the previous studies and justify the possibility of further investigation or suggest new implementation.

SMS planning phase is much similar to that of Systematic Literature Review (SLR), however resulting protocol is much shorter and the focus is on, searching criteria, inclusion/exclusion criteria, study quality assessment (bias/validity). In compare to SLR, data extraction stage is much broader (Bailey et al., 2007).

3.1 The search

This is the first phase of the research which started with selecting the databases for journals where the primary investigation was made. In this paper the actual SMS will be done on strictly on Journal Articles, Proceeding Papers have been excluded from the search as they contain less information and less comprehensive and always tends to receive less citation and research suggest historically proceeding papers turned into articles in only 9% of the cases (González-Albo and Bordons, 2011). Hence, selecting article only was to obtain quality information.

The primary databases that was found to conduct our investigation was found from the Nelli portal (Nelliportaali.fi, 2016), the search was on the basis of category as "Information Technology", only

the databases provide full text was taken into primary consideration. Later based on the search possibility within the databases and area relativity the final database selection was made, apart from that, keyword searching in Google Scholar also provided us with few journal databases, the lists are as follow:

- ACM Digital Library (Dl.acm.org, 2016)
- ScienceDirect (Sciencedirect.com, 2016)
- EmeraldInsight (Emeraldinsight.com, 2016)
- IEEE Xplore (Ieeexplore.ieee.org, 2016)
- Taylor and Francis Online (Tandfonline.com, 2016)

At the first stage of search it was required to have specific criteria for identifying relevant papers in general. Hence, the total search stage can be explained in four stages:

i. Establishing search attributes
ii. Finding attribute value
iii. Execute query
iv. Manual Inclusion and Exclusion

- **Establishing Search Attribute**

In this stage, this is required to fix the search criteria and the attributes, for this research the search criteria can be stated as the paper attributes and the attribute value that is desired to be found by a systematic query. Therefore, the attributes that can be taken into account are: Date, paper Keywords, Abstract, Full Text, article title, type of publication (e.g. Articles, proceeding papers, books), paper topic, paper group, journal topic and journal title. In this paper we decided, Date, Keyword, full text, abstract, article title, type of publication and paper topic are the right attributes to be used to obtain our desired papers.

- **Finding Attribute Value**

Now it is needed to find the appropriate value for the attributes. Choosing the values are the vital part for the research as intended results for the research can be only availed with proper search as

the main content of this research is bases on the search. Below, each of the attributes are explained with the values chosen for each of them.

Date – This attribute states the publishing date of a particular paper. Date is considered to be an important attribute as research changes over time. For our paper we have decided to have dates between the year 2000 and 2015 to be able to have recent studies in the relevant field. Hence, the criteria can be stated as below:

Date **BETWEEN** "01-01-2000" **AND** "01-08-2015"

Keywords – Keywords are important feature of a paper, that gives a quick idea about the content has been emphasized in that particular report. Therefore, finding appropriate values for keyword is also important. However, this values for keyword is not only important for this particular attribute but also for abstract and text attributes. In some of the journal databases **Keyword** field might not be present in the search option. In this research to find appropriate value first the research topic has been taken into account, the values that has been taken into account from the topic are, "ERP" or "Enterprise Resource Planning", "B2B" or "Business to Business", "Integration". In the next the research questions have been taken into consideration, and the values determined form the research question are, "Methodology", "Method" and "Model". However, some papers might have discussion on overall business integration but could have relevant discussion over B2B, so, "Business" could be a generalized but useful value if used with "ERP". Hence, the query matrix for search can be represented as following:

I. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("B2B" **OR** "Business to Business") **AND** "Integration" **AND** "Methodology" **AND** "Method" **AND** "Model"
II. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("B2B" **OR** "Business to Business") **AND** "Integration" **OR** "Methodology" **OR** "Method" **OR** "Model"
III. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** "Integration" **AND** "Methodology" **AND** "Method" **AND** "Model"
IV. **KEYWORDS** = ("B2B" **OR** "Business to Business") **AND** "Integration" **AND** "Methodology" **AND** "Method" **AND** "Model"

V. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("B2B" **OR** "Business to Business")

VI. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("B2B" **OR** "Business to Business") **AND** "Integration" **AND (**"Methodology" **OR** "Method" **OR** "Model")

VII. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** "Integration" **AND** "Methodology" **AND** "Method" **AND** "Model"

VIII. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("Integration" **OR** "Methodology" **OR** "Method" **OR** "Model")

IX. **KEYWORDS** = ("ERP" **OR** "Enterprise Resource Planning") **AND** ("B2B" **OR** "Business to Business" **OR** "BUSINESS") **AND** ("Integration" **OR** "Methodology" **OR** "Method" **OR** "Model")

X. **KEYWORDS LIKE** ("ERP" **OR** "Enterprise Resource Planning" **OR** "B2B" **OR** "Business to Business" **OR** "BUSINESS" **OR** "Integration" **OR** "Methodology" **OR** "Method" **OR** "Model")

XI. **KEYWORDS =** (("ERP" **OR** "Enterprise Resource Planning") **AND** "Business") **AND KEYWORDS = (**("Integration" **OR** "Methodology" **OR** "Method" **OR** "Model"))

Therefore, the basic principle is to find any paper within the selected database, where, at least there is a discussion on "**ERP**" and "**B2B**", then the paper will be filtered based on any of the term, **"Integration**", "**Methodology**", "**Method**" or "**Model**" has been discussed within. "**Supply Chain Management"** and "**Electronic Commerce**" are used secondarily to find papers discussing on account of B2B, since, these topic areas have close link to our research. There are certain features that is common in each system, since, studies related to B2B and ERP and B2B and SCM studies regarding integration have several commonalities if we think on system's perspective, reasoning SCM enables certain functionalities of ERP, and in broader view, SCM could be integrated into ERP (Tarn, Yen and Beaumont, 2002).

Abstract and Text – Same criteria that has been applied on Keywords relevant search, will be applied on Abstract and Text attribute, where abstract are the brief of a paper and text refers to the full text of the paper.

However, the search matrix might not be possible to use extensively on the search engine provided by the journal databases, hence, manual searching is required after the initial findings to obtain the required findings.

- **Execute query**

Based on the database's search functionalities search query have been executed to obtain the intended journal articles in this stage. The results obtained from the query has been checked for any unwanted results, such as Indexes, advertisements and other non-article materials. Keywords are searched in the article for the attributes, Keyword, full text, abstract and article title. It is possible some articles might not have the required keyword in the keyword attribute but in the main text.

- **Manual Exclusion and Inclusion**

Once the results from the primary search is obtained a manual go through it the articles are required to find what has been discussed in the articles to optimize the results. Manual Exclusion and Inclusion criteria has been decided based on the following area of investigation in the papers.

Inclusion: Articles discussing in details about ERP and B2B, in areas of integration, implementation, contains integration models, methods, implementation or integration results, transaction process, data process and process technology.

Exclusion: The exclusion reasons are different for each journal database, depending on the articles found in each of them. Although, "Supply Chain Management" is considered an important keyword, but, studies that has been focused purely on SCM aspects in various way, and not emphasized on the study of ERP and B2B has been excluded. The other exclusion reasons are stated briefly in accordance with each database in the next section.

3.2 The results

Below are the results obtained from each of the database:

Database 1: ScienceDirect – Elsevier B.V. (Sciencedirect.com, 2016)

Phase I: Search with keywords, date, content type.

Number of Articles found: **405**

Phase II: Applying filter on the result: **TOPIC** ERP, ERP SYSTEM, Knowledge, Process, Product, System, Supplier.

Number of Articles found: **91 (**Excluding irrelevant item (e.g. advertisements, indexes)**)**

Phase III: Manual Exclusion and Inclusion: Excluded due to study emphasis on Workflow Mining, web system, Synchronized Supply Chain, Sustainability, Strategic IT, SME's, Simulation Model, SCM Management, Sales Force Automation, Run-time prediction, Product Life cycle management, Process Mining, Pricing Tactics, Operation Management, Network Economy, Lean Production, Knowledge Sharing, KMS, IT, IS Collaboration, IS, ICT in general, Hospital Information Systems, Fraud Mitigation, e-supply chain, Environment, Enterprise Software system, e-market strategy, Big Data and AIS.

Number of Final Articles Included: **11**

Database 2: IEEE (Ieeexplore.ieee.org, 2016)

Phase I: Search with keywords, date, content type.

Number of Articles found: **56** (Excluding irrelevant item (e.g. advertisements, indexes))

Phase II: No further filters available.

Number of Articles found: **56**

Phase III: Manual Exclusion and Inclusion: Excluded due to study emphasis on Web Technology, Web Services, Sustainability, SOA, Service Strategy, Service ecosystem, SCM Automation, SCM,

Quality Management, Project Management, Programming, Private Trading Exchange, Mobile technology, KMS, IT Strategy, IS, Internet, e-procurement, e-contracts, Auction, Agility and IS.

