Network Effects in the ERP Systems Market – An Analysis of the Implications of Business Intelligence and Cloud Computing

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Abstract

Presently the vendors of ERP software are facing threats as well as opportunities by new technological challenges. In particular, business intelligence and cloud computing are, besides others, important trends in the ERP market. It is crucial for the ERP vendors to gain strong positions in both fields to remain competitive. Since the software market is often influenced by network effect we analyzed four big ERP vendors, namely Microsoft, Oracle, Sage, and SAP with respect to these effects on business intelligence and cloud computing. We enriched our analysis by IBM which is not an ERP vendor but is a leading IT company in both fields: business intelligence as well as cloud computing. The four ERP vendors have notably different histories. While SAP started as an ERP vendor, Oracl began as a vendor of data base systems. Microsoft's most important products are still the operating system Windows and its office suite. Sage, like SAP, is an ERP vendor but primarily addresses SME while SAP's main strength is still in the field of EPR systems for large co-operations.

Keywords: *Business Intelligence, Cloud Computing, Enterprise Resource Planning Systems, Network Effects*

1. Introduction

Presently the vendors of ERP software are facing threats as well as opportunities by new technological challenges. In particular, business intelligence and cloud computing are, besides others, important trends in the ERP market. It is crucial for the ERP vendors to gain strong positions in both fields to remain competitive. Since the software market is often influenced by network effect we analysed four big ERP vendors, namely Microsoft, Oracle, Sage and SAP with respect to these effects on business intelligence and cloud computing. We enriched our analysis by IBM which is no ERP vendor but is a leading IT company in both fields: business intelligence as well as cloud computing. The four ERP vendors have notably different histories. While SAP started as an ERP vendor, Oracle began as a vendor of data base systems. Microsoft's most important products are still the Windows operating system and its office suite. Sage, like SAP, is an ERP vendor but primarily addresses SME while SAP main strength is still in the field of EPR systems for large co-operations.

Hence, the objective of this paper is to quantitatively analyse the five companies with respect to their network effects, in particular in the fields of cloud computing and business intelligence. Hence the paper is an extrapolation of the paper by Peters, Thoma and Weber [20] who analysed these companies with respect to network effects in 2008. Nonetheless,

since the mega trends cloud computing and business intelligence started later their paper does not address these. However, in the meantime, cloud computing and business intelligence have become possibly two of the most dominating trends. As in the paper by Peters, Thoma and Weber [20] the complexity of the topic limits it to an overview of network effects and a brief discussion on their effect on business intelligence and cloud computing solutions for the ERP systems of the respective vendors. Hence, the paper also functions as a roadmap for our on-going research where we are planning to address these factors in more depth.

The remaining paper is organized as follows. First, we discuss the foundations of the theory of network effects. In Section 3 we introduce the concepts of business intelligence and cloud computing. In the subsequent section we describe the companies under analysis. In Section 5, we qualitatively analyse their business intelligence and cloud computing solutions with respect to the ERP market. The paper concludes with a summary in Section 6.

2. Network Externalities[1]

2.1 Foundation of Network Theory

Often superior quality and state of the art technology are regarded as the most crucial factors for a product to become a success. However there are many examples where inferior products and technologies eventually dominate a market after creating better products. A classic example is the competition between several video cassette recorder technologies (VCR) in the 1980s [17]. Although Sony's Betamax technology was considered to be the best it failed to become market standard. Instead the VHS format of JVC squeezed Betamax out of the consumer market and dominated the VCR era.

This, at first sight, "odd" market behaviour can be explained by network effects: The utility of a technology is not only determined by its quality but also by its diffusion, or in other words by the size of its network:

$$\text{Utility} = \text{Product\_Quality} + \text{Size\_of\_the\_Network}.$$

Consider the video cassettes. The more consumers own a certain format the more cassettes are offered in video stores, the easier it is to exchange cassettes with friends etc. In the end the network size are more important than the video quality. JVC managed to convince more users of its VHS technology [17] so that its inferior technology was overcompensated by its large network. Another example of an "odd" market outcome is the QWERTY keyboard [6] that is regarded as ergonomically inefficient but seems to be set in stone. Network effects have gained special attention to explain market outcomes in the software sector (see e.g. [4] or [24]).

