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How to Move from Agile to Agility in Software Organizations

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Abstract: Agility adoption in software development organizations is considered a strong solution to managing a rapidly changing, uncertain, and unsteady workplace. Especially, as the objective of Agility is to control changes that may happen. So, moving from Agile to Agility increases the organizations' ability in swiftly and effectively react to unexpected variations in market requests. Agile refers to a mindset emphasizing teamwork, frequent value delivery, and the ability to deal with functional changes. The distinction between Agile and Agility needs to be understood in order to prevent misunderstandings, because Agility is recognized as one of the most important attributes of an organization against market turbulence. Through systematic mapping, this research explores the transition from Agile to Agility in software development companies. Systematic mapping is a technique for gathering, collating, and presenting research evidence. Eight research questions were identified, and to provide answers to these questions, several research papers have been explored in electronic databases. Eventually, 33 research papers were inspected, and answers to all research questions were provided. The results that have been achieved by this research proved that Agile and Agility differ in terms of definitions, attributes, numbers of dimensions, and the dimensions themselves.

كيفية الانتقال من Agile إلى Agility في مؤسسات البرمجيات

الكلمات المفتاحية :
Agile , Agility ، نموذج . أبعاد

المستخلص : يعتبر اعتماد Agility في مؤسسات تطوير البرمجيات الحل المناسب لإدارة التغيرات السريعة والغير مستقرة في مكان العمل خصوصا أن الهدف من Agility هو السيطرة على التغيرات التي يمكن أن تحدث. لذلك فإن الانتقال من Agile الى Agility يزيد من قدرة المؤسسات على الاستجابة السريعة والفعالة للتغيرات المفاجئة في متطلبات السوق. يشير Agile إلى طريقة التفكير التي تشجع على العمل الجماعي، و التسليم المتكرر، والقدرة على التعامل مع التغييرات الوظيفية. يجب فهم الفرق الجوهري بين Agile و Agility لإزالة أي لبس بينهما، لأن Agility معترف بها كواحدة من أهم سمات التنظيم في مواجهة اضطرابات السوق باستخدام الخرائط البحثية. يستكشف هذا البحث الانتقال من Agile إلى Agility في شركات تطوير البرمجيات. يعد رسم الخرائط المنهجية أسلوبًا لجمع الأدلة البحثية ومقارنتها وعرضها. تم تحديد ثمانية أسئلة بحثية، ولإيجاد إجابات عن هذه الأسئلة تم التحري وإجراء دراسة أولية في عدة أوراق بحثية تم نشرها في قواعد بيانات إلكترونية. في نهاية المطاف، تم فحص 33 ورقة علمية وتقديم إجابات عن جميع أسئلة البحث. اثبتت النتائج التي تم تحقيقها من خلال هذا البحث أن Agile و Agility تختلفان من حيث التعريفات، السمات ،عدد أبعاد كل منهما، بل ان لكل منهما أبعاد مختلفة عن الآخر.

INTRODUCTION

Agile associations implant a common objective and utilize new information to give choice privileges to the groups nearest to the data. In addition, Agile associations can preferably merge speed and adaptability with steadiness and effectiveness. So Agile development has taken broad steps somewhat recently, significantly further developing programming delivery and establishing more acceptable workplaces in many associations (Highsmith, 2013). These days, companies work in an exceptionally tempestuous climate adapting to a heightened speed of progress.

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Changes in business climate and doubt have entered administration studies and exploration for quite a while (Sherehiy et al., 2007). How to deal with the acceleration to adapt to expanding dynamism and disturbance of the workplace has been the main determinant of an association's prosperity or lack of success for a few decades. These aggressive and stressful conditions power companies to combine new business esteem, increment functional proficiency, and recognize and promptly react to actual organizational dangers. In reality, continuing with process association continues to be a struggle, as it requests the high ability of quick adaptation (Triaa et al., 2016). However, numerous academics and counselors have been looking for fruitful ways to assist companies to succeed in this quickly changing, doubtful, and unstable workplace. One of the best and most current methods of continuity and achievement of organizations is Agility, considered an unavoidable aspect of the present forward-looking companies. The objective of Agility is to dominate changes that may happen. Throughout the most recent twenty years, corporates have concentrated on developing the Agility of their business processes over two aspects: organizational and technological levels (Triaa et al., 2016).

