NETWORK EXTERNALITIES FOR
ENTERPRISE RESOURCE PLANNING SOFTWARE
A Research Roadmap

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Abstract: Presently the ERP software market is characterized by a fierce competition of some of the largest software producers of the world. While SAP tries to defend its position as the market leader, Oracle, founded as database vendor, has heavily invested into its ERP business by taking over large related software producers like Peoplesoft or Siebel. Microsoft also bought ERP vendors as a basis for its MBS (Microsoft Business Solution) division. IBM and Sage are further players in the multi-billion market of ERP software. Currently the market faces two big challenges. (1) The classic ERP market addressing large corporations has become mature and is characterized by growth through displacement today. However the ERP market for SME still promises big growth rates. (2) The classic monolithic ERP systems are presently replaced by new middleware based technologies that provide open platforms to easily integrate business applications of third party software producers. Network externalities will significantly influence which ERP vendor(s) will dominate the future market. Therefore we will qualitatively analyse the current strengths and weaknesses of the presently most promising ERP producer with respect to network externalities.

1 INTRODUCTION

Currently the market for Enterprise Resource Planning systems (ERP) is characterized by a fierce competition of some of the biggest and strongest software companies in the world. The competition goes along with a market consolidation that makes many even former large software companies to disappear.

While SAP is considered to be the market leader, Oracle is aggressively investing in the market with the objective of bypassing SAP.

In the last few years Oracle took over several major players in the ERP sector. In late 2004, Oracle acquired Peoplesoft for USD 10.3 billion that already bought J.D. Edwards in 2004 (La Monica 2004). Siebel, the pioneer and former market leader in CRM software, was bought for USD 5.85 billion (including Siebel's cash of USD 2.24 billion) (Ihlenfeld 2005). Recently, in 2007, Oracle announced to take over Hyperion, a specialist for BPM - Business Performance Management software for about USD 3.3 billions (Kahn et al. 2007).

In contrast to Oracle, until recently, SAP's strategy has been to grow organically instead of aggressively buying big software company to complete its own portfolio. However, in 2007, it announced to buy the French software company Business Objects for EUR 4.8 billions (more than USD 6.5 billions) to strengthen its position in the field of Business Intelligence (Prodhan 2007b).

In the recent years Microsoft has bought several ERP vendors, namely Axapta, Great Plains, Navision and Solomon, which have formed the core

of its MBS division (Microsoft Business Solutions). The MBS division is considered as one the core areas within Microsoft's future grow. Like Sage a leading Norwich UK based ERP producer Microsoft's products focus on smaller business (SME) rather than the core products of SAP and Oracle which address large organisations.

And finally, very recently IBM announced to take over the Canadian software company Cognos for USD 5 billions (Wu 2007).

The competition and market consolidation is mainly driven by the following factors.

(1) The ERP market for large organisations has creased to grow rapidly. It has become a mature market that is characterized by growth through displacement. Only the market for ERP systems for SME is considered to generate high growth rates in the next years. Therefore new and established ERP vendors introduce software products especially designed for this clientele. For example -besides its already established product lines for SME like Business One - SAP recently introduced its Business ByDesign applications (Prodhan 2007a) and has started to even advertise its software on television.

(2) There is a technological shift from monolithic ERP systems like SAP R/3 to open middleware based systems that allow integrating and running small software pieces from third parties. Besides ERP vendors like SAP that introduced Netweaver and Microsoft that promotes its .NET technology software company, like IBM, that has no close affiliation to ERP software are offering middleware technology as platform to run business applications. IBM promotes its middleware platform Websphere as neutral and truly open since it has no ERP package to sell with it like classic ERM vendors have.

The network externalities are having a significant influence how the ERP market of tomorrow will look like, in particular which software companies will dominate it.

The objective of this article is to qualitatively analysis the strengths and weaknesses of leading ERP software companies with respect to network externalities and provide a roadmap for future research. The complexity of this topic requires it to limit our presentation to an overview on network externalities and a short description of each factor with respect to each company. So the paper also functions as a guidebook for our ongoing research where each factor is address in depths.

The remaining paper is organized as follows. The next Section gives an introduction to the theory of network externalities. In Section 3 we present the results of a qualitative analyse of the positions of some leading companies related to network externalities. The paper concludes with a summary in Section 4.

2 NETWORK EXTERNALITIES

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 the market after they squeezed out better products with superior technologies. So, in literature, the question was addressed if such occurrences can be considered as market failure (e.g. Liebowitz, Margoli 1995b).