Economides [8] defines networks as follows: “Networks are composed of complementary nodes and links. The crucial defining feature of networks is the compatibility between the various nodes and links”. Katz & Shapiro [14] define two types of network effects, namely direct and indirect network effects. Liebowitz & Margolis [18] give the following example: "Direct network effects have been defined as those generated through a direct physical effect of the number of purchasers on the value of a product (e.g. fax machines). Indirect network effects are ‘market mediated effects’ such as cases where complementary goods (e.g. toner cartridges) are more readily available or lower in price as the number of users of a good (laser printers) increases”.

In our paper we deal particularly with learning effects, economies of scale, information and communication, sub-technologies and technological standards.

[1] This section is a condensed and updated version of [20].

2.2 Sources of Network Effects

2.2.1 Learning Effects: Learning plays an important role in industry. It is one essential precondition for any progress and long term growth. One of the core objectives in a company is to improve efficiency of the production process based on experiences gained in the past. Or as Henderson [12] says "costs […] do continually decline as a function of experience." The famous related concept is the learning curve which goes back to Wright [27]. Later the more involved Crawford model also gained big attention [25]. In the context of network effects we distinguish between two types of learning: Learning-by-Doing and Learning-by-Using. Learning-by-Doing is related to improvements in productivity. See, e.g. [1, 16, 22] for more details.

2.2.2 Economies of Scale: Economies of scale is a supply sided network effect. Often the term network effect is interpreted as demand sided effects only. However, we consider economies of scale in our analysis here too. See, for example, Banker for a discussion of economies of scale in new software development. [3]

2.2.3 Information and Communication: When a consumer plans to purchase a product, she/he collects information of suitable products. Normally it is easier to obtain information on a popular product than on a product that is not widely spread. This gives the popular product a head start in comparison to an exotic product. In literature this concept is known as bandwagon effect [15]. Customers mainly buy a product because other customers bought the same product before. In trust theory, network based trust [13] can be observed when consumers regard products as trustable because other consumers trust the same product also.

2.2.4 Sub-Technologies: A sub-technology network emerges when additional products or services accompany the core product. These products and services increase the utility of the core product. For example, regard the success of the mobile operating system Android. It is considered that one advantage of Android is that many small applications (apps) have been developed for this platform [2]. These applications are sub-technologies which increase the utility of the core product.

2.2.5 Technological Standards: Last but not least, the most important source for network effects is probably (technological) standardization [11], [14]. In contrast to sub-technologies we address here the direct compatibility within a network (e.g. see the VCR example). There are many further examples in history where companies compete to make their technology the de facto industry standard.

3. Some Notes on Business Intelligence and Cloud Computing

Business Intelligence and Cloud Computing are regarded as mega trends in information technologies. Both are complementary and can mutually enrich each other. Hence, we briefly discuss their foundations separately in the following sections.

3.1 Business Intelligence

In the past few decades the amount of data recorded has increased dramatically. Reasons include advances in database technology, decreasing costs of hardware, including storage costs, and the interconnectivity of computer systems across platforms through Internet technologies, namely the IP protocol. Using these data has become a crucial challenge for virtually any organisation to keep their competiveness in a global economy.

The efforts of managing the data have been subsumed under the label Business Intelligence and two different areas can be identified:

- the area originating from the database technologies
- the area originating from data mining

We explicitly distinguish between these areas since they originate from different communities, the database and data mining communities.