Number of Final Articles: **7**

Database 3: EmeraldInsight - Emerald Group Publishing Limited (Emeraldinsight.com, 2016)

Phase I: Search with keywords, date, content type.

Number of Articles found: **252**

Phase II: Separate keyword filter Integration (10), supply chain management (53), electronic commerce (45) and communication technologies (14)

Number of Articles found: **122**

Phase III: Manual Exclusion and Inclusion: Excluded due to study emphasis on WWW, Wireless Product Identification, Web Service Business, strategy development, SRM, RFID, quality management, Product Benchmarking, Procurement Process, online auction, knowledge management, IS, GMS, extranet, e-supply chain, e-Procurement, e-marketplaces, e-learning, Economic Analysis, e-commerce, e-business, Digital Economy, Database, CSR, Business Process and business continuity driver.

Number of Final Articles: **13**

Database 4: Taylor and Francis Online (Tandfonline.com, 2016)

Phase I: Search with keywords, date, content type.

Number of Articles found: **191**

Phase II: Screened out Book Review, Indexes, Editorial, Abstracts

Number of Articles found: **175**

Phase III: Manual Exclusion and Inclusion: WebQual, Web Services, Trust, Tourism, Software Development, Service Management, Server operating System, SCM, Risk, RFID, Nanoclay and

other non-relevant technology, Mobile Technology, Mobile Application, KM, KAM, IT Investment, ISP, Interview, Global Production System, E-Procurement, Brand Loyalty, Audit, e-manufacturing, e-HRM, Cyberspace, Business studies, Business Intelligence.

Number of Final Articles: **6**

The table below shows the database search scenario in brief:

Name of the Database	**Phase I: Query** **Total Found**	**Phase II: Filtering & Screening** **Filtered Out**	**Phase III: Manual Exclusion** **Excluded**	**Final Phase: Inclusion** **Total**
ScienceDirect – Elsevier B.V.	405	314	80	11
IEEE	56	0	49	7
EmeraldInsight – Emerald Group Publishing Limited	252	130	109	13
Taylor and Francis Online	191	16	169	6
Total	**904**	**460**	**407**	**37**

Table 1: Search results

During the search, some of the databases are overlooked due to lack of relevant papers or type of publications. Such as ACM Digital library contained mostly proceeding papers on the topic area. However, the results obtained from the databases provided with adequate information for the mapping study. Therefore, the mapping study will be based on the 37 papers (appendix).

4. OVERVIEW OF THE RESEARCH ARTICLES

Based on the data collected during the mapping study, in this paper several aspect of general research overview has been observed. This observation has been made to understand the research pattern in the field. Through the pattern it can be identified how researches in the future can be made to obtain better understanding of such integration, also to support integration managers with better documentation for real-life projects.

4.1 Research methodologies observed

Study over the previous research shows an interesting picture of different kind of research conducted on the area of B2B-ERP integration in last 15 years. Researchers are more emphasizing on quantitative methodology rather than qualitative methodology. Quantitative research methodology is the systematic empirical study of a subject through statistical, mathematical or computational techniques (Given, 2008), on the other hand qualitative research methodology uses descriptive data collected through: observations, conducting interviews, document analysis, and analyzing participant products such as journals, diaries, images or blogs (Lodico, Spaulding and Voegtle,2006).

In this investigation, seven different research methods have been observed that indicates the research methodology the researchers have been approached with, to conclude their objectives. In this paper the research methods used in the papers of our mapping study array has been summarized in table 2, the justification of segregation of the methods has been made according to the underlying definitions of each of these methods. Experimental Research – a quantitative methodology, approaches with real life testing result of a product, theory or framework (Condori-Fernandez et al., 2009). Case study – qualitative approach, studies real life scenarios to answer to the research question based on the evaluation of real life facts in that scenario (Yin, 2014). Action research – a combined research method, that studies an output such as product or theory (Condori-Fernandez et al., 2009) (Miskovic, 2006). Narrative research – a qualitative approach based on researcher's past experience and related study in a story telling fashion (Lodico, Spaulding and Voegtle,2006). Descriptive survey research – this qualitative approach analyzes and interprets data to arrive at a generalization and prediction by critically analyzing and examining the data generated from the target population within the study scope (Neeru, 2012). Literature review – a qualitative

methodology, answers to the research question by comparing methods, observations and results discussed in other closely related studies (Creswell, 2014), the key difference between literature review and narrative research is that, narrative research is based on author's own experience where literature review approaches based on the other researcher's work (Lodico, Spaulding and Voegtle,2006) (Creswell, 2014). Grounded theory method – a qualitative methodology to discover theories by simultaneously grounding the theoretical account of general features of a topic using empirical observation or data (Martin, 1986).

	Research Approach			%
Research Method	**Quantitative**	**Combined**	**Qualitative**	
Action Research		35.1		35.1
Experimental Research	13.5			13.5
Case Study			8.1	8.1
Descriptive Survey Research			8.1	8.1
Literature review			8.1	8.1
Narrative Research			10.8	10.8
Grounded theory method			2.7	2.7
Action Research & Literature Review		2.7		2.7
Action Research & Survey		2.7		2.7
Experimental Research & Case Study		5.4		5.4
Descriptive Survey Research & Literature Review		2.7		2.7
Grand Total	**13.5**	**48.6**	**37.8**	**100.0**

Table 2: Research methodology in the articles

From the view of Table 2 it can be seen, a significant number of papers are approached through action research, more than 35% of the overall research, making combined methodology of research scoring 48.6% including few other papers where the researchers used more than one method to approach making the research fall into combined or mixed methodology. Case studies, descriptive surveys and literature reviews score more than 24% and almost 11% of narrative research making qualitative research covering almost 38% of total study in this area together with few studies using grounded theory. Lastly, experimental research, the only method found in quantitative approach in this study, scores 13.5% of the overall research. One assumption can be drawn from the results in Table 2 that, most of the researchers are still investigating different integration concept and integration products such as applications, tools, models, frameworks or theory by testing and

studying them that indicates prospective development opportunities in B2B-ERP integration scenario as experimental research and action research covers almost 49% of the total research that has been done in this scope.

4.2 Year-on-year research emphasis

Another interesting scenario that can be observed form this mapping study that how the research has progressed in last 15 years which area of integration received more focus. According to Figure 1, it is visible integration in general was always a study subject, where platform, application and integration process has the highest concentration throughout.

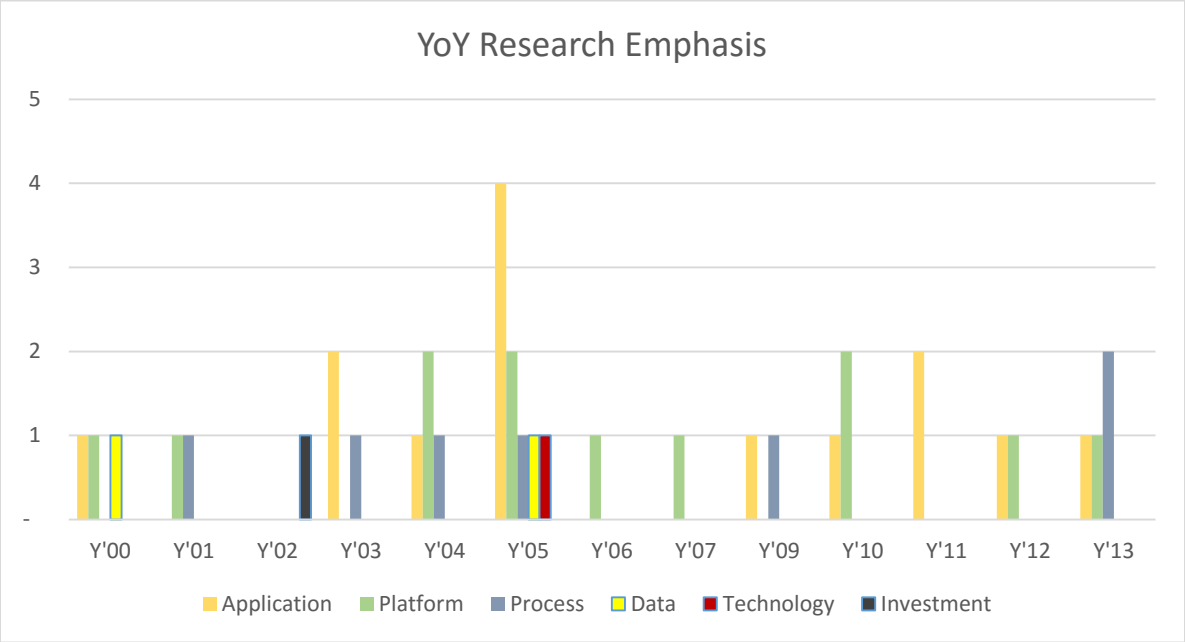

Figure 1: Year-on-Year research area emphasis on B2B-ERP integration

In this graph (Figure 1) application refers to study conducted in EAI and B2B applications integration under various perspective such as e-commerce, business strategy and management strategy. Platform related studies covers integration scenario in terms of EM, B2B e-procurement platform, buyer-supplier relationship, web based e-commerce platform, global supply chain management and communication interface integration. Process integration studies highlights business process integration mechanism, business value creation (Hsu, 2013a) through process integration, dynamic exchange models and also discusses about the tools for business integration and collaboration. However, the figure also shows that study in the area of data integration to understand data structures in different industries, databases and normalization of data to support

smother integration, B2B enabling technologies (Power, 2005) and integration investment might get more focus in terms of B2B-ERP integration research.

