

# Development of a Digital Ecosystem Using the Example of Amazon

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**Abstract**— Economic changes have been driven in recent years due to the digital transformation. Companies like Amazon are adapting to this development by using digital ecosystems. It is assumed by the authors that changing customer needs lead to an adaption at the ecosystem level. Amazon's digital ecosystem expands with the integration of new technologies. These technologies are acquired through company acquisitions. This paper deals with the questions of how the future development of Amazon's digital ecosystem can be predicted and which method could be used to analyse the development of Amazon's digital ecosystem. To answer these questions, the technology-portfolio of Pfeiffer et al. combined with other criteria and modified was applied to the previous and the future development of Amazon. A possible future alternative of Amazon's digital ecosystem was developed.

**Keywords:** Amazon; expansion strategies; digital ecosystem; innovationsmanagement; technology-portfolio.

## I. INTRODUCTION

In recent years, society and especially the economy have changed dramatically due to digital technologies. This process of change, often described in the literature as digital transformation, will progress even more rapidly in the coming years. Intelligent systems and ever more extensive networks will trigger a process that can help those companies that react flexibly and do not ignore this development to achieve a huge growth [1]. Therefore, digital business models, especially digital ecosystems, are becoming more important in research and practice. Digital ecosystems are changing and developing continuously, forcing companies to analyse their digital ecosystem in order to identify (environmental) changes early and to be able to act and react [1]. There are a large number of studies that discuss (digital) ecosystems. The term business ecosystem was first used by Moore in 1993. Just like a natural ecosystem, a business ecosystem moves progressively from a collection of products and services to a more structured community [2].

As an extension of business ecosystems, digital ecosystems focus on the central importance of the digital technologies that make up the ecosystem [3]. There are some studies that focus on the development of digital ecosystems in general from an economic perspective, e.g., network analysis, the formation of digital ecosystems, and co-evolution, a large part of the studies, however, focuses a technical view of digital ecosystems [3].

Companies like Amazon often acquire new technologies and integrate them into their structures and products. The integration avoids competition between new and conventional products [4]. Amazon's business model consists of a digital ecosystem that includes the entire value chain [5]. In the last few years, there have been some studies that have focused on the development of Amazon towards a digital ecosystem [6]. So far, there are no scientific studies that focus on the future expansion of Amazon's digital ecosystem. For this reason, this paper deals in particular with the following question:

*How can the future development of Amazon's digital ecosystem be predicted?*

This also leads to the question: Which method could be used to analyse the development of Amazon's digital ecosystem? To answer the research question of how the development of Amazon's digital ecosystem can be predicted, the technology-portfolio of Pfeiffer et al. [7] was used in a modified form as an analytical method. It is assumed by the authors that feedback of the customers and changes in customer needs lead to an adaption of Amazon's service system. These changes might also support an adaption at the eco-system level. The adjustment rules in this context are based on human decisions.

Section 2 of this paper includes the description of Amazon's digital ecosystem and a specific method, the technology-portfolio according to Pfeiffer et al. [7]. Section 3 is about the previous development of Amazon's digital ecosystem. The results are used to forecast the development in the future. Section 4 includes the future development of Amazon and Section 5 deals with the influence on Amazon's digital ecosystem. This paper ends with the limitations of the analysis and a conclusion.

## II. BACKGROUND

The following section presents the background of the analysis, including a description of Amazon's digital ecosystem and the explanation of the technology-portfolio according to Pfeiffer et al. [7]. The technology-portfolio analysis is typically used to value new technologies in order to identify the most relevant strategic technology areas and to make an investment decision based on the results [8]. Further criteria used in this analysis, e.g. to determine resource strength and technological attractiveness, are explained in more detail in this section [14].

A. The digital ecosystem of Amazon

To analyse the development of Amazon’s digital ecosystem, Amazon’s digital ecosystem should be described previously. There are many definitions of digital ecosystems in the literature.

In general, a digital ecosystem is defined as a network of businesses, individual stakeholders, institutions, and consumers interacting both physically and electronically to provide combined services and value to each other [9].