- Database Technologies. In the past decades this area has been associated with data warehousing as a technology to optimally store, access and analyse huge amounts of data. These data are normally recorded from transactional systems and persistently stored in so called data warehouses. Sub-units of a data warehouse are data marts. To optimize access to the data they are stored in schemas like the star schema. To analyse data online analytical processing and data mining methods are applied.
- Data Mining Methods. The term data mining is not uniquely defined. They are statistical as well as non-statistical methods. The latter often originate from computer science rather than mathematics and are mostly algorithmically driven. They include machine learning approaches. Clustering, soft computing, neural nets and fuzzy sets are examples for this area.

The complementariness of these approaches is obvious. The database approach secures the optimal storage and accessibility of the data, data mining the analysis of the data.

3.2 Cloud Computing

Cloud computing is defined by the National Institute of Standards and Technology as "a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources" [19]. Hence, cloud computing enables organizations to centralize data and applications which can be accessed by a wide range of devices independently of their location. Devices include classic PC, laptops but also tablet PC and smart phones [23].

According to NIST the characteristics of cloud computing are [7]:

- "On-demand self-service involves customers using a web site or similar control panel interface to provision computing resources such as additional computers, network bandwidth or user email accounts, without requiring human interaction between customers and the vendor.
- Broad network access enables customers to access computing resources over networks such as the Internet from a broad range of computing devices such as laptops and smart phones.
- Resource pooling involves vendors using shared computing resources to provide cloud services to multiple customers.
- Rapid elasticity enables the fast and automatic increase and decrease to the amount of available computer processing, storage and network bandwidth as required by customer demand.
- Pay-per-use measured service involves customers only paying for the computing resources that they actually use, and being able to monitor their usage. This is analogous to household use of utilities such as electricity."

Cusumano [5] says that "cloud computing platforms exhibit direct network effects to the extent they have specific application programming interfaces (APIs) or Web services that encourage application developers to tailor their applications or that make it difficult for users of these applications to switch platforms. The direct network effects do not seem as powerful as between Windows and applications written for PCs, or between particular smartphone operating systems like Symbian, Blackberry, or Palm, and applications written for those environments".

It is assumed that cloud computing could make the classic PC obsolete, since the data and the applications are no longer locally stored on a PC but in cloud. An early example is Google's lean Chrome OS and Microsoft is integrating cloud (computing) into its operation system and office suite. [7]

Warfield [26] explains "If the cloud is small in relationship to its largest user, there is very little room for elasticity. Elasticity represents unused capacity that the Cloud Vendor had to pay for in order to have inventory to sell when demand comes." Hence, a big cloud with many clients using it seems to have advantages in comparison to a small cloud with just a few clients.

4. Characteristics of the Analyzed Companies

In this section we briefly describe the important characteristics of the five companies:[2]

- IBM. The history of IBM goes back to 1911; in 1924 the company was named IBM. In its beginnings IBM was a producer of hardware, including typewriters etc. In the early years of computing IBM produced mainframes and later personal computers. Approximately 15 years ago IBM made a strategic turn away from hardware towards an IT service and software company. The company itself offers no ERP solution but provides middleware technologies (Websphere) as a platform for ERP systems. IBM promotes its middleware as independent of any ERP vendor and therefore truly open. Furthermore IBM heavily invested in business intelligence, most notably by the acquisition of SPSS some years ago.
- Microsoft. Microsoft core business is in the field of operating systems (Windows) and office suites (MS Office). However, in the last decade Microsoft has bought a number of ERP vendors, namely Axapta, Great Plains, Navision and Solomon, which have been integrated into the business division Microsoft Business Solutions (MBS). This division is considered as one of the core areas within Microsoft's future growth. The ERP systems are designed for SME. Hence, Microsoft is a direct competitor of Sage.
- Oracle. Oracle started as a database vendor and has also become the world market leader in the section. About 15 years ago Oracle began to expand its businesses into the section of ERP systems. Oracle aggressively bought important ERP vendors (for example JD Edwards, Peoplesoft or the CRM specialist Siebel). It very successfully integrated the products of these acquisitions and has become number two in the ERP market. To strengthen its cloud business, Oracle bought Taleo this year.
- Sage. Sage's ERP system addresses the needs of small and medium sized companies. These systems have reduced functionality and are easier to implement

[2] See their websites for more details.

and maintain in comparison to ERP systems for large firms. New competitors have entered the market for EPR for SME, for example Microsoft (see above) and SAP.

