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EDITORIAL

In the times like today where the World is still recovering after more than two years of covid pandemic, all fields of life are drastically affected. Although, in the beginning of pandemic, it looked scary to know that we might never recover from this, but humans know their way out of the trouble, which is why today we have very much recovered as well as developed and innovated through the tragedy.

The editorial board of IJ-TIM are delighted to introduce the second issue of the second volume to 2022 year of the "International Journal of Technology, Innovation and Management" (IJTIM). The IJTIM is published by Global Academic Forum on Technology, Innovation and Management (GAF-TIM). The IJTIM aims to bring out the best of quality manuscripts from the field of technology, computation, and information. IJTIM's focus is on research that brings out the best of technological world that is not only theoretical but is realistically practical.

The second issue of International Journal of Technology, Innovation and Management (TIM) of second volume presents six papers on technology and innovation. The theme of the issue shows how the mankind has developed its ways into technology to ease the troubles of life. There is gaming software that have helped into designing new marketing strategies for the products and for leisure purposes. Artificial intelligence is the answer to the questions that are arising in today's world. Starting from censor technology as we are now at meta-verse era.

This versatile range of articles being published in the second issue of 2022 is proof that IJTIM is aimed for high achievements. But the team of IJTIM is highly motivated to make sure that IJTIM achieves great results and reader and viewership. This can only be done, if the quality of articles is not being compromised at any cost.

IJTIM appreciates all the support that it is receiving from its members as well as from its readers.

Editors-in-Chief
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A DECK OF CARDS TO HELP TRACK DESIGN TRENDS TO ASSIST THE CREATION OF NEW PRODUCTS

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ABSTRACT

Innovation is the best cure for the survival of dying trends and their designs for new products. This paper looks for the answers on how the innovation can come handy especially for the creation of new products in the market. This is done through the analysis of weak and routine signals. A game based on the concept of Gin Rummy, is developed to recognize the weak and routine signals, and then working them into the favor of products. The game was introduced among groups of people, and they were taught the rules of the game. At the end of the game the players created a map that highlighted the major attributes of the products. the play help to identify shapes and trends, while the tool, in addition to stocking and graphically shaping the data, learns to recognize shapes and improves its possibilities of automating a monitoring in this way.

Keywords: Deck of cards, Rummy of attributes, Game, Design trends, New products

1. INTRODUCTION

The more competition becomes important, the more companies need to innovate in order to survive. But to innovate, they must be able to do so in terms of production and technologies, but also in terms of competitive positioning. This requires the ability to be creative, adaptable, communicative, and strategic intelligence. We will focus here on the latter capacity, which we believe is essential for anticipating product design changes and recognizing opportunities as well as threats related to possible innovations. From this point of view, the implementation of a knowledge acquisition involves the search, identification, and monitoring of signals that will allow us to recognize the appearance of such and such a danger, such and such a possibility of development, such and such a new need, such and such a new trend, etc. [1][2]. As for monitoring current or potential innovations resulting from continuous or incremental improvement development, it seems to us that monitoring them requires above all the implementation of "classic" monitoring techniques such as: reading the specialized press, visiting trade fairs, monitoring patent applications, observing

clients, etc. [3]. On the other hand, it seems to us that the search for and monitoring of opportunities and threats related to radically new innovations still pose many problems. This is why we propose to focus here on the search for and the identification of signals that allow us to identify manifestations or leads to disruptive innovations in product design [4]. To do this, we have chosen to position ourselves upstream of the innovation process, i.e. before the start of its diffusion. This means positioning ourselves