Agility is identified as one of the most significant attributes of an organization in lasting against market turbulence. The idea was first presented by the specialists of the Iacocca organization of Lehigh University (USA) in the mid-1990s and got significant consideration from that point forward. (Bottani, 2009; Sherehiy et al., 2007; Yusuf et al., 1999). Agility is characterized as the capacity of associations to react powerfully and swiftly to sudden variations in market requests (Bottani, 2009; Harraf et al., 2015). Such a reaction is directed to satisfying diverse client needs relating to item specification, value, quality, amount, and delivery (Lyytinen & Rose, 2005).

Organizational Agility is firmly obligated to notions of adaptability and elasticity and these concepts are sometimes interchangeably utilized to signify the endeavors made by an association for dealing with dynamic and unpredictable changes in the market. In other words, adaptability and flexibility comprise two principle attributes crucial for the evolution of associations toward accomplishing Agility. The most significant level of development is reflected in the type of organizational Agility, which contains the two ideas of adaptability and flexibility (Sherehiy et al., 2007).

In the way to illustrate the difference between Agile and Agility (Park & Cho, 2022) explained that the Agile methodology is not dependent on academic theories, but rather, it is a result of how different technologies and tools are designed, used, and organized in the software development business. When it comes to the creation of competitive behavior and chances for innovation, Agility is the capacity of an organization to react rapidly and effectively to changes in the market, supply, and demand. Innovation is one aspect of organizational performance that Agility is known to enhance. Moving from Agile to Agility increases the ability of organizations to react effectively and swiftly to surprising variations in market requests. Business organizations need to adopt Agility to deal with unexpected changes in the market. Still, some organizations may have doubts about adopting Agility. For this reason, a systematic study was carried out to answer some questions pertaining to Agile and Agility movement. This systematic study attempts to evaluate, combine, and present the current finding. The structure of this paper is introduced as follows: Section II illustrates related research; Section III presents the research method; Section IV reports the results of the study; Section V contains the discussion; Section VI contains threats to validity; Section VII holds the conclusion, limitations, and future work.

RELATED WORKS

Businesses now run in a worldwide and speedily changing environment. They have to respond to new chances, changing economic conditions, and the emergence of vying services. As software is used in practically all business operations, new software is produced swiftly to take advantage of new opportunities and adapt to competition pressure. These requirements confirm the need to use Agile software, were Agile methods are incremental development methods and based on iterative delivery of software to customers in which the increments are short, and new system releases are routinely generated and made available to clients every two or three weeks. Customers are involved in the development process to obtain quick feedback on changing requirements. They minimize documentation by using informal communication rather than formal meetings with written documents (Sommerville, 2015).

Agile is primarily intended to serve dynamic and small team sizes, which are typically collocated in one location. These characteristics make Agile methodologies suitable for use in managing small and medium-sized enterprises (SMEs), where the number of members is limited, and the nature of their projects is typically dynamic and flexible (Bin-Hezam et al., 2018). However, with Agile software development, teams can quickly adapt to changes in requirements without affecting release dates. Not only that, but it also aids in the reduction of technical debt, the improvement of customer satisfaction, and the delivery of a higher-quality product. Due to rapid changes in business organizations as well as the need to respond to these changes, the trend towards "Agility" has become important to keep pace with this evolution. The attributes of Agile supported some business companies and factories to apply Agility in their work.

The idea of adjusting to unanticipated changes has led to the evolution of some concepts in business strategies and is referred to as the concept of Agility. Agility is quickly becoming a key business driver for all organizations, as well as a critical factor in a company's ability to survive and thrive in uncertain and volatile markets (Ganguly et al., 2009). Many studies have been conducted regarding Agile development, Agility measurement, and the effectiveness of Agile methods (Gandomani & Nafchi, 2014). But there are not many studies about the transition from Agile to Agility.

