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History will Repeat: Industry 4.0 Brought Lean, Agile, Resilience and Green

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ABSTRACT

According to reviews of a number of authoritative articles, which some of them were researched on a specific case and some of them were themselves the result of research on a large number of other articles, We were able to get an overview of the process of integrating information technology and industry .The integration that led to Industry 4.0 was the beginning of a leap forward. With library research on a number of cases and a group of authoritative research articles and reviews in Scopus journals, we were able to enumerate and fully explore many of the outcomes and achievements of the industry 4.0 , which we refer to as a leap .As a result, by considering all the dimensions of this leap and how it is advancing, as well as considering the latest technology in the world and the growing trend that information technology has undergone, we can be aware of the continuation of this leap and with a little argument about it We are talking about the not-too-distant future of industry and even human life (which is certainly quite influenced by these trends) so that we can be aware of this and analyze it.

Keywords: *Industry 4.0, Lean, Agile, Resileince, Green, Sustainable Development, Information Technology, Larg, artificial intelligence.*

INTRODUCTION

The manufacturing industry underwent changes in the 1970s, and these changes led to the entry of information technology into the industry[1] Information technology was accepted in the manufacturing industry and was given a special place, but the implementation of these changes and their stability took a while. The main change and final stability that led to the formation of the new concept called "Industry 4.0" took place in 2011. These events and the change of trends and the entry of information technology into the manufacturing industry were so good and took advantage of new and appropriate features that Germany used in its strategic plan for 2020. [2] This event opened the door for the manufacturing industry to leap in all aspects, especially in communication channels, tools, machines, and so on.[3] many research has been done in the field of Industry 4.0 (or in other words, the Fourth Industrial Revolution) which are available for study in many journals, conferences, seminars and symposiums. [4][5][6][7] Of course, some of these researches have reviewed a large number of written articles, sometimes each research contains 660 journal articles and 3,901 new articles or even more. [8]

The characteristics of the industry have always been important to a society and have a great impact on many different areas and issues [9], therefore The Fourth Industrial Revolution (Industry 4.0) gave rise to many new ideas in many fields. The field of information technology always has a very wide world and full of surprises, so its entry into different industries will bring these surprises into those industries. In fact, these changes can be described as stimuli or coercions that require changes in production, maintenance, training, and even a leap in theory and research that lead to the emergence of new concepts and definitions. We will review them. Of course, history has shown that changes has always seen many obstacles, especially that "Industry 4.0" has also had special Openness .information technology By entering any field, leads the focus and process towards quantitative cases with high accuracy and comprehensive review; according to this trait, many traditional cases which completely opposite in this direction, they did not agree with such changes, but Industry 4.0 was not without incentives. In any period of time,

there are many reasons and cases that can be examined to find that the entry of information technology into that field is very useful, even if it happens at the cost of many major changes in administrative and technical processes. Can bring us positive and extraordinary effects on the results.

RESEARCH METHODOLOGY

This study was conducted to investigate the general trend of the emergence of industry 4.0 and its effects on human life, and examines the approaches and concepts that have emerged from this evolution to understand the continuation of this path. The research was done by studying the cases and a group of research and review articles, as well as studying the results of previous studies and comparing the two with each other. Finally, it has expressed the salient features of each concept and approach and finally the different effects that each one has in different dimensions of human life.

The researches that have been used from their results have been selected by reviewing and validating the research method and how to obtain the results in this research. Also, with the connection between different topics, we have been able to observe the general course of this process.

Due to the rapid growth of technology and the constant change in the level of knowledge in all fields, the majority of research and selected cases have been done in the last ten years at most. Based on library research, it covers all industry-related topics 4.0 and examines it from all angles.

The reason for choosing this issue can be considered the comprehensive penetration of information technology into human life and the impact on human life; On the other hand, with the necessary knowledge about the continuation of this process, appropriate decisions can be made for the future of mankind.

Industry 4.0

One of the hallmarks of Industry 4.0 is its openness, which leads to results such as:

- Openness leads to better performance
- Leads to a greater understanding of barriers
- This feature motivate.

In addition, Industry 4.0 makes it possible to respond effectively to obstacles by identifying strengths and weaknesses that were not known in the past; As a result of this response, the necessary strategies have been developed to meet the needs [9] Beyond and more important than the effects and results of this transformation is the creation of approaches and change of attitudes; Approaches such as Lean, Agile, Resilience and Green.

Lean

Lean start from Toyota [10] and its extension from production lines to other parts of the company [11] and Eventually the creation of the concept of "lean company" [12] caused that over time, pure concepts in all sectors and according to the situation with different structure but with the same concept was created And implemented [13].Lean has five main principles on which it is based and pays special attention to it: " value", "pull" ," value stream" ," flow" and " perfection" [14]it called Lean house. Lean is always looking to remove waste and create value [15][16].

Lean implementation depends on many factors, from technical issues to cultural issues.[17] In the meantime, by examining the factors affecting implementation, the special importance of the position of senior manager can be reached. [18] [19] [20] Of course, the importance and influence of the senior manager can be both positive and negative [21][22].