A classic example is the "battle" between several video cassette recorder technologies (VCR) in the eighties of the last century. Although Sony's Betamax technology was considered to be the best but it failed to become market standard. Instead the VHS format of JVC squeezed Betamax out of the consumer market and dominated the VCR area until recordable DVD eventually replace video cassettes (for simplicity we restrain from the consideration of further VCR technologies like the European format Video2000).

This, at the first sight, "odd" market behaviour can be explained by network externalities. Basically the idea of network externalities is as follows. 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:

$$u = q + n$$

with

u = utility, q = quality, n = 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 advantages generated out the network size are more important than a marginally crisper video with a slightly better sound of a technology that rarely anybody else has.

JVC simply managed to achieve more users for its VHS technology by quicker and better identifying the consumers preferences and demands (Liebowitz, Margoli 1995b) so that its inferior technology was overcompensated by its larger network. Therefore,

in the end, the utility for the consumer of the VHS technology was higher than the utility of Sony's Betamax system.

Another famous example for an "odd" market outcome in the presence of network externalities is the QWERTY keyboard (David 1985) that is regarded as ergonomically inefficient but seems to be set in stone. A current example, quite similar to the VCR case and again under the participation of Sony, is the battle of the two new DVD technologies, BlueRay and HD DVD. Network externalities have gained special attention to explain market outcomes in the software sector (e.g. the classic paper of Brynjolfsson, Kemerer 1996 or Succi et al. 1998).

Formally "Networks are composed of complementary nodes and links. The crucial defining feature of networks is the compatibility between the various nodes and links" (Economides 2003). The key characteristic of network externalities is the fact that the utility of each member in a network increases with the size of a network. (Katz , Shapio 1985).

Katz and Shapiro (1985) defined two types of network externalities, namely *direct* and *indirect* network externalities. (Liebowitz and Margolis 1998) 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".

Network externalities can result out of different effects. In our paper we deal with:

- Learning effects
- Economies of scale
- Information and communication
- Sub-technologies
- Technological standards

which will be introduced in the following Section.

2.2 Sources of Network Externalities

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 1974) says "costs […] do continually decline as a function of experience." The famous related concept is the learning curve which goes back to (Wright 1936). Later the more involved Crawford model also gained big attention (Teplitz 1991).

In the context of network externalities we distinguish between two types of learning, (1) learning by doing and (2) learning by using.

Learning-by-Doing. Leaning-by-Doing is related to improvements of productivity. The more a product is produced the more the production process can the optimized with respect to time and costs. See (e.g. Leiby, Rubin and Lu 1997) for an overview of studies related to Learning-by-Doing.

Learning-by-Using. In contrast to Learning-by-Doing Learning-by-Using (Rosenberg 1982) is not related to the production process but directly to the usage of the product itself.

- The more a product is used the more ideas for product improvements will be generated.
- The more a product is used the better it is understood. Therefore it can be used more efficiently.

Often Learning-by-Using results in a lock-in of a technology (Arthur 1989). For example, the QWERTY keyboard is considered to be a locked-in technology (David 1985). There are better keyboard layouts. However, since the QWERTY layout is the standard it would be to expensive (training costs etc.) to replace it with a superior keyboard layout. Therefore the suboptimal technology QWERTY keyboard is locked-in.

2.2.2 Economies of Scale

Economies of scale can be divided into supply side and demand side economies of scale. Supply side economies of scale are related to the production side and to decreasing production costs when production increases. In economic literature these effects are often not considered as network effects.

Network effects are, in a narrow sense, no economies of scale, or they are defined as demand side economies of scale. For the context of our survey we will restrain from these definitions and will smatter of economies of scale meaning both effects.

2.2.3 Information and Communication

When a consumer is in the decision process what to buy, 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. Therefore, due to its larger network, a (good) popular product has already a head start in comparison to an exotic product characterized by a smaller network. It is even rational to stop searching for information on exotic product when the search costs exceed the savings obtained by buying the exotic instead of the popular product.

In related literature the concept is known as bandwagon effect (Leibenstein 1950). Customers mainly buy a product because other customers bought the same product before. Or in trust theory, network based trust (Henning-Thurau 2004) 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 recent announcement of Google, Qualcomm, Samsung, T-Mobile and another 30 companies to promote the open operating system Android for mobile phones. It is considered that one advantage of Android is that many small applications will be developed for this platform (Auchard et al 2007). These applications are sub-technologies which increase the utility of the core product. The larger the network is the more applications will be produced and the more useful is the core product.

2.2.5 Technological Standards

Last but not least, the most important source for network externalities is probably (technological) standardization (Katz, Shapiro 1985), (Farrell, Saloner 1985). In contrast to sub-technologies we address here the direct compatibility within a network. For example users of video tapes can only exchange movies if they have chosen the same technological platform/standard (e.g. VHS).