"Agile" does not equate to "Agility". Following the Agile manifesto in small projects can lead to Agility (VanderMeer, 2008).

Customer and employee satisfaction is the goal of an Agile enterprise. An enterprise essentially owns a set of capacities that allow it to respond appropriately to changes in its business environment. However, the business conditions in which many companies find themselves are characterized by volatile and irregular demand due to the growing urgency to pursue Agility.

Agility can thus be defined as an enterprise's ability to respond quickly to changes in business and customer demands. To be truly Agile, a company should have a number of distinct Agile enablers (Dahmardeh & Banihashemi, 2010).

A conceptual model was proposed by (Dahmardeh & Banihashemi, 2010; Zhang & Sharifi, 2000) for implementing Agility (as Figure 1 shows). It consists of three major stages: 1. Determining a company's Agility needs and current Agility level; 2. Determining the Agility functionalities required for the company to become Agile; 3. Identifying business practices and tools that could bring about recognized capabilities for the company. This model improves the fact that companies which need to achieve Agility must be Agile.

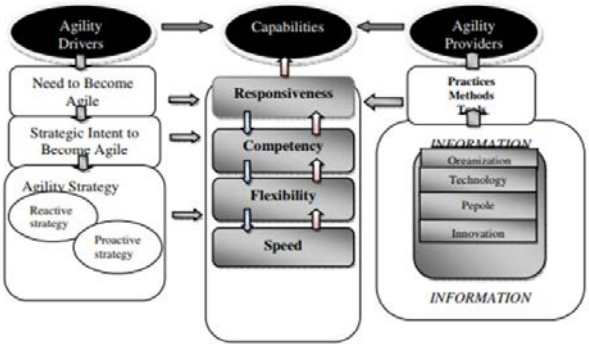

Figure: (1). Conceptual model for implementing Agility (Zhang and Sharifi, 2000)

Many software engineering researchers have focused on measuring the Agility of software companies. Although a few Agility assessment models have been proposed, they have significant drawbacks, such as being inconsistent with the Agile approach, having less flexibility, having limited scope and application, and so on. (Gandomani & Nafchi, 2014) proposed a model in their paper that has none of the disadvantages of the previous models. To create an assessment model, they used 44 Agile practices and their values in achieving Agility in software companies. The proposed model can simply compute a company's Agility based on the practices that the company has adopted.

In terms of business management and cultural lenses, (Karvonen et al., 2018) introduced the definition of enterprise Agility for analyzing large-scale Agile transformation. They summarized their findings, stating that there are numerous proportions associated with enterprise Agility, as well as numerous ways to transform. Agile transformation may focus on operational, strategic, or cultural aspects of Agility; however, holistic transformation to enterprise Agility requires a sophisticated and unique interplay of all of these elements. They addressed contemporary challenges associated with a large organization's transformation to 'enterprise Agility' in the higher education domain. Enterprise Agility transformation is difficult because it necessitates the application of numerous considerations at the same time.

The author of (Sidky, 2017) presented a chapter to introduce a transformation approach for achieving sustainable organizational Agility. He presents the organization's ecosystem, which plays a key role in the culture of an organization and subsequently in its Agility. Next, a couple of common Agile transformation approaches were explored while highlighting sustainability challenges with both. Then, the Culture-led Transformation was presented, which focuses on changing organizational habits in a staged approach leading to sustainable changes.

The Agile Manifesto and Agile Principles are usually used to identify "Agile" and "Agility". But, to understand how they can scale Agile Software Development and achieve Agility, they took a look at the available definitions, especially from sources that look at Agility from a viewpoint that it is more than just one team. They attributed that to the different perceptions that people have of "Agile" and "Agility" making deployment of Agile Methods very hard. The conclusion of this study showed that people really do mean different things when they are talking about Agile Software Development (Laanti et al., 2013).