5. MODELS FOR INTEGRATION

There are various aspects needed to be understand to go towards the integration of B2B and ERP. These models presented by the authors are based on different industries in the context of B2B. However, the collective understanding of these models might highlight the key approach model towards a successful integration process. The mapping study has provided with various models that will be discussed in this section. This models can be used to collect necessary requirements to understand business and technical functionalities to be integrated.

5.1 Business process integration model

As-Is model and To-Be Model

Both of these models discusses the business processes that might be vital to understand business processes for integration. As-Is model (Davenport, 1993) representing the current situation as it is, and doesn't incorporate any change or improvements (Datta, 1998) (Küster, Koehler and Ryndina, 2006). On the other hand, To-Be model results from incorporating changes to the As-IS model (Chang et al., 2009).

According to the As-Is model there are five stages that the production businesses function:

1. Investigation and decision making for finalizing product to be manufactured.
2. Producing sample according to the customer specification.
3. Small quantity production for marketing.
4. Order stage where retail sales will start its function.
5. Reorder stage where product retains market.

However, there are several drawbacks of this model, as, each of the stage involves different business entities to work together, where each business entity has its own information channel and data transfer method and database format, it is potentially difficult to maintain data in a single accessible source, as it requires rework on the data in business entity (Chang et al., 2009). This

contributes, waste of manpower and time. Also, for each product development whole process is required to be re-run as because of manual processing there is no option for creating indexes for reference.

Hence, the whole process was re-structured as IT point of view, and named as To-Be model. Here, the whole process is concealed in one integrated platform for a B2B collaborative information system, containing a e-vendor management inventory (VMI), an e-production and an e-library. The VMI contains the modules to facilitate replenishment and ordering, e-production modules allow all supply and manufacturing related interfaces and e-library contains all products, patterns, sample and R&D databases. Therefore, the whole As-Is stages are visible under one platform where all the suppliers, customers and manufacturers are connected and able to access specific interface and all data is visible and accessible by relevant party with specific format for different entity (Chang et al., 2009). The problem of indexing is solved and time and manpower is also saved as no rework is required on same data. In figure 2, the To-Be model is illustrated.

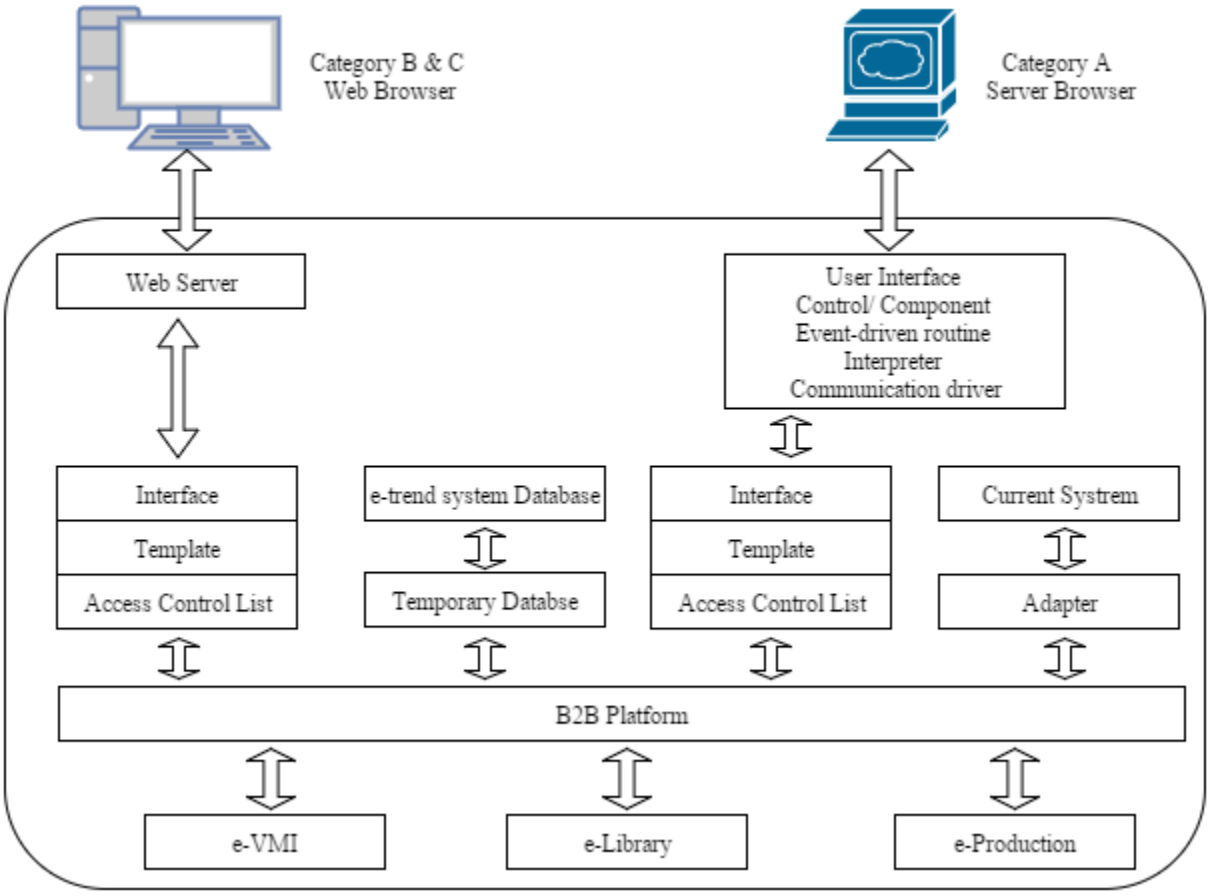

Figure 2: To-Be Model adapted (Chang et al., 2009)

In To-Be model the users are divided into 3 categories A, B and C, based on the business and ownership. Category A considered to be High IT-level with server to server connectivity, long-term and closed partnership. Category B and C both with average IT-level. However, Category B connects server to browser and also having long term and close partnership. Category C are basically the customers and low business linked buyers. Uses mostly the enquiry and ordering functions.

5.2 E-business strategy integration model

Business strategy transformation is another vital part of total integration of B2B into ERP. This leads the organization to integrate to a IT infrastructure that supports the B2B to be accessible within a common platform by various organization. Here, two models are presented that might show the possibility of the strategic transformation to facilitate integration.

5.2.1 E-business transformation model

E-business transformation model (Burn and Ash, 2005) represents the strategic transformation shifting by three stages of development. This three stages involves, Integration of technologies (Coltman et al., 2001), Differentiation of products and services (Chang, Jackson and Grover, 2003) and demonstration of value proposition within an inter-organizational network (Venkatraman and Henderson, 1998). Furthers discussion on the three stages of E-business transformation model based on case study (Burn and Ash, 2005) as below:

Stage	Technologies	Products and Services	Business Model
Integration	e-ERP - Various back-end, sell-side and buy-side application makes the integration of the architecture possible	e-malls – integrated online sales system offering variety of products and services.	e-commerce B2B integration.

Differentiation	Differential outsourcing.	e-branding – cultural changes observed, organization differentiate between corporate and end customers.	e-positioning.
Demonstration of value proposition	Innovative technologies – bottom-up driven approaches to develop technologies supporting different business and customer relationship.	e-communities - intranet based self-service applications to develop a practice of industry-based communities.	e-enterprise model.

Table 3: e-business transformation model

5.2.2 Dynamic planning model

Based on the e-business transformation model and changing strategic focus in the various stage of the model the Dynamic planning model (Burn and Ash, 2005) was derived. This model is supportive to the business transformation model, however independent. Interaction between strategy, e-business, change management and evaluation is important to the creation of dynamic capabilities and will enable organizations to gain sustainability in terms of competitive advantages (Burn and Ash, 2005). In the table below, the model has been explained by showing the focal area based on the tree stages of e-business transformation model:

Stages	Strategic Focus	Planning Focus	Outcomes and performance gain
Integration	Self-service	Top-down approach, training included, internal organization targeted.	Improved return on investment – operating expense.

Differentiation	Empowerment	Bottom-up approach, self-learning modules, value-chain community targeted.	Effective quality of work-life and upskilling.
Demonstration of value proposition	Relationship Building	Combined planning, value enhancement of collaboration chains, global network targeted.	Virtual and economic value addition.