There are many examples in history where companies "fought" to make their technology the de facto industry standard. Besides VRC and the already addressed competition of the new DVD

standard standardization is of great importance in the software sector also.

Well known examples are the Windows operating system of Microsoft or the current discussions on an industry-wide standard for office documents like word processing or spreadsheets and others: OASIS Open Document Format for Office Applications vs. Microsoft's Office Open XML.

3 ERP-VENDORS IN THE PRESENCE OF NETWORK EXTERNALITIES

In this Section we qualitatively analysis the strength and weaknesses of five leading ERP software vendors - IBM, Microsoft, Sage, SAP, Oracle - with respect to their network externalities.

Please note, that we also consider IBM as the producer of the middleware WebSphere without any classic ERP solution. However, middleware platforms are regarded as central technologies for ERP systems. Their significance can be compared with the importance of an operating system for personal computers.

Therefore, currently, the competition in the ERP sector for large organisations is determined by the emphasis of the vendors to dominate the market of middleware solutions.

3.1 Learning Effects

3.1.1 Learning-by-Doing

We consider learning-by-using related to the expertise in developing relevant software systems.

IBM
- *Strengths*. IBM is one of the biggest players in information technology with a high expertise especially in large scale systems.
- *Weaknesses*. Within the scope of its market IBM has no significant weaknesses.

Microsoft
- *Strengths*. Microsoft has a high expertise in the development of office software which it utilises for the design of ERM software for small organisations. Since it bought several ERP vendors it has expertise in this sector too. Its technology .net has gained increasing popularity.
- *Weaknesses*. In the beginning Microsoft has struggled to successfully develop software for

larger IT infrastructure (e.g. Windows Server). However, in the meantime they have gained knowledge in this field.

Sage
- *Strengths*. Sage has a high expertise in the development of ERP applications for small organisations.
- *Weaknesses*. There is no information available if Sage ever considers entering the ERP market for large organisations.

SAP
- *Strengths*. SAP is the market leader in ERP systems for large organisations. Therefore it has the highest expertise in its development of all companies.
- *Weaknesses*. Although SAP has a high expertise in the development of ERP systems for large corporations it has to proof that it can transfer this knowledge to the development of ERP applications for small organisations and middleware technology.

Oracle
- *Strengths*. Oracle, as the second largest software company worldwide, has a high expertise in the development of complex software systems, particularly databases. It has also gained high expertise in the ERP sector by buying several large ERP vendors like Siebel or Peoplesoft.
- *Weaknesses*. The integration of the products could divert from an enhancement of the products.

3.1.2 Learning-by-Using

Here we analyse if the user feed helps to improve the product.

IBM
- *Strengths*. IBM is a well established producer of middleware systems. Therefore it should have high expertises gained by user feedbacks.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Microsoft
- *Strengths*. Due to the distribution of its products Microsoft has constant and high feedbacks of its customers.
- *Weaknesses*. The feedback in the ERP section is smaller since the recent start of this products and the smaller number of customers. However its customer basis is increasing rapidly.

Sage
- *Strengths*. Sage has a large customer base and long experience in ERP sector. Therefore it has got a number of high feedbacks.
- *Weaknesses*. SME might not provide the same level of feedback as large organisations do.

SAP
- *Strengths*. As the market leader in the sector for large organisations SAP gets constant and frequent user feedbacks.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Oracle
- *Strengths*. As the second largest ERP vendor Oracle gets constant and frequent user feedbacks. It also gets feedback of its ERP customers.
- *Weaknesses*. The integration of recent acquisitions may distract from the feedback.

3.2 Economies of Scale

As discussed above economies of scale are supplier side network effects. Software production is characteristic by large fix costs and small variable costs. The effect for software development was addressed by (Banker et al. 1989).

IBM
- *Strengths*. As a large software producer IBM should generate reasonably economies of scale.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Microsoft
- *Strengths*. As the largest software company of the world Microsoft should be able to generate significant economises of scale.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Sage
- *Strengths*. As leading company of EPR solutions for SME Sage should generate reasonably economies of scale.
- *Weaknesses*. Sage has a decentralized structure.

SAP
- *Strengths*. SAP is the market leader in the ERP market. Therefore it should generate economies of scale in its core market.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Oracle
- *Strengths*. Oracle is the second largest software company of the world. Therefore it should generate significant economies of scale.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

3.3 Information and Communication

In this overview we do not distinguish between information and communication.