MATERIALS AND METHODS

RESEARCH QUESTIONS

RQ1. Which journals and conferences are more focused on Agile and Agility?
RQ2. What is the yearly distribution of articles?
RQ3. What is the country-wise distribution?
RQ4. How many researchers have a long-term interest in Agile and Agility?
RQ5. What are the attributes of Agility?
RQ6. Is Agile and Agility the same?
RQ7. Do we need a practical model to achieve organizational Agility?
RQ8. What are the dimensions that each of Agile and Agility have?

RESEARCH METHODOLOGY

A systematic mapping was used in this paper to determine the kind and the extent of the obtainable research papers to answer the research questions as it is shown in figure 2.

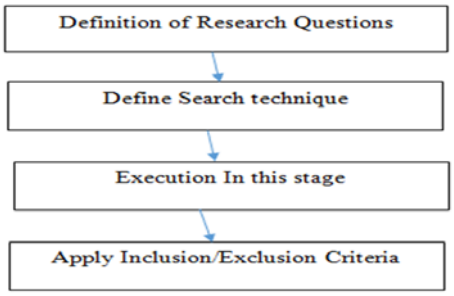

Figure: (2). Research Methodology

1. Definition of Research Questions

Eight research questions (RQs) were set up to decide the premier researches that investigate if Agile is the same as Agility which are:

RQ1. Which journals and conferences are more focused on Agile and Agility?
RQ2. What is the yearly distribution of articles?
RQ3. What is the country-wise distribution?
RQ4. How many researchers have a long-term interest in Agile and Agility?
RQ5. What are the attributes of Agility?
RQ6. Is Agile and Agility the same?
RQ7. Do we need a practical model to achieve organizational Agility?
RQ8. What are the dimensions that each of Agile and Agility have?

2. Define Search technique

A number of keywords and their equivalent words were identified to look for pertinent papers in electronic databases: "Agile" and "Agility". A logical operator AND was utilized to make a combination of the essential terms. The timeframe was set between 1999 and 2021 when this SM was conducted. During this research, five electronic databases were chosen, as they are the most well-known scientific search engines for article locating and publication. The chosen databases as displayed in table 1.

Table: (1). Selected databases.

Source	Location
IEEE xplore	http://ieeexplore.ieee.org
ACM digital	http://portal.acm.org
Springer ink	http://www.springer.com
Science direct	https://www.sciencedirect.com
Google scholar	https://scholar.google.com
Research gate	https://www.researchgate.net

3. Execution In this stage

Different electronic databases were looked through, utilizing the search string. At first, around 149 preliminary studies on Agile and Agility were observed.

4. Apply Inclusion/Exclusion Criteria

As a rule, each title, abstract, and conclusion were investigated to distinguish articles that focus on Agile and Agility. Some studies were excluded based on the accompanying rules:

- Studies not presented in English.
- Studies not accessible in full-text.
- Studies not related to the subject
- Literature review studies

The number of papers initially acquired and later included in this research concentrates after applying the exclusion criteria can be shown in table 2.

Table: (2). Articles related to Agile and Agility

Database	Obtained	Included
IEEE xplore	30	10
ACM digital	43	4
Springer ink	32	10
Science direct	12	3
Google scholar	19	3
Research gate	13	3
Total	**149**	**33**

RESULTS

RQ1. *Which journals and conferences are more focused on Agile and Agility?*

The most studied papers in the current research are conference papers at 52%. The remaining papers are journal publications at 39%, and others (Books & Workshops) at 9.1%, as displayed in figure 3.