Table 4: Dynamic Planning model (Burn and Ash, 2005)

5.3 B2B integration model based on e-commerce scenario:

B2B e-commerce model (Cullen and Webster, 2007) is identified to be a brief guideline for scenario driven integration for B2B with ERP or other sub-systems. Nine scenarios have been classified under this proposed model. Each of the scenario are explained in Table 7, by the characteristics and options.

	Characteristics			
Scenario	**Connectivity**	**Purpose/Control**	**Technology**	**Interaction**
Individual Trading	Open	Selling	WWW	Direct
Collaboration	Open	Selling	WWW	Intermediary
Marketplace	Open	Selling and Buying	WWW	Intermediary
Proprietary Sales	Open	Selling and Integrated exchange	Extranet	Direct

Private Exchange	Restricted	Integrated Exchange	Extranet	Intermediary
Aggregation	Open	Buying	WWW	Intermediary
Intranet/EDI	Restricted	Integrated Exchange	Intranet or EDI	Direct
Restricted Bid	Restricted	Buying	Extranet	Direct
Reverse Auction	Open	Buying	WWW	Direct

Table 5: B2B e-commerce model

This model provides with top level view of nine B2B e-commerce scenario in terms of business and connectivity. Hence, this model allows the decision to be made regarding the integration of all or some of the scenario based on integration requirement for a specific organization for its internal integration and integration with external parties involved in the B2B interaction process.

5.4 B2B integration model for service oriented architecture:

The open EDI reference model (ISO/IEC 14662:2010) includes all aspects of the business and information technology for e-commerce business transaction. This model proposes two views for the transaction process (ISO/IEC 14662:2010) (Tarn, Yen and Beaumont, 2002),

Business operation view (BOV) – contains business specification, captures business knowledge irrespective to the technology and addresses the e-business semantics and business transactions. **Function service view (FSV)** – contains implementation specification and addresses the technological aspects that support business information exchange and collaboration. This includes application and transfer infrastructure interfaces, security and translation mechanism and internetworking protocols for different organization included in the model.

The whole transaction process can be described according to the Figure 3,

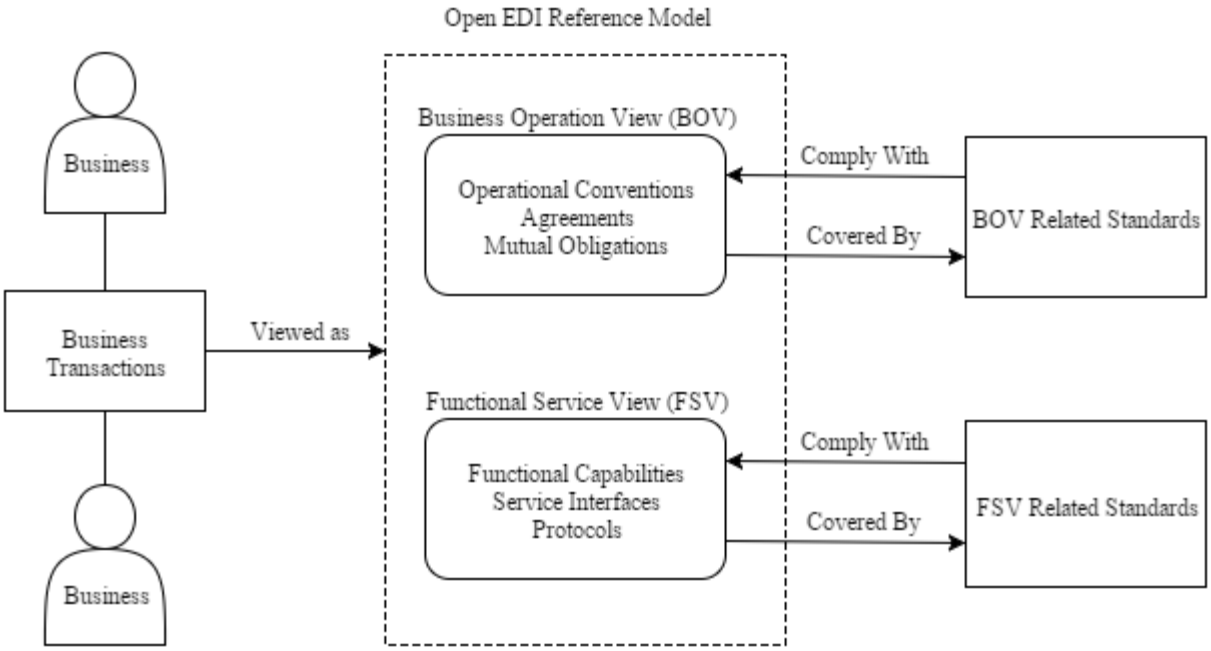

Figure 3: Open EDI reference model, adapted from (ISO/IEC 14662:2010) (Tarn, Yen and Beaumont, 2002)

In order to comprehend the Open EDI reference model further understanding is required of the components it includes, such as:

- Business Model – an architecture that represents products, services and information flow and describes the interactions between various actors and defines their roles towards profitability (Versteeg and Bouwman, 2006).
- Business Service and SOA Service – Proper understanding of business service is required to develop corresponding SOA service. Business services are the functionality laying with a particular business function where SOA services are executable codes that can translate the business service logic to computational form (Zeithaml, Bitner and Gremler, 2005).
- Business Process – It's a set of activity that is required to occur to complete a particular business function, these activities are logically related and upon completion provides with output for the entities requesting the process.
- Implementation specification - These are the technology and application layers that is required to implement B2B business model.

- Deployment artefacts: Deployment artefacts are within software environments layers and include business process specifications, workflow descriptions and document schemes in a machine executable language that enables solid implementation of information systems (Zeithaml, Bitner and Gremler, 2006).

5.5 Meta model for b2b integration

Data flow and the databases are essential part of integration of B2B customers and processes into ERP. Hence, the meta model (Wang et al., 2005) is required to understand to observe the records, access paths, IP addresses and the semantics of physical data model. Meta model describes the database schemas, storage locations with the infrastructure, permissions and accessibility, relationship among the entities and attributes in development of an integrated system. There are several characteristics to be understood in this model (Wang et al., 2005). These characteristics explains the details of the model:

a. Storage locations and database characteristics – contains location for database servers (e.g. IP addresses, ports).
b. Database schema – details about the database structure, attributes, entities, relationship and indexes.
c. Semantics – describes the attributes and explains the how semantically attributes corresponds to the real life objects.
d. Method for attribute transformation – this method enables similar attributes from different system to stand independently to be able to establish a relationship among them.
e. Primary key generation – this indicates towards the operational formula that enables generating Primary key as primary key is vital for integrated system.
f. XML Standard – this meta model suggest use of XML standards, however, EDI should also follow the similar approach for meta data model. This meta model suggest the following two criteria for integration:
    i. XML Standard for partners.
    ii. XML standard for non-partners.

    These two criteria specify the communication interfaces among different partners, and transaction process.

In Figure 4, the meta model can be viewed according to the characteristic and relationship with the B2B system and integrated ERP system.

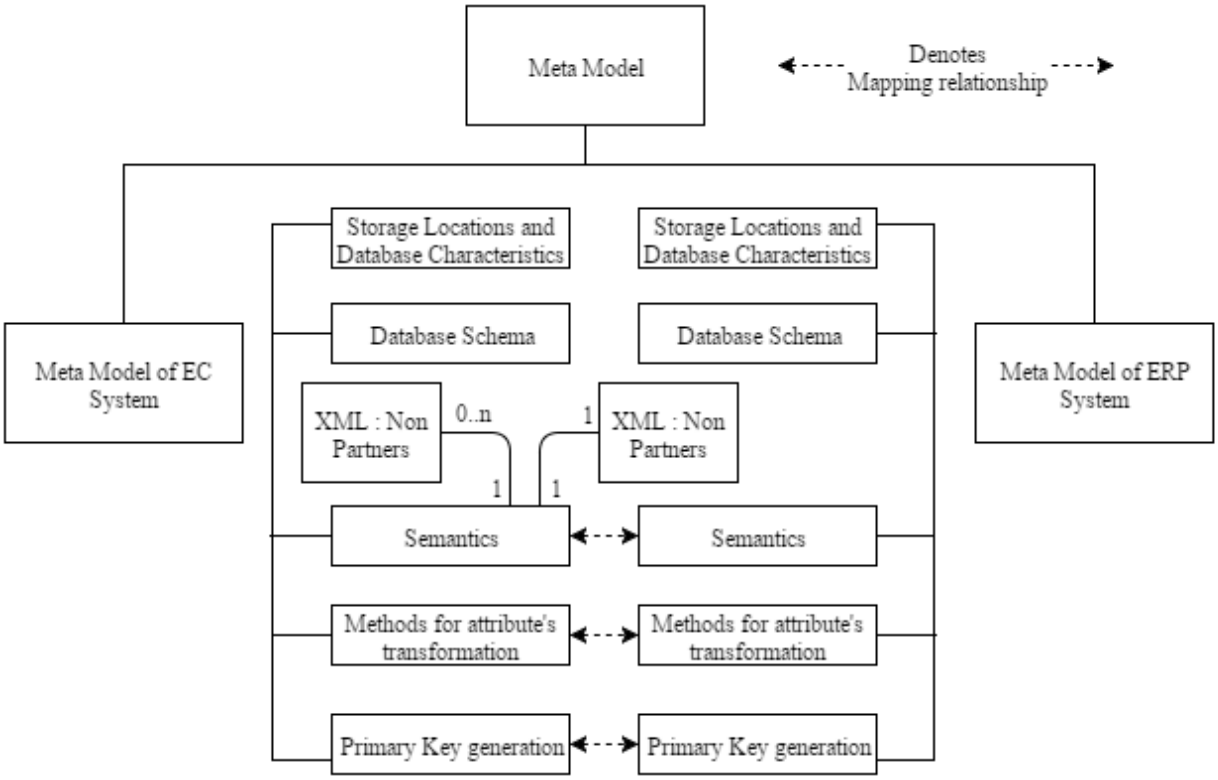

Figure 4: The Meta model, adapted (Wang et al., 2005)