IBM
- *Strengths*. As the largest IT company of the world IBM has an excellent image and is considered to produce high quality solutions for large organisations.
- *Weaknesses*. IBM may have the conviction to its customers that a neutral platform has significant advantages in comparison to more integrated products.

Microsoft
- *Strengths*. As market leader in the fields of desktop operating systems and office products Microsoft has a high reputation and can argue that it can smoothly integrate ERP products also.
- *Weaknesses*. Microsoft may have to convince medium and, in the long run, large size organisations that their products suit them too.

Sage
- *Strengths*. Sage ERP products for SME have a good image.
- *Weaknesses*. Sage must try to keep the image that it will survive the competition of Microsoft and SAP because have entered the ERP market of SME.

SAP
- *Strengths*. As a market leader SAP is the choice that has the least risk. If one chooses the market leader the decision cannot be wrong.
- *Weaknesses*. Small companies consider SAP as complex and expensive. SAP must convince SME that their ERP suites for small organisations are easier to install and use than its classic applications.

Oracle
- *Strengths*. Oracle is known for its expertise in database systems.
- *Weaknesses*. During the integration phase of Peoplesoft, Siebel and others Oracle faces the challenge that it has to manage the integration and takes care of its old clients.

3.4 Sub-Technologies

We consider to sub-technologies, add-on software and consulting expertise to run and maintain the systems.

IBM
- *Strengths*. As one of the biggest information technology companies the world IBM demonstrates consulting expertise and has related products that function as sub-technologies for its middleware platform.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Microsoft
- *Strengths*. As the largest software company offers a wide range of sub-technologies for its ERP products.
- *Weaknesses*. Often Microsoft is regarded to have a close-door so that third party applications might not be developed in the numbers as in the open source community. However it very successfully communities etc. around its .NET technology.

Sage
- *Strengths*. We could not identify a special strength of Sage in this category.
- *Weaknesses*. We consider Sage's position related to sub-technologies not as strong as the positions of its competitors.

SAP
- *Strengths*. SAP has a wide range of products that function as sub-technologies. Furthermore it has a large network of consultants and software solutions by third parties around its core products.
- *Weaknesses*. We could not identify any significant weakness related to this topic.

Oracle
- *Strengths*. As a large software company Oracle can offer sub-technologies to their ERP product.
- *Weaknesses*. The network of consultants might not be as strong as the one of SAP.

3.5 Technology Standards

Setting a (technological) standard is the most important network effect. The middleware technologies are advertised as open with a high degree of interoperability.

IBM

- *Strengths*. Since IBM offers the platform only its police must be to disclose as much information on its standard as possible to attract third parties to run applications on it.
- *Weaknesses*. The above said is a strength and a weakness as well.

Microsoft

- *Strengths*. Microsoft has a successful history of setting proprietary standards. Furthermore the end users already know Microsoft products and how to use them. Its .NET platform is very widely used.
- *Weaknesses*. Because of Microsoft's history in setting proprietary standards customers might look for other products.

Sage

- *Strengths*. We could not identify a special strength related to this topic.
- *Weaknesses*. We could not identify a special weakness related to this topic.

SAP

- *Strengths*. SAP is the market leader and sets the standard for ERP systems.
- *Weaknesses*. It has to demonstrate if it can leverage this standard to its products for SME since SAP R/3 and successors, the product for large organisations is considered as very complex.

Oracle

- *Strengths*. Oracle is the second largest software company and also the second largest ERP vendor.
- *Weaknesses*. SAP is reasonably bigger in the ERP market.

4 CONCLUSIONS

In this paper we applied the theory of network externalities to the vendors of ERP software and analysed how these effects may influence the future shape of the market for ERP software.

In our analysis shows that SAP still has a very strong position in the core sector of ERP software for large organisations. However, in the last few years, Oracle has enlarged its ERP business dramatically by aggressively buying big software companies in this section. Furthermore it can draw on its core business, database systems, and possibly leverage this "sub-technology" to further strengthen its position in the ERP sector.

Microsoft can possibly leverage its strong position in operating systems and office products to help to grow it ERP business for SME.

In our survey IBM has a special position since it offers WebSphere as platform for ERP solutions. However, it seems to have not intensions to enter this market. This approach avoids conflicts of interest, as they are discussed in the case of Microsoft and its operating system Windows and applications running on this platform. Therefore it relies on the applications of third party vendors.

In the long run Sage seems to be the weakest vendor although it presently has a strong position in the market section for SME. However the other companies, besides their financial power, can draw on strong networks of sub technologies besides other effects that will be real threats for Sage.

As the main purpose of our paper is to serve as an overview of important network effects for ERP vendors, in our future research we address each network effect in separated research projects.

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