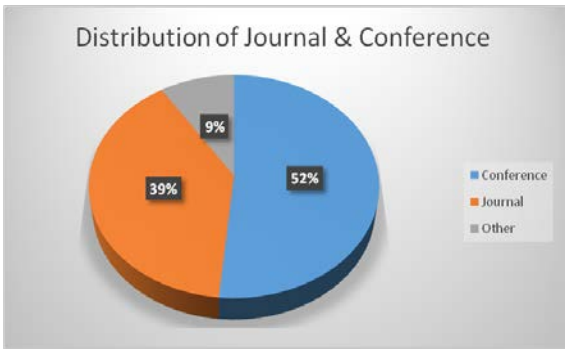

Figure (3). Distribution of Journal & Conference

There are three papers published in the same conference, which is the ***International Conference on Agile Software Development*** conference**,** and the other three conferences published two papers. These conferences are: ***Conference on Extreme Programming and Agile Methods***, ***Agile Conference***, and ***International Conference on Software Engineering***. The rest of the conferences published ***one*** paper, as shown in Table 3.

Table: (3). Conference focused on Agile and Agility

Conference Name	Number of Papers
International Conference on Agile Software Development	3
International Conference on Software Engineering	2
Agile Conference	2
Conference on Extreme Programming and Agile Methods	2
European Conference on Software Process Improvement	1
International Conference on System Science, Engineering Design and Manufacturing Informatization	1
IEEE International Conference on Management of Innovation and Technology	1
Euromicro Conference on Software Engineering and Advanced Applications (SEAA)	1
Malaysian Software Engineering Conference (MySEC)	1
Proceedings of ISSM2000. Ninth International Symposium on Semiconductor Manufacturing	1
International Working Conference on Transfer and Diffusion of IT	1
IFIP International Working Conference on Business Agility and Information Technology Diffusion	1
AIS SIGSAND Symposium on Research in Systems Analysis and Design	1

In terms of journal publications, there are about 2 different papers published in the same journal which is IEEE Software journal. The rest of the journals published one paper related to the study topic as shown in Table 4.

Table: (4). Journals focused on Agile and Agility

Journals Name	Number of Papers
IEEE Software	2
IEEE Transactions on Engineering Management	1
Technological Forecasting and Social Change	1
Public Relations Review	1
Production Economics	1
European Journal of Economics, Finance and Administrative Sciences	1
Review of Managerial Science	1
Information Systems Frontiers	1
Research in Engineering Design	1
Technovation	1
Research Journal of Applied Sciences, Engineering and Technology	1
Academy of Management Annual Meeting Proceedings	1

RQ2*. What is the yearly distribution of articles?*

The papers included in this study were published between 1999 and 2021. The highest number of papers was published in 2018 at 4% in comparison with other years, as shown in figure 4. In the meantime, the most minimal number in this regard, was between 2001- 2003 and 2011-2012.

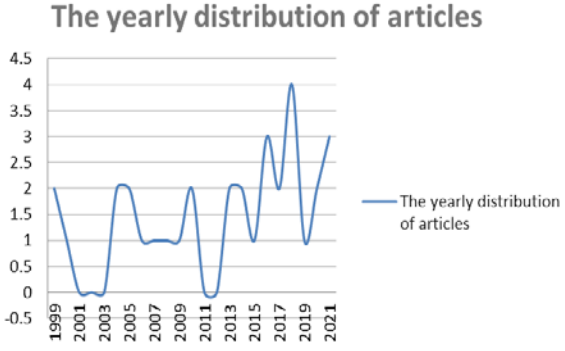

Figure. (4): Number of papers per year

RQ3*. What is the country-wise distribution?*

The primary authors of the papers included in the current study are from thirteen distinct nations, as displayed in table 5. The vast majority of the lead authors are from the U.S.A and Portugal, followed by the United Kingdom as nations having the highest number of authors in this field of research.

Table: (5). Country wise distribution

Country	Number of Journals and Conference Publications
USA	6
Portugal	2
United Kingdom	1
Canada	1
India	1
Ireland	1
China	1
Singapore	1
Austria	1
Malaysia	1
Japan	1
Argentina	1

RQ4*. How many researchers have a long-term interest in Agile and Agility?*

Long-term researchers are important, as they have a greater chance to follow the area of study in more depth, enhancing their results.