From an economic point of view, an ecosystem can be perceived as an association of market participants that are in a certain relationship. The relationship between the participants is basically one of partnership, but competitive situations can also exist [10].

In contrast, digital ecosystems can form limited systems in the technical field, combining hardware, software, content, and services [11]. In the following sections, the term digital ecosystem is based on this description.

Amazon’s service offer, which includes products and services in Amazon’s core business as well as in its subsidiaries, has been visualized based on the understanding of a digital ecosystem by T. Ammon and A. Brem [11] (Figure 1).

B. Technology-portfolio according to Pfeiffer et al. and further criteria

The focus of this analysis should be based on technologies because the related software, hardware, content, and services build the digital ecosystem. For this reason, a technology-portfolio is used in this paper. In the course of the paper, the technology-portfolio according to Pfeiffer et al. [7] is discussed further because it is in contrast with different technology-portfolio approaches empirically proved [13].

In advance, the technology-portfolio according to Pfeiffer et al. [7] is used in a modified state and in combination with other criteria as an analytical method regarding the Amazon case. The technology portfolio according to Pfeiffer et al. originally provides recommendations for investment, selection, and disinvestment [7]. Modified in this context means that the technology portfolio analysis is applied to acquisition decisions. Technology attractiveness and resource strength are determined according to criteria that will be explained in detail in the course of this paper [14]. This paper covers Amazon’s acquisitions according to the corresponding technologies. To analyse the technologies, it is important to explain the chosen technology-portfolio [7].

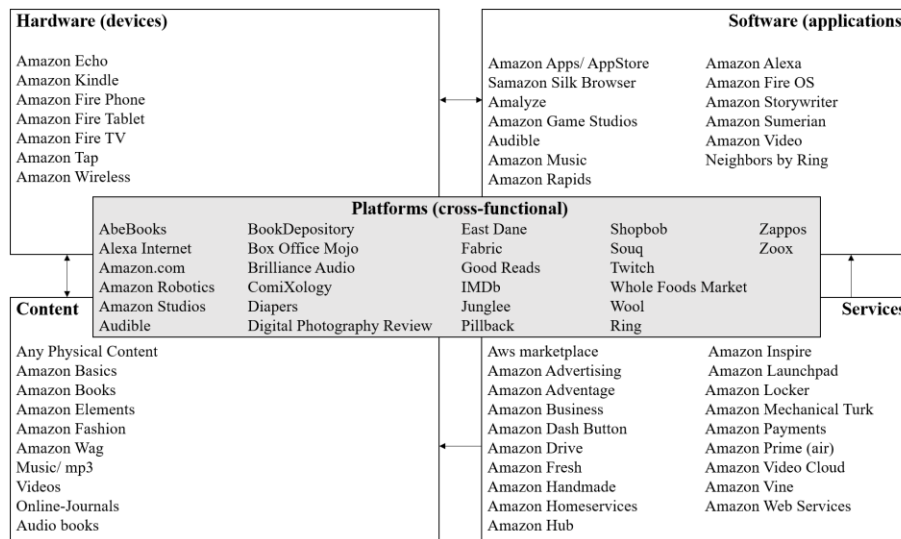


Figure 1. The digital ecosystem of Amazon (adapted from [11])

The allocation was made according to the assessment of the authors. Amazon’s digital ecosystem consists of hardware like the Kindle eReader, software for example Kindle Apps, content including eBooks and services [11]. The majority of Amazon’s value proposition is bundled on the Amazon platform [12]. In addition, there are other, cross-functional platforms for which it is not obvious at first sight that they belong to Amazon. These are mainly platforms, like Zappos, or Twitch that have been acquired by Amazon.

The objective of a technology-portfolio-analysis is to gain a recommended action based on the position of a specific technology [7].

During this portfolio-analysis, there is a difference between the two dimensions. The first dimension is the attractiveness of technology, whereas the second dimension is the strength of resources. Depending on the position, the technology is located at the investment, the selection, or the disinvestment area of the matrix [7].