Agile

Agile, like Lean, plays a vital role in enhancing the production process. Lean production examines duplicate and worthless processes, and Agile standardizes, optimizes, and automates development processes. Agility can also be mentioned as a key competitive factor because the Agile is designed to adapt to unpredictable changes and provide the ability to react quickly to the market.[23].Another result of Agile that has itself been affected by the changes in the 4.0 industry is digitalization, because with this technology , how to respond to sudden changes will be better, more accurate and timely; Digitization, which originates from the Entering of information technology, greatly affects and changes production. Therefore, a lot of research is currently being done to digitize factories.[24]On the other hand, many studies have been done on the relationship between electronic integration and agility (study of 303 business units of manufacturing organizations) and the existence of a relationship between them has been proven. Both Are proportionate in turn to respond to different requests and changes. Of course, the role of knowledge and process coordination mechanisms are undeniable in better understanding this integration and communication [25].

Resilience

Resilience means the ability to sustain oneself and adapt to adverse conditions. Always in any

time period and under any circumstances (taking into account the progress of science, the power of forecasting and updating machines, trends and How to do things) There is still the possibility of a series of unforeseen and unforeseen events. Therefore, resilience emerged to avoid such declines in the face of such events. To better understand this issue, we can describe the outbreak of the COVID-19 virus, which the world is struggling with. The effects of this virus on all production, maintenance, training, economic, etc. activities can be clearly seen. In such situations, the issue of resilience is raised and the importance of its position is reminded.

Of course, this resilience, which is one of the achievements related to industry 4.0, is not limited to companies and work-related issues, and it has reached all human issues, for example, one of the most important issues is the cities flood resilience[26]Or for another example, we can refer to the resistance of reconfigurable electronic assembly line under spatio-temporal disruptions. [27]In general, resilience is an important issue for survival.

Green

It has always been proven that lean implementation improves the situation, but this is not enough and there is a need to pay attention to other things as well.[28]With the all-round progress of science, human beings realized that they should pay special attention to their surroundings and not proceed without paying attention to their environment and surroundings. Green appeared so that human beings should pay attention to the environment along with all their affairs and be careful about their effects on environmental factors. Green By developing strategies for the organization, tries to consider the important issues and factors that affect the environment and aligns the forward trend of the organization with these issues so as not to damage the environment. Green is not only found in manufacturing industries[29] and now we can see Green's approach in other industries, for example, we can refer to green IT.[30] According to the positive results of paying attention to Green; This approach, with its general framework [31], removed obstacles to the implementation of green production methods

And expanded its framework in most areas and fields, For example, value chains could be reconstructed with this approach Or even SMEs were no exception [32][33].

The special importance and position that Green found for himself, was able to introduce a new approach and concept called "Sustainable Development", which has become one of the basic concepts in most countries and has been widely studied and researched.[34][35][36].

Result

Mankind has always tried to use its available resources and facilities in all directions and to the maximum. With the passage of time and the continuous growth of human beings, after a while, acombination of the said concepts was formed called **"LARG"** ; Larg(An integrated socio-technical system), which derives its name from the first letters of these four approaches(L:Lean – A:Agile – R:resilience – G:Green), simultaneously implemented the principles of all four concepts.[37]

If we want to explain, we can say that Lean focuses on quality, delivery and cost, Agile focuses on customer orientation and flexibility, Resilience focuses on knowledge and innovation and risks, and Green focuses on transportation and production issues and environmental issues.[38]

As a result, it can be said that research, growth of attitudes and integration of approaches create new approaches and concepts that always overshadow and perfect human life, a growth that is sometimes a huge leap like industry 4.0 And it persuades all attitudes and approaches to change, and these changes are so continuous and large that every particular area and focus in human life is directly or indirectly affected by it, for example, Green Remind us to pay attention to environmental areas and finally, by creating the concept of sustainable development, created this attitude for all aspects of human life and transmitted it to them. The issue of sustainability is one of the most important and widely addressed human issues today. [39][40] [41][42] And in all industries, even the construction industry has been developed. Or for another example we can find usage of Larg in supply chain management and creating a new model for it[43]Or in an example we say that it affects the performance of the supply chain[44][45]. Generally It is easy to understand how every small and big event in human life can change attitudes and create new currents and procedures, and finally change the whole set.

Conclusion and Recommendations

According to the study of the entry of information technology into the industry and the emergence of industry 4.0, it can be considered a leap, a leap that caused the birth of many new concepts and definitions in all industries and

areas. As mentioned, the achivments of this leap provide concepts such as Lean, Agile, Resilience, Green, Sustainable Development (which can be fully extended to any other industry and field), and the concept of Larg (Which was formed simultaneously due to the need for features of 4 separate approaches) or even in more recent research, we are seeing a new version of Larg Manufacturing integrated with IT to witness greater environmental, economic and operational benefits. [46]

But this is certainly not the end of Industry 4.0. With the research done and the progress of science, especially in the field of technology and information technology, we can reach important points that may mark another leap for the not-too-distant future. Advances in modern technology have been able to bring artificial intelligence to a good and acceptable position in the information technology industry. Companies in the 4.0 industry have implemented automation in some parts, but According to artificial intelligence and its process, what we can see in the world of information technology today is that we have to witness new, extraordinary and wonderful events. If we want to divide the passage of time into three general parts, we can divide them as follows:

- The pre-IT era
- The era of industry with IT (now)
- The arrival of artificial intelligence

The progress of human beings can be divided into these three parts to realize the greatness of artificial intelligence and the process that human beings have taken; With the future changes and transformations of human life, the power of artificial intelligence in industry and human life will be so enormous that it can completely overshadow the dimensions of life and even change human goals.

With what has been said, we can see how much and how much the introduction of information technology in the industry has changed our lives and what new and important concepts it has reminded or expressed to us and Also, by generalizing it to the introduction of artificial intelligence and the process that artificial intelligence is going through, it can be understood that after that happens, these changes will be bigger and stranger in nature.

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