RQ5*.What are the attributes of Agility?*

In attempting to define the main attributes of Agility, there was an initial analysis of Agile organizations and unification of exploration on Agility that has prompted ten tentative attributes to serve as principal attributes of Agility. These ten attributes are: a culture of innovation, empowerment, tolerance for ambiguity, vision, change management, organizational communication, market analysis and response, operations management, structural fluidity, and the development of a learning organization (Harraf et al., 2015).

RQ6*. Is Agile and Agility the same?*

Agility can be identified in software development as the capability of a software developer to feel and respond to advanced technical and business chances to remain inventive and competitive in an unstable and rapidly changing business climate (Lyytinen & Rose, 2005). While Agile is a perspective that centers on cooperation, recurrent conveyance of value, and the capacity to manage functionality changes. It comprises rules, values, methods, and practices. At the end of the day, Agile is a number of tools and strategies that assist us with accomplishing Agility (Laanti et al. 2013)**.**

RQ7. Do we need a practical model to achieve organizational Agility?

One of the primary integrated systems to accomplish Agility is presented by (Gunasekaran, 1998), which shows how the fundamental capabilities of Agile industrialization, for example, collaboration, worth- based pricing methodologies, investments in individuals and data, and organizational changes, ought to be confirmed and integrated with proper lithe empowering agents to evolve an adaptable association (Gunasekaran, 1998; Sharifi & Zhang, 2001; Zhang & Sharifi, 2000) evolved a 3-step method to implement Agility in industrialization associations, which ties Agility drivers (i.e., changes or tensions from the business climate that lead organizations to embrace the Agility model) to four fundamental Agile attributes, to be specific, responsiveness, capability, elasticity, and speed (Sharifi & Zhang, 2001; Zhang & Sharifi, 2000).

In addition, one of the studies that propose a technique to accomplish organizational Agility is led by (Bottani, 2009). The Author has evolved a model that links Agile attributes

to Agile enablers utilizing the quality function deployment (QFD) method and fuzzy logic (Bottani, 2009).

RQ8*.What are the dimensions that each of Agile and Agility have?*

Each of Agile and Agility has different numbers of dimensions and different dimensions. In Agile there are six dimensions which are: Organization, Talent, Technology enablers, Planning and performance management, Ways of working, and Risk and compliance (Siegel, 2020). While, there are four dimensions of business Agility which are: The degree of Agility, Research & development, Agility, Transformation Agility, and Operation Agility (Gagnon & Hadaya, 2018).

DISCUSSION

To obtain the research publications on the transformation from Agile to Agility, the study explores six electronic databases IEEE Xplore, ACM Digital, Springer, Science Direct, Google Scholar, and Research Gate. Initially, there were 149 research studies on Agile and Agility. However, only 33 research publications on the subject topic were retrieved. The title, abstract, and conclusion of each paper were examined to filter the results and acquire the publications that focused more on the research topic. A substantial number of publications were eliminated because they were not presented in English, were not publicly available as a full text, or were unrelated to the research subject (transformation from Agile to Agility). Following that, a spreadsheet was created to extract the properties related to the research questions. Generally, as can be seen from table 2, the study discovers that 60.6% of the results were accessed through IEEE Xplore and Springer, while the remaining papers were retrieved from the other databases. Figure 2 shows that about half of the articles examined in the present study (52%) are conference papers, while the (39%) are journal publications and the remainder are books and workshops at (9.1%).

Apparently, as shown in table 3, the (International Conference on Agile Software Development) is the most focused conference on transforming from Agile to Agility, with three conference papers published. Meanwhile, there are three conferences (International Conference on Software Engineering), (Agile Conference) and (Conference of Extreme Programming and Agile Methods), and each one of them published two papers related to the topic of research. IEEE, on the other hand, is the most focused in terms of publishing journal papers, where two research papers have been published in the research relating to transforming to Agility from Agile.