A diagonal between the upper left corner and the lower right corner of the matrix symbolizes the selection area. The upper right corner is the investment area and the lower-left corner is called the disinvestment area [7].

In a work of Perspectives4You, criteria were used to determine the attractiveness of the technology and the strength of resources [14]. To determine the attractiveness of the technology and the strength of resources three questions are respectively answered. The answers are consisting of values between zero to four. The answers are weighted with the given percentages [14]. This is the basis to evaluate the general values of the attractiveness of the technology and the strength of resources. During the evaluation of the technology attractiveness, it is determined for example which potential the used technology has regarding the performance enhancement and/or the minimization of the overall cost.

The question of how the technology is mastered flows for example into the determination of the resource strength [14]. The following sections combine the technology-portfolio according to Pfeiffer et al. and the specific criteria [7][14]. The questions will be answered based on data from the literature. It is important to examine if this combination leads to useful results in the case of Amazon.

### III. METHOD APPLIED TO THE PREVIOUS DEVELOPMENT

The method applied to the previous development of Amazon is used to identify which companies and corresponding technologies Amazon could acquire. Because of that, the corresponding technologies of Amazon's acquisitions and their competitors are positioned in the matrix of the technology-portfolio. The selection of the technologies includes successful, unsuccessful technology and technologies of companies with different acquisition prices, in order to select a meaningful cross-section.

The input of the analysis is data, which was generated during the time of the acquisition. If there is no data about this time in the literature, the data of the next possible point in time is chosen as input. The positioning regarding the technology-portfolio depends on the criteria of technology attractiveness and strength of resources. If there is no data about the criteria in the literature, data of similar criteria are the basis of the analysis.

The technology of the company Kiva Systems was positioned in the matrix. The company has made a major contribution to improving the goods-to-person concept in the field of warehouse logistics. Robots transport shelves to specific stations [15]. Mick Mountz founded the company in 2003 and Kiva Systems was acquired by Amazon in 2012 [16]. After the acquisition, the company name was changed to Amazon Robotics [17].

Kiva Systems technology in this paper is understood to be any technology used to create, implement, and develop the so-called Kiva Schema. In order to determine the positioning, it should be explained what potential the Kiva technology has. The more efficient design of the process, the use of an improved indoor GPS system, and the use of certain 3D sensors could be further developed in the future [15]. On the basis of the potentials mentioned, the authors

assume that the Kiva technology has a very high innovation potential.

In this context, the question of the extent to which Kiva technology can open up further areas of application is also interesting [14]. Kiva's customers have similar demands in the field of logistics. The company's customers are for example part of the shopping industry or pharmaceutical industry [18]. Because companies from different industries are potential customers, a wide range of applications is assumed by the authors [14].

Major customers, such as retailers Toys "R"Us, GAP, and Staples use the Kiva technology [19]. For this reason, it is assumed that Kiva technology was urgently anticipated as a further step towards fully automated warehouses.

The Kiva concept has been imitated by several companies, such as GreyOrange [15]. GreyOrange was founded in 2011 [20]. Since Kiva Systems was already established in 2003, the company can benefit from a lead in the release of the technology of over two years compared to the competitor [14].

Considering the general potential of the Kiva Systems technology it is important to notice the good legal conditions. The company has filed more than 20 patents in the USA and many have been approved [15]. Despite the success of the GreyOrange technology, it is an imitation. For this reason, it is assumed by the authors that the Kiva Systems technology has a higher speed to market entry [14].

Because Kiva Technology and GreyOrange Technology are similar technologies, the innovation potential and the range of applications of these technologies are considered to be equally high. In classifying the technology-portfolio, it is assumed that customers may have reservations about GreyOrange because it is an imitative technology [14].

All the information and decisions lead to a positioning.