The construction of the meta model follows three stages towards the final integration, this stages can be stated as the table below:

Construction Stages	**Step 1 : Analysis**	**Step 2: Identification**	**Step 3: Construction**	**Step 4: Finalization**
1. Meta Model for Existing System	Database Location and Schema	Semantics of each attribute of each entity, Primary and Foreign key for the attributes of each entity.	Data model for each database	Merge the data models to form a Meta Model

2. Meta Model for Current System	Attributes and their characteristics	XML standard for the attributes, relationship between the two system's databases, attributes and entities.	Primary Key for each entity and corresponding Foreign Key.	Meta model structure table containing all the data obtained in this stage.
3. Semantics Correspondence	Semantic correspondence of the tables found in stage 1 and 2.	Relationship between the database elements in stage 1 and 2.	Meta Model structure table.	Final Meta Model by combining all the meta model structure tables in stage 1 and 2.

Table 6: Meta model construction stages

6. INTEGRATION ARCHITECTURE AND FRAMEWORK

During the investigation, various integration architecture and framework proposed in different papers has been studied. Although, the detailed architecture has been studied are based on XML platform. In this section we will highlight architectural framework for integration. These architectures are represented based on the previous section of the integration models; architecture or framework gives a broader look of the IT infrastructure that will enable the integration.

6.1 B2B e-commerce hub architecture

This architecture (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010) proposes how the "Open EDI Reference Model" (ISO/IEC 14662:2010) (see Section 4.3) can be applied for integration. The main objective is to build an automated path between the Business Operation View (BOV) and Functions Service View (FSV). This means the e-marketplace operation team can create run-time services to the participants by combining SOA and management view in a single framework. This will provide for participants with flexibility in creating:

- Business models
- Business services
- Shared business process

Hub architecture also provides with multiple communication layers with back-end system for simultaneous transaction (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010). This architecture also aims to overcome the gap between BOV and FSV (Dorn et al., 2007) by using service oriented architecture.

6.1.1 Components of the architecture

In order to create user interfaces (UIs), the architecture also bundles repositories, using modelling tools, processes and information. These repositories include – business model repository, business services repository, business process repositories and web service repository (Scheer, 2005). The origin of these repositories can be understood from the study on BOV and FSV. The proposed components of the architecture are:

- Business operation View – contains also the following sub-components:

- Business Model – uses e3-Value ontology, a methodology for modelling and designing business models for business networks integrating concepts from requirements engineering and conceptual modelling (Hofreiter, 2008).
- Business Process Model – This uses simple UML modelling for the purpose of presenting the processes, three UML diagrams that are used in this model are, the UML profile (UMM), activity diagram and Event-driven process chain (EPC).
- Business services repository – this also includes subset of models such as – Common B2B business services, includes technical and business services.

- Functional Service View – this contains basically the deployment artefacts and the software specifications. Deployment artefacts FSV includes are –
    - Repository (Web service management): this repository relies on three standard specifications, SOAP, WSDL and UDDI.
    - WSO and WSC: this comprises of technologies such as Web Services Orchestration (WSO) and Web Services Choreography (WSC), consecutively refers to web services for business processes and web services for business collaboration (Carter, 2007). This enables suppliers and customers to be connected for transaction under a peer-to-peer connectivity (Scheer, 2005). WSC also enables communication between BOV and FSV.
    - Business process execution language (BPEL): specifies business process behavior by providing an XML notation and semantics based on web services. BPEL is generated from UMM and EPC. BPEL specifies order to a collection of services and assigns responsibilities to the services thus orchestrates the web services (Goldkuhl and Lind, 2008) (Zapletal, 2008).
    - Multi-channel framework (MCF): MCF is the integration layer and resolves the interoperability problems. It also enables synchronous and asynchronous integration with different back-end systems and channels. MCF contains three sublayers that has different functionalities. Communication layer – this layer enables the communication between the channels and systems using communication protocol and adapters (i.e. socket and third party adapters). Data transformation and data transfer mapping - this layer enables different data to be

transformed into a standard form and enables the map for transfer of that data through the network, this all activities are performed using different parsers and core XML engine (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010).

6.1.2 Different roles and workflow in the architecture

The integration process requires several characters to play their role, starts from the users of the system and the experts providing their definitions, mappings, designs and semantics to make the whole system performs towards the user requests (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010). Here a list of characters and their roles are explained:

Buyer and Supplier: Although the both characters are different however, these two characters have similar role of requesting services through direct MCF connectivity layer or indirectly through the e-marketplace platform which is also requests the MCF connectivity layer for service request.

Integration Team: Modelling Team - This team delivers business models and business process models to the BOV layers based on e3-value ontology, based on the models BOV segregates the user service request through business process layer into common B2B business, vertical business and private business services. Ontology Engineers – these people supply the semantic and ontology layers' process distribution models. Mapping Team – this team performs all the mapping operations in the system that enables the communication process. Their mapping operation includes defining an XML map for each buyer and supplier in the system, then the team will use an XSLT transforms all the maps into specific industry standards to simplify integration.

The hub architecture can be explained with the open EDI reference model (ISO/IEC 14662:2010) base. This architecture shows how user request flows in the system and how different components of the architecture plays roles to enable the integration (Figure 5).

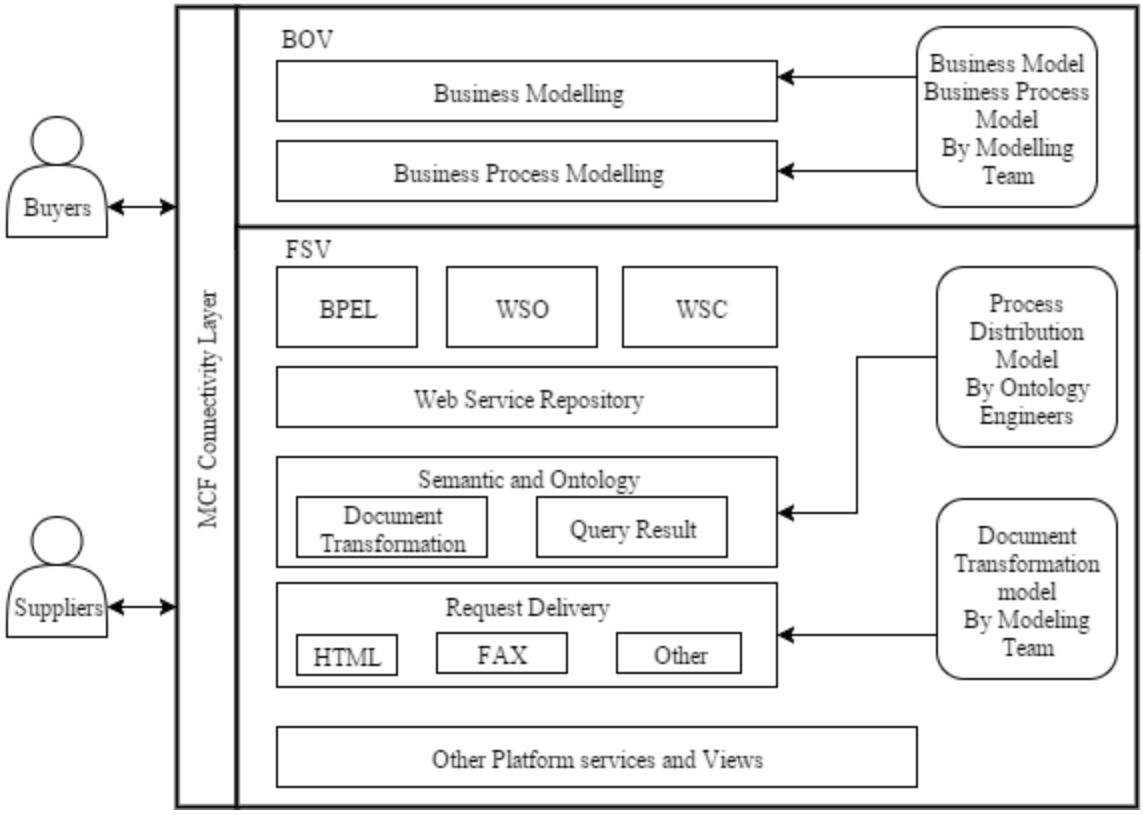

Figure 5: B2B Hub Architecture adapted (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010)

Understanding of B2B hub architecture is useful to understand the ERP-B2B integration in terms of XML standards. The whole architecture states how data is flown from the customer and how the data is transformed in the system, the people involved in the integration and delivery of data in a standard format for every user.