The study includes papers published between 1999 and 2021. It can be seen from Figure 3 that in the period 2016 - 2018, the number of published papers increased by 4% when compared to previous years. Meanwhile, the periods with the lowest numbers in this regard were 2001- 2003 and 2011-2012. Which means there was an increase. Interestingly, the great majority of the present study's lead authors are from the United States of America, 6 out of 18 authors, which can be seen in table 5. That is one-third of the lead authors all over the world. Despite the necessity of a long-term researcher with a comprehensive understanding of the field and its limitations, our research shows that there is no dedicated author in the field of Agile to Agility transition.

Following an initial analysis of Agile businesses and organizations as well as the consolidation of Agility research, the investigation resulted in ten tentative attributes to serve as the main attributes of Agility. These ten characteristics are: innovation culture, empowerment, ambiguity tolerance, vision, change management, organizational communication, market analysis and response, operations

management, structural fluidity, and the formation of a learning organization.

(VanderMeer, 2008) found that Agile is not equivalent to Agility while doing a detailed theory-based investigation of the "Agile manifesto" and developing the "Agility principle". In response to question 8, the finding shows that Agile and Agility differ in terms of the number of dimensions and the dimensions themselves. It has been found that: degree of Agility, research and development Agility, transformation Agility and operation Agility are the four dimensions of business Agility (Gagnon & Hadaya, 2018), while Agile has six dimensions which are: Organization, Talent, technology enabler, planning and performance management, ways of working, and risk and compliance (Siegel, 2020).

The study addressed the subject of whether or not a practical model for organizational Agility was required. It was shown that many studies suggest and evaluate practical models during their research. (Gunasekaran, 1998) presents one of the key integrated systems for achieving Agility. In addition, a three steps model for implementing Agility in industrialized organizations has been developed by (Gandomani & Nafchi, 2014; Sharifi & Zhang, 2001; Zhang & Sharifi, 2000) create an assessment model that can simply be used to compute a company's Agility based on 44 Agile practices and their values that have been implemented in the companies' software.

THREATS TO VALIDITY

The validity issues are fundamentally in the papers' picked cycle. Especially, the issue identified with the chance of losing relevant papers. To ensure the totality of our paper archive, the most known scholarly web indexes, including IEEE Xplore, Research gate, and so forth, are chosen. In addition, different mixes of the subject of interest and their equivalent words identified with Agile and Agility are utilized.

CONCLUSION, LIMITATIONS, AND FUTURE WORK

In recent years, the software development industry has seen a significant increase in the use of Agile methods. Almost all software companies claim to be ''Agile'' on some level and employ Agile practices in their software development processes. With globalization, technology, and outsourcing all contributing to uncertainty and unpredictability in all sectors, an organization's ability to adapt to unexpected change is critical to achieving and maintaining a competitive advantage. This concept of adapting to unforeseen changes has resulted in the evolution of one of the most recent concepts in business strategies, which is known as the concept of ''Agility''. As a result, transitioning from Agile to Agility improves an organization's ability to respond quickly and effectively to unexpected variants in business requests.

Our search shows there are no researchers who have a long-term interest in the transformation from Agile toward Agility. This, we believe, is due to the confusion that Agile and Agility are synonyms, which has been discussed in our research and we found that they are not. The findings clearly show that Agile and Agility differ in terms of definitions, attributes, number of dimensions, and the dimensions in themselves.

During the search process, the most popular electronic databases were searched (IEEE Xplore, ACM Digital, Springer, Science Direct, Google Scholar, and Research Gate). However, we might have missed some related papers published in these databases during the elimination process either because of the constraints imposed by some of them, such as the paper's full-text accessibility, or because they were not written in English . In terms of future work, examining the success and failure factors of adopting Agility in software

organizations would be interesting. As a result, these factors can be used to measure the success of software organizations that have adopted Agility. Also, further research needs to be done to know if Agility can work well with large organizations.

Duality of interest: The authors declare that they have no duality of interest associated with this manuscript.

Author contributions: Sumia Albera & Samia. Abdalhamid conceived & design of the study, starting with collected the data, then performed the analysis using analysis tools, and approval of the final version of the manuscript, Asma Abd-Aljalil Interpreted of data, drafted the manuscript/revising for important intellectual context and approval of the final version of the manuscript

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