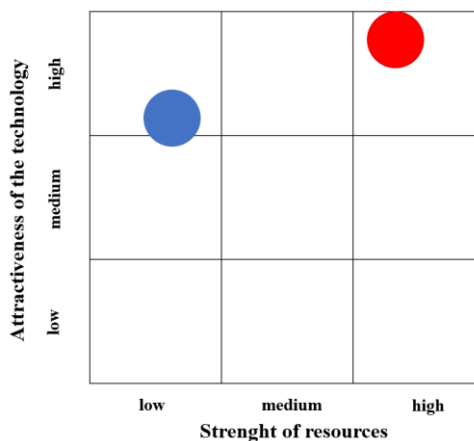


Figure 2. Technology-portfolio of the Kiva Systems technology (adapted from [7][14])

The positioning of the Kiva Systems technology and the GreyOrange technology is shown in Figure 2. The figure includes the two dimensions of the technology-portfolio. It is also shown that the Kiva Systems' technology is clearly in the investment area.

Whereas the GreyOrange technology shown in blue can be found in the selection area. A total of six technologies are compared with selected competitors. All technologies, which have been integrated in the long term in Amazon’s digital ecosystem are located at the investment area.

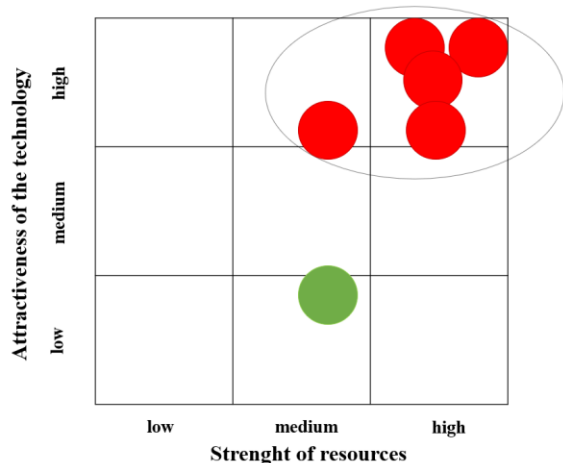


Figure 3. Technology-portfolio of six technologies (adapted from [7][14])

In Figure 3, these technologies are shown in red. One technology is shown in green because it is the only one that was discontinued a few years after the acquisition of Amazon.

IV. METHOD APPLIED TO THE DEVELOPMENT IN THE FUTURE

Using the method applied to the previous development leads to reasonable results. That is why the same method applied to the development in the future is described in Section 4.

In order to select a technology, a specific market is first selected into which Amazon could enter.

L.E.K. Consulting has published why Amazon could be seriously interested in health care. Decreasing health care cost would be a financial advantage for Amazon as a company. There are also a lot of processes in the health care markets that could be improved. The improvement of the health care could be one of the huge challenges that Jeff Bezos is looking for [21]. There has been already a report, that Amazon, Berkshire Hathaway and JPMorgan Chase are working together to decrease spending in the health care sector. One objective is the decreasing of health care expenses of the families of their employees [22].

Furthermore, people in the health industry speculate that Amazon could expand the offers in this sector [23]. Due to these reasons, a company in the healthcare industry is selected for this analysis.

The focus of the analysis lies on a digital physiotherapy of the company Sword Health, which enables a physiotherapy service at the home of the customer [24]. In Figure 4, the possible future technology is shown in red and

a similar technology of a competitor is symbolized by a blue circle.

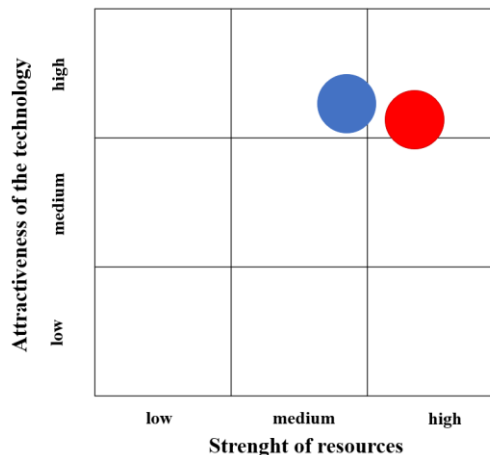


Figure 4. Technology-portfolio of a possible technology (adapted from [7][14])

Both technologies can be found in the investment area, but the position of the chosen technology is marginally better. Based on these results it is assumed in the following sections that the chosen technology might be an alternative in the future. Amazon could perhaps acquire the company that owns the chosen technology. That is why the acquisition of Sword Health might be a possible alternative.