6.2 The integration architecture

Once the integration requirements are known the integration architecture can be produced, B2B Hub Architecture (Section 5.1), provides enough understanding of the requirements and infrastructure. The integration architecture (Lam and Shankararaman, 2004), proposes a point-to-point integration solution through this architecture. The integration architecture provides a simplified view of integration scenario based on the supplier's perspective.

6.2.1 Components of the architecture

Since, the previous section has provided with most of the definitions, in this section the components are listed and their functionalities or actions are briefed according to the author's research (Lam and Shankararaman, 2004). The components listed in the literature are based on integration scenario with Unix and SAP:

- B2B servers – part of online trading hub, all the activities related to tender and quotation by buyers and suppliers are made here, this is the primary communication module between all the clients in the architecture.
- Workflow engine – business rules for business process are maintained here, contains GIU front-end, also contains all the messages that might flow to other component related to the business processes.
- Inventory control system (ICS) – this integration interface allows the workflow engine to check availability of products.
- Customer account system (CAS) – workflow engine obtains necessary customer information from this integration interface.
- Logistic and delivery system (LADS) – allows inter-communication between suppliers and the communication protocol can be implemented by the buyer with permission of the supplier.

6.2.2 Integration workflow in the architecture

The integration workflow in the architecture can be describe according to the components workflow in the architecture. The whole process starts with a buyers request and ends at the suppliers' response. The buyer communicates with the supplier server through the online trading hub. The workflow engine allows the suppliers to set business rules for business processes. The buyer receives primary response through the set rules. The ICS provides the trading information, includes inquiry result for tenders, ques and quotations. CAS provides details of the clients withholding the products to the buyer. This works on the supplier end to look for potential buyers for the future production. CAS performs all these operations by sending and receiving premediated messages available in the workflow engines GUI. Finally, the LADS provide the confirmation on purchase process through XML messages over the internet. However, LADS can be implemented

on the suppliers' side by the requested logistic entity's permission. The architecture in details has been presented in Figure 6.

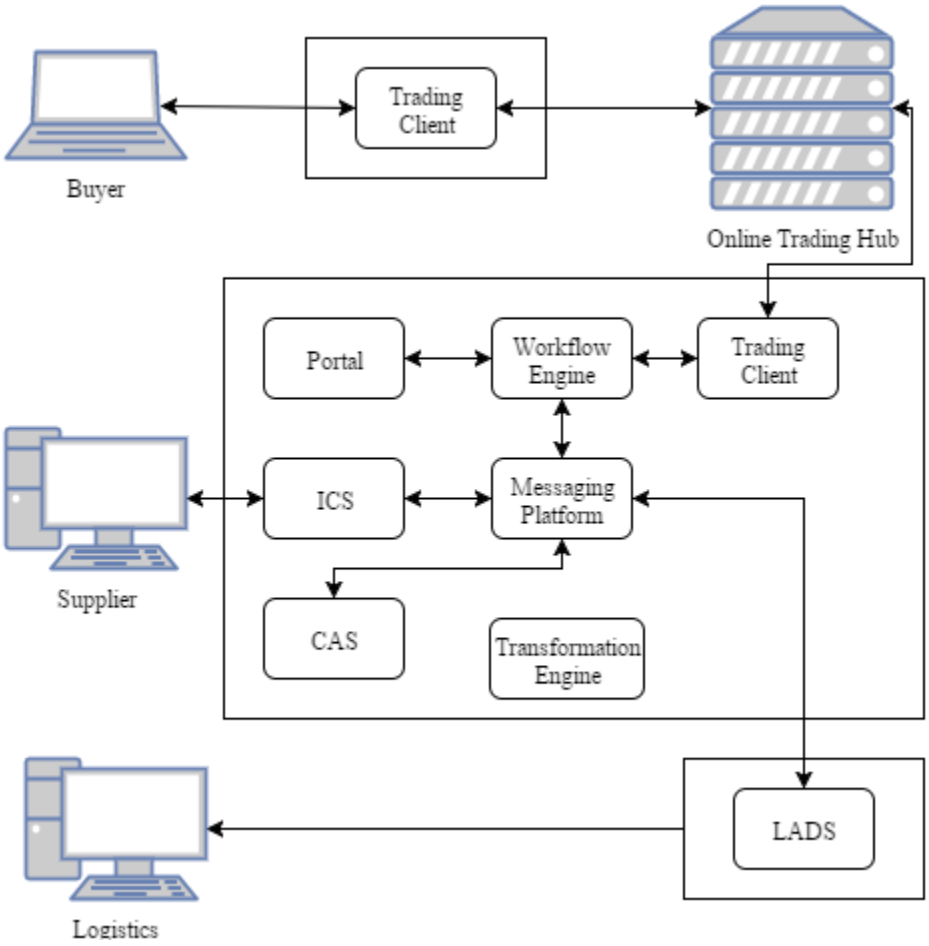

Figure 6: Integration architecture adapted (Lam and Shankararaman, 2004)

Integration architecture provides a simplified view of the integration process, where in the hub architecture the details functionalities can be seen. The trading client, a packaged application enables the buyer to communicate with client through the online hub. The messages sent to and fro buyer and supplier through the hub is on HTTP with XML message.

7. CHALLENGES AND POSSIBILITIES

Integration of different concepts tends to have several challenges, same is found in B2B-ERP integration. These integration challenges are seen in different stages of the integration process, further investigation into the challenges open possibilities of new development. In this section the prominent challenges and possibilities for further research have been discussed based on the research paper of the mapping study array. The primary challenges that has been observed are the challenges regarding streamlining the information transaction standard, specific to the platform and interfaces and organizational and cultural challenges such as cost, policy and cultural issues. Possibilities to overcome these challenges can be also determined if the challenges can be understood and alternatives can be found.

7.1 Integration interface standards

There are several standards to obtain interoperability between the companies B2B framework, these standards have one major problem between them, that is compatibility problem. Due to incompatibility integration of B2B face challenges to follow certain standard for all the ERP connectivity platform (Shim et al., 2000). Another way this can be also said to be challenges regarding ERP system with standardized interfaces (Schubert and Legner, 2011).

Data security is one of the major feature that makes EDI still a suitable choice for many organizations. Significant benefits were achieved by different companies through effective implementation of EDI. Although tremendous cost associated with EDI implementation qualified only large companies and their suppliers to obtain benefit from it (McIvor and Humphreys, 2004). However, previous study shows despite such huge cost, 60% of the electronic transaction are still performed using EDI. Although, adaption of internet based standard such as XML-based standard holds the remaining share of data exchange and it's growing (Caniato et al., 2010). However, this standard has some potential drawbacks compare to EDI, such as size of data transfer is huge compare to that of EDI at the same time security is also big threat for big companies to consider this standard (Erasala, Yen and Rajkumar, 2003) (Edidev.com, 2015).

Considering both of the standard has its own positive characteristics many of the companies have already chosen particular standard for their B2B framework for connecting with the ERP or any

other enterprise application. These companies usually do not intend to re-engineer the standards considering huge re-integration cost involved (Brewer, 2013). However, for new integration scenario or willing partners for re-integration the new solution to overcome the possible demerits of standards are believed to be solved by RosettaNet through its' security features (section 1.3). Although, technology is rapidly evolving and this can be a great challenge throughout to adapt or adopt these new changes in an already integrated system.

7.2 Other technical challenges

There are issues related to the technicality during the integration, these problems are global and common and not only integration but can be seen in any IT development. Such as poorly communicated objectives and requirements and inadequate understanding of them makes it difficult to develop any module and often leads to rework and misalignment (Zafar, Ali and Shahzad, 2011) and sometimes it leads to integration failure (Herbsleb and Grinter, 1999). Ill-tested components and redundant codes caused by lack of coordination between the remote location often leads to re-alignment of the whole project (Kotlarsky, van Fenema and Willcocks, 2008). Frequent changes in requirements delays the integration and introduces errors while shifting from design to implementation, also create bugs in the code (Cusumano, 2008). Furthermore, rapid emergence of new technologies, protocols, and standards pushes developers to work with numerous integration approaches (Al-Naeem et al., 2005). Hence, this might be extremely important to investigate, as integration of B2B-ERP is also a development, what development tool or method could be the best fitted for a particular integration scenario to overcome such technical challenges.