- SAP. SAP is the leader in the market of ERP systems for large enterprises. Its products virtually cover any function in a company. SAP is also expanding their business towards ERP solutions for SME. Recent acquisitions include Business Objects (business intelligence), Sybase (databases) and Ariba (cloud computing) to further strengthen its position in future markets.

In cloud computing several other important enterprises are also offering a diverse range of related services e.g. Amazon, Google or Salesforce just to name a few. However, in the context of our analysis we concentrate on IBM, Microsoft, Oracle, Sage and SAP.

5. Implications of Business Intelligence and Cloud Computing on the Network Effects in ERP

In this section we discuss the implications of business intelligence and cloud computing on the network effects of ERP vendors and IBM. Please note, that we also consider IBM as the producer of the middleware. Furthermore IBM is very active in fields of business intelligence and cloud computing. These technologies are of special importance for ERP systems.

5.1 Business Intelligence

In the context of the ERP vendors Oracle and SAP bought established business intelligence vendors to enrich their product portfolio. Also IBM bought business intelligence companies, most notably SPSS. Hence these companies can leverage on already existing strong customer bases. By the integration into their current portfolio they can make these products also available to their customers. Microsoft integrates its SQL Server, SharePoint Server and Office into a business intelligence platform leveraging on their existing portfolio. Sage has an integrated business intelligence module in their product portfolio and therefore can also leverage on its customer base.

So all vendors seem to be strong with respect to database business intelligence; however we identify advantages of IBM, Oracle and SAP with respect to data mining business intelligence.

- Learning Effects: As already discussed learning can be learning by using and learning by doing. With respect to the business intelligence solutions we would regard the learning effects in the subfield of database driven business intelligence almost on the same level across the ERP vendors. Possibly Oracle and IBM, as big database vendors, might have a particular mature learning curve. With respect to data mining in particular IBM, Oracle and SAP enriched their own expertise by the acquisition of data mining specialists.
- Economies of Scale: Economies of scale is of particular importance for software vendors, since the production costs of software are fixed and mostly significant. In contrast to this the variable costs are relatively low and primarily consist of the costs for distribution. Hence, an established customer base is of particular advantage with respect to economies of scale. Oracle and SAP as the two leading ERP vendors seem to have a strong position here. However, the other companies can also leverage on their customer bases: IBM as a leading software and service company, Microsoft forms its dominating position in the fields of operating systems and office suites and Sage as the leader of ERP systems for SME.

- Information and Communication: Information and communication is a matter of awareness and trust in a company's products. Since all the analyzed firms are renowned IT companies in their particular domains, awareness and trust can be considered on high levels. The challenge is if they can leverage on their reputation when they are entering a new market. In this context IBM, Oracle and SAP not only just bought business intelligence companies but they also can gain significantly from the reputation of these companies.
- Sub-Technologies: Sub-technologies have gained increasing attention lately. E.g. the number of apps for smart phone operating systems is regarded as one of the crucial competitive factors. As the ERP market leaders Oracle and SAP have large customer bases. Hence, the provision of sub-technologies by third parties can be an attractive business model. Microsoft's dominating role in the field of operating systems is also an excellent basis for sub-technologies for business intelligence solutions.
- Technological Standards: Market leaders often set technological standards. When these standards are proprietary they can leverage on the related advantages. However, public competition guardians investigate whether these standards reduce competitiveness within a certain sector. With respect to business intelligence solutions the market leaders can leverage on their standards.