V. INFLUENCE ON THE DIGITAL ECOSYSTEM

The company Amazon has started as an online bookstore [25]. That is the reason, why Amazon’s digital ecosystems, in the beginning, consisted probably of content like books, services like delivering service, software, and hardware that supported the trading. By integrating the technologies already considered, Amazon’s digital ecosystem has become more complex in hardware, software, content and services.

The acquisitions of the company, which offers the online physiotherapy and afterwards the integration of the technology, could extend the digital ecosystem of Amazon. In this context, it is important to understand in which way the technologies were integrated into Amazon’s digital ecosystem. It should also be explained how the digital ecosystem could change in the future.

The Kiva Systems robots for example really have been used by Amazon since 2014. This leads to a reduction in costs of the warehouse processes of the company [26]. Kiva combined hardware and software to improve the warehouse processes [27]. Since Amazon already uses Kiva technology, it is expected that the hardware and software of Kiva extend Amazon’s digital ecosystem.

Christina Farr describes in an article in which way Amazon could offer health care services. It may be possible for customers to describe their symptoms to a doctor through Alexa. If necessary, the doctor can send tests to the

customer [23]. The company Sword Health that is according to this analysis a potential candidate for an acquisition could be integrated in Amazon's ecosystem in a similar way.

Sword Health offers digital physiotherapy. Sensors allow physiotherapists to monitor and adjust the therapy [24]. This service, the software and the associated hardware could be integrated into Amazon's digital ecosystem, e.g. through Alexa.

## VI. DISCUSSION

The results of this analysis are not binding and should be viewed as recommendations for actions, suggestions or trends, rather than general rules. The inclusion of more factors or other methods might generate different results. For example, a lot more factors than strength of resources and attractiveness of technology influence acquisition processes. In this specific context the determination leads to comprehensible results.

The appropriateness of this method should be proved with further analysis. Furthermore, the preparation of this work is based on a difficult data situation, because technologies are classified that can only be viewed from an external perspective in this paper. The determination of resource strength and technology attractiveness is based on the answers to certain questions. The answers are consisting of values between zero to four. The determination of the values on the basis of the data could be carried out in further work by different persons to prove whether similar results are obtained. The analysis could also be carried out with more technologies, because other results might be generated.

It could be proved in further investigations if the technology-portfolio according to Pfeiffer et al. [7] is a viable method in this context. It is also important to examine if other methods and data lead to different results or trends.

## VII. CONCLUSION

The technology-portfolio according to Pfeiffer et al. [7] combined with other criteria and modified was used to evaluate the development of Amazon. In this paper companies with different acquisition prices and state of success were examined to create a meaningful cross section. Because the long-term successful technologies were positioned in the investment area of the technology-portfolio, the same method is used to forecast the future development of Amazon's expansion. A technology in the health industry was found that is also located at the investment area of the portfolio. The health industry was chosen for several reasons, for example because Amazon has already started activities in this area. The company Sword Health that offers a digital physiotherapy could therefore represent a possible acquisition alternative. For this reason, the technology of Sword Health was positioned in the matrix. The company is assumed as an acquisition alternative, because it is positioned in the investment area of

the matrix. The integration of new technologies like the possible alternative could expand the digital ecosystem of Amazon by extending software, hardware, content, and services. The integration of the Sword Health Services in the digital ecosystem of Amazon through Alexa could be a possible alternative in the future. The basis of these results is the use of a method from the field of investment decisions and further criteria with the aim of developing a future prognosis of the digital ecosystem of Amazon. The method leads to reasonable results, since the technologies acquired by Amazon, which have been integrated into the ecosystem in the long term, are positioned in the investment in this analysis. Expanding the sources and technologies that are used during the positioning process could improve the outcome. The number of people carrying out the analysis influences the results and has also potential for improvement.

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