7.3 Integration expenditure and cultural issues

Although financial returns are huge for ERP integration in the business but implementation is extremely expensive and involves financial and technical risks (Jones and Young, 2006) (Lee, Moon and Lee, 2006). However, it is always a big challenge to convince executives about the return on integration expenditure as financial benefits are usually uncertain (Devenport, 1998) (Deutsch, 2015). ERP integration tends to disrupt the business process and corporate culture and there are written documentations to support these facts (Devenport, 1998) (Deutsch, 2015) (Wailgum, 2015). Furthermore, due to the fact that B2B-ERP integration might require

international business collaboration, not only the corporate culture, also the government organisms need proper visualization of the integration to be certain that it ensures social obligations and accountability (Botta-Genoulaz, Millet and Grabot, 2005).

The integration of an ERP-B2B emerges from the idea of integrating all business functions within the buyer-supplier scope, though there is no empirical evidence of the possibility. Hence, in such integration scenario, project manager is required to face a difficult communication with the key executives of different culture (Ghosh, 2002). Research on integration benefits in terms of return on investment (Vojdani, 2003), financial gains and technical risk identification and mitigation can bring a helpful reference to the integration managers and the company executives.

7.4 Business process and accounting variation

when it comes to B2B-ERP integration, it involves multiple organization and in many cases multiple multi-national organization. Therefore, the challenge begins; business process in different organization varies and integration of all these different business processes up to an extent that enables all the organizations to operate their transaction is pretty tedious (Arestis, McCauley and Sawyer, 1999). Furthermore, it involves huge communication and negotiation activity. As, business processes tends to be secretive and partner companies not always prefers these processes to be anonymously visible. Hence, proper understanding for privacy and security regarding business process integration is vital. Thus, further research to document business process integration pertaining privacy and security can provide comfort to the investors.

Another important fact is unified accounting policy, when multi country companies involves in such integration process. Accounting practice is not the same in different countries, also there is not any common accounting regulatory authority. Although, Europe is walking towards harmonization of theses accounting practices and regulations, other continents are still far behind (Ghosh, 2002). Without the unification of accounting practices, the challenges of inter country transaction and integration might always face trust and accountability issues by the government.

7.5 Non-technical challenges

Conflict of interest is one of the major non-technical and psychological challenge that can have possibly a large list, however, here some of the prominent challenges can be discussed.

Unwillingness of integration – as different companies have their own ERP and in many cases each of these can be different in each company, and in many cases they are non-integrated. When it comes to integrating all the systems into one platform, some might require higher level of integration requirement and functional managers might not be willing to support the change as business as usual might highly affect (Ghosh, 2002). Also, learning a whole new system always requires higher motivation which might link with job security.

Choosing the right standard – changing to a new interface standard leads to total change of data structure and work process (Brewer, 2013), employees who are already use to particular standard requires considerable amount of training and motivation to adapt new standard. Companies always want to push changes to the others that supports less changes to their own.

End user – to implement the integration module requires tremendous effort by the user of the system to invest on testing and understanding. This always loads user with extra work besides the daily scheduled work. End users are not necessarily willing to take this extra work load.

These issues of unwillingness to support integration cannot be technically solved, rather it requires psychological measurement by visualizing benefits of integration and providing the people of the system with incentives and training. In many cases, co-operation of senior function manager provides huge assistance. In larger organization, temporary special dedicated project teams are created for such integration and development tasks, that combines members from different departments directly involved with the system, that reduces such obstacles of the integration process. However, for smaller organization it might not be a possibility. Hence, understanding and research on user involvement towards integration might bring options in such scenario.

8. DISCUSSION

Integrating B2B clients into ERP requires data exchange system that enables communication regardless of interface standard, data content or IT infrastructure (Gupta, 2000). However, such integration is not yet a possibility, as, we have observed in the earlier sections that interface standard is not universal and unless all the partners comes under same standard data exchange is tedious and integration is not complete. Before XML came into picture EDI was the most used standard for the organizations to integrate their business with ERP. However, implementing EDI has always been a challenging scheme because of its high entry costs and complexity and was only affordable by large organizations (Hart and Saunders, 1997).

XML might solve the integration picture for small and medium enterprises due to its' lower implementation cost, although, security could be still a big issue (Brewer, 2013). However, RosettaNet came with a proper integration structure with industry level dictionaries, framework, communication protocol and security feature, that might be the solution to security problem related to XML (section 1.3). In this paper B2B e-commerce Hub Architecture (Section 5.1) uses RosettaNet standard, this architecture can be investigated more in the context of B2B and ERP integration to find better implementation framework and cost effectiveness. According to this mapping study, although reference model of EDI (Section 4.3) has been used but was described to draw the framework of the hub architecture which.

Integration of B2B-ERP is not as simple as just to integrate few system, it involves integrating business process, strategy, databases and gradually the whole system. Lack of proper understanding in any of these might lead to a total integration failure (Cusumano, 2008). Thus, proper model is required for each of these processes individually to understand the requirements correctly to design accurate modules (Grant, Hwang and Tu, 2013), as more complete B2B module and e-business technology is more likely to gain business value. However, this might not be possible to understand all the requirements for a particular process, whether it's the business, strategy or system using a particular model because every process vary from each other when it comes to multi-company or multi-national dimension. Hidden requirements and processes might not be seen just through the documentation of the process, but requires frequent and detailed

communication (Zafar, Ali and Shahzad, 2011) with the function managers of the companies, where willingness to support integration is extremely important element (Ghosh, 2002).

B2B-ERP integration has deep involvement with technology such as Enterprise application integration (EAI) and e-marketplace and has great link with supply chain management (SCM), these technologies are interlinked and essential for the whole integration infrastructure (Gunasekaran and Ngai, 2004) (Wang, Zheng and Archer, 2005). Hence, such integration is huge in scale requires huge investment, although, it's documented that through the use of B2B marketplaces, companies with ERP systems capable of greater reductions in procurement costs (Bendoly and Schoenherr, 2005). It is also observed that the greater the cost perceived the less is the overall use of the B2B system (Schubert and Legner, 2011). However, detailed research on return on investment should bring further light into the integration investment justification.

Quality of integration essential for overall success for integration project and directly links with user's loyalty to the integrated system, these qualities should be seen in the system, information, service, process and collaboration (Victor Chen, Chen and Paolo S. Capistrano, 2013). The use of integrated system also highly influenced by the compatibility with current system, customer cooperation, firm size and seamlessness of production system. On the other hand, demand unpredictability and centralization of integration tends to reduce the overall use of the integrated system (Claycomb, Iyer and Germain, 2005).

9. CONCLUSION:

Enterprise resource planning system is an important tool for business process automation, and in the context of business-to-business, it is essential to have all the business data consolidated and accessed to meet accountability, profitability and demand predictability. These qualities are vital for business success. ERP enables such options by unifying all the necessary business data and business processes. In B2B scenario, several companies working together by establishing a supply chain, and creating a transaction cycle between buyers and suppliers. Apart from theses buyer or supplier company's internal business data, it is extremely important to have other peer's data to predict demand, access catalog, participate in bidding, placing quotes and necessarily access all

these data in any given time without manual intervention or re-work. Therefore, integration of these B2B customers into the ERP comes into picture. In this mapping study, this integration process has been observed through 37 (appendix) journal articles, however, detailed clarifications have been obtained from further studies. Based on the mapping study of last fifteen years, the research focus, research methodologies and tools, different process integration and related models and related architecture has been captured. The models presented in this paper can be used for requirement analysis and requirement artefacts gathering and the architectures can guide the overall system design based on the requirements. Furthermore, challenges and possibilities in such integration has been also discussed. This paper observes opportunities to suggest detailed guidelines related to some challenges identified in B2B-ERP integration. Hence, future research scope can be drawn from here, regarding interface standard improvement, technical and non-technical challenge mitigation, B2B platform integration and return on investment for such integration.

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Appendix.