In summary, we think that all companies have strong positions in the field of business intelligence. The market leaders Oracle and SAP can leverage on their dominate positions as ERP vendors; they have also bought business intelligence know-how recently. Microsoft can leverage on its strong position in operating systems, office and SQL. However, it might be able to improve its portfolio in the field of data mining. Also, third party vendors can fill this gap also. In principle the same applies to Sage. However, as a specialized ERP vendor it cannot leverage on its own supporting products like operating systems and office products similar to Microsoft.

5.2 Cloud Computing

Cloud computing will possibly change the nature of computing [21]. Hence, the regarded companies are intensively investing and expanding into cloud computing currently. Besides these major players in the ERP sector, companies like Google, Amazon, big telecoms etc. are also offering cloud services. With respect to the network effects we observe:

- Learning Effects: "The biggest challenge for every user when trying to deal with cloud computing is learning the application presented by the enterprise" [10]. However, in the context of the ERP systems the users already know the software. So, a main challenge for the ERP vendors is to make the transformation into the cloud as inconspicuous as possible for the user. We think that the installed bases of all vendors provide excellent bases for smooth transformation into the cloud.
- Economies of Scale: The economic impact of cloud computing has been described by Etro [9] as substantial on both households and companies. In particular a core advantage of cloud computing is the shared platforms and therefore possible cost reductions and efficiency increases in comparison with local services. Warfield [26] discusses a related issue of the elasticity of cloud services showing relationship between the size of the largest user and the size of the cloud. Sage, as

a relative small company in comparison to the others, might experience greater challenges here than the others.

- Information and Communication: The regarded companies are leading in their particular fields. Hence, they are all renowned and respected. With respect to information and communication and the trust in their cloud computing solutions we do not see any significant differences between them.
- Sub-Technologies: The sub-technologies affect the ERP software, i.e. the add-ons provided by third parties. However, with respect to cloud computing itself sub-technologies do not play a similar important role.
- Technological Standards: Similar to the discussion above in the paragraph of sub-technologies technological standards are important on the level of the ERP software independently if they run locally or in a cloud.

In summary, all regarded companies have similar strengths with respect to network effects of cloud solutions. However, Sage may have a slightly weaker position with respect to economies of scale.

5.2 Summary

The following table summarizes our evaluation of the implications of Business Intelligence and Cloud Computing on vendors of ERP systems.

Table 1. Summarized Evaluation of the Implications of Business Intelligence and Cloud Computing on ERP Vendors

	Business Intelligence (Database / Data Mining)	Cloud Computing
IBM	+ / +	+
Microsoft	+ / =	+
Oracle	+ / +	+
Sage	+ / =	=
SAP	+ / +	+

6. Conclusion

In this paper we investigated the implications of business intelligence and cloud computing on the network effects of ERP companies (Microsoft, Oracle, Sage and SAP) and IBM as a leading services and software provider. We found that all companies are intensively investigating business opportunities in cloud computing. In comparison, the ERP vendors solely are concentrating on SME. Microsoft seems to have a stronger position than Sage since the integration of cloud services into the Windows 8 operating system. Microsoft's ERP solutions could leverage on this. Regarding Oracle and SAP's solutions for large enterprises it can be observed that both companies are intensively investing into cloud technologies. We regard the network effects of business intelligence on ERP systems not as strong as the effects of cloud computing. However, Oracle and SAP seem to have a lead in comparison to Microsoft and in particular Sage. IBM, as a non-ERP vendor, is strong in both, business intelligence and cloud computing. Its main strength is its neutrality which may result in solutions that are more easily assessable and manageable than ERP vendor specific solutions, especially when enterprises run a heterogeneous infrastructure.

In the medium to long run cloud computing facilities will have a strong impact on the competiveness of the ERP vendors. Business intelligence solutions also have to be smoothly integrated into the ERP systems since generating information out the data becomes more and more a crucial competitive factor for virtually any company.

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