Mapping Study Data

No	Title	Author	Publication Info	Year
1	A case study for implementing a B2B collaborative information system: a textile case	Tien-Hsiang Chang, Hsin-Pin Fu, Shao-Chang Li, Hung-Hsuan Lee	Journal of Manufacturing Technology Management, Volume: 20 Issue: 3, 2009	2009
2	A dynamic model of e-business strategies for ERP enabled organisations	Janice Burn, Colin Ash	Industrial Management & Data Systems, Volume: 105 Issue: 8, 2005	2005
3	A model of B2B e-commerce, based on connectivity and purpose	Andrea J. Cullen, Margaret Webster	International Journal of Operations & Production Management, Volume: 27 Issue: 2, 2007	2007
4	ERP system and implementation-process benefits: Implications for B2B e-procurement	Elliot Bendoly, Tobias Schoenherr	International Journal of Operations & Production Management, Volume: 25 Issue: 4, 2005	2005
5	Customer relationship management (CRM) in business-to-business (B2B) e-commerce	Yun E. Zeng, H. Joseph Wen, David C. Yen	Information Management & Computer Security, Volume: 11 Issue: 1, 2003	2003
6	B2B e-hubs and information integration in supply chain operations	Xiaofeng Zhao, Hui Zhao, Jianrong Hou	Management Research Review, Volume: 33 Issue: 10, 2010	2010
7	Building an integrated B2B e-commerce hub architecture based on SOA and semantic ontology	Usama Abdulazim Mohamed, Galal H. Galal-Edeen, Adel A. El-Zoghbi	Journal of Enterprise Information Management, Volume: 23 Issue: 6, 2010	2010
8	Enterprise information portals	Martin White	The Electronic Library, Volume: 18 Issue: 5, 2000	2000
9	ERP II: a conceptual framework for next-generation enterprise systems?	Charles Møller	Journal of Enterprise Information Management, Volume: 18 Issue: 4, 2005	2005
10	Implementation and use of B2B-enabling technologies: five manufacturing cases	Damien Power	Journal of Manufacturing Technology Management, Volume: 16 Issue: 5, 2005	2005
11	Process quality and collaboration quality on B2B e-commerce	Jengchung Victor Chen, Yawen Chen, Erik Paolo S. Capistrano	Industrial Management & Data Systems, Volume: 113 Issue: 6, 2013	2013
12	The implications of electronic B2B intermediaries for the buyer-supplier interface	Ronan McIvor, Paul Humphreys	International Journal of Operations & Production Management, Volume: 24 Issue: 3, 2004	2004
13	Towards full integration: eProcurement implementation stages	Federico Caniato, Ruggero Golini, Davide Luzzini, Stefano Ronchi	Benchmarking: An International Journal, Volume: 17 Issue: 4, 2010	2010
14	Design of a Meta Model for integrating enterprise systems	Chin-Bin Wang, Tsung-Yi Chen, Yuh-Min Chen, Hui-Chuan Chu	Computers in Industry, Volume 56, Issue 3, April 2005, Pages 305-322	2005
15	Predicting the level of B2B e commerce in industrial organizations	Cindy Claycomb, Karthik Iyer, Richard Germain	Industrial Marketing Management, Volume 34, Issue 3, April 2005, Pages 221-234	2005

No	Title	Author	Publication Info	Year
16	Drivers, barriers and critical success factors for ERPII implementation in supply chains: A critical analysis	S.C.L. Koh, A. Gunasekaran, T. Goodman	The Journal of Strategic Information Systems, Volume 20, Issue 4, December 2011, Pages 385-402	2011
17	An empirical investigation of six levels of enterprise resource planning integration	Delvin Grant, Yujong Hwang, Qiang Tu	Computers in Human Behavior, Volume 29, Issue 6, November 2013, Pages 2123-2133	2013
18	A survey on the recent research literature on ERP systems	V. Botta-Genoulaz, P.-A. Millet, B. Grabot	Computers in Industry, Volume 56, Issue 6, August 2005, Pages 510-522	2005
19	Information systems in supply chain integration and management	A Gunasekaran, E.W.T Ngai	European Journal of Operational Research, Volume 159, Issue 2, 1 December 2004, Pages 269-295	2004
20	Integrating ERP and e-business: Resource complementarity in business value creation	Pei-Fang Hsu	Decision Support Systems, Volume 56, December 2013, Pages 334-347	2013
21	B2B integration in global supply chains: An identification of technical integration scenarios	Petra Schubert, Christine Legner	The Journal of Strategic Information Systems, Volume 20, Issue 3, September 2011, Pages 250-267	2011
22	Commodity or competitive advantage? Analysis of the ERP value paradox	Pei-Fang Hsu	Electronic Commerce Research and Applications, Volume 12, Issue 6, November–December 2013, Pages 412-424	2013
23	Business technology complementarities: impacts of the presence and strategic timing of ERP on B2B e-commerce technology efficiencies	Elliot Bendoly, Frederick Kaefer	Omega, Volume 32, Issue 5, October 2004, Pages 395-405	2004
24	Enterprise Application Integration in the electronic commerce world	Naveen Erasala, David C. Yen, T.M. Rajkumar	Computer Standards & Interfaces, Volume 25, Issue 2, May 2003, Pages 69-82	2003
25	Enterprise application integration: a manager's perspective	Gleghorn, R.	IT Professional Year: 2005, Volume: 7, Issue: 6 Pages: 17 - 23	2005
26	Key Dimensions of Inhibitors for the Deployment of Web-Based Business-to-Business Electronic Commerce	Teo, T.S.H.; Ranganathan, C.; Dhaliwal, Jasbir	Engineering Management, IEEE Transactions on Year: 2006, Volume: 53, Issue: 3	2006
27	Automating any-to-any content exchange	Gupta, A.	IT Professional Year: 2000, Volume: 2, Issue: 5 Pages: 52 - 54	2000
28	Business-to-business e-commerce frameworks	Shim, S.S.Y.; Pendyala, V.S.; Sundaram, M.; Gao, J.Z.	Computer Year: 2000, Volume: 33, Issue: 10 Pages: 40 - 47	2000
29	Matching buyers and suppliers: an intelligent dynamic exchange model	Sung Ho Ha; Sang Chan Park	Intelligent Systems, IEEE Year: 2001, Volume: 16, Issue: 4 Pages: 28 - 40	2001
30	An enterprise integration methodology	Wing Lam; Shankararaman, V.	IT Professional Year: 2004, Volume: 6, Issue: 2 Pages: 40 - 48	2004
31	Tools for real-time business integration and collaboration	Vojdani, A.F.	Power Systems, IEEE Transactions on Year: 2003, Volume: 18, Issue: 2 Pages: 555 - 562	2003
32	The Impact of Internet-Based Electronic Marketplaces on Buyer-Supplier Relationships	Shan Wang , Wuping Zheng , Norm Archer	Journal of Internet Commerce Vol. 4, Iss. 3, 2005	2005

No	Title	Author	Publication Info	Year
33	Electronic Marketplace: A Distinct Platform for Business-to-Business (B-to-B) Procurement	Dothang Truong , Thuong T. Le , Sylvain Senecal , S. Subba Rao	Journal of Business-to-Business Marketing Vol. 19, Iss. 3, 2012	2012
34	Critical Success Factors in the Development of Business-to-Business Electronic Commerce	Beverley G. Hope , Michal Hermanek , Charmaine Schlemmer , Sid L. Huff	Journal of Information Technology Case and Application Research Vol. 3, Iss. 3, 2001	2001
35	Investment in Enterprise Resource Planning: Business Impact and Productivity Measures	Lorin M. Hitt, D.J. Wu, Xiaoge Zhou	Journal of Management Information Systems Vol. 19, Iss. 1, 2002	2002
36	Integrating ERP Systems in a Decentralized Company: A Case Study	Gee-Woo Bock, Emilia Flores, Donald Latumahina, Harry Cheng, Vu Tung Lam, Chan Stephanie, Ronald Soeharto & Youn Jung Kang	Journal of Information Technology Case and Application Research	2009
37	Systematic Approaches for Designing B2B Applications	Tariq Al-Naeem, Fethi A. Rabhi, Boualem Benatallah & Pradeep K. Ray	Journal of Civil Engineering and Management	2012

This appendix contains the following papers, (Schubert and Legner, 2011), (Bendoly and Kaefer, 2004), (Chang et al., 2009), (Burn and Ash, 2005), (Cullen and Webster, 2007), (Wang et al., 2005), (Abdulazim Mohamed, Galal-Edeen and El-Zoghbi, 2010), (Lam and Shankararaman, 2004), (Shim et al., 2000), (Erasala, Yen and Rajkumar, 2003), (Botta-Genoulaz, Millet and Grabot, 2005), (Gupta, 2000), (Grant, Hwang and Tu, 2013), (Gunasekaran and Ngai, 2004), (Wang, Zheng and Archer, 2005), (Victor Chen, Chen and Paolo S. Capistrano, 2013), (Claycomb, Iyer and Germain, 2005), (Bendoly and Schoenherr, 2005), (Zeng, Wen and Yen, 2003), (Zhao, Zhao and Hou, 2010), (White, 2000), (Møller, 2005), (Power, 2005), (McIvor and Humphreys, 2004), (Caniato et al., 2010), (Hsu, 2013a), (Hsu, 2013b), (Koh, Gunasekaran and Goodman, 2011), (Gleghorn, 2005), (Teo, Ranganathan and Dhaliwal, 2006), (Sung Ho Ha and Sang Chan Park, 2001), (Vojdani, 2003), (Hope et al., 2001), (Hitt, Wu and Zhou, 2002), (Bock et al., 2009), (Al-Naeem et al., 2005) and (Truong et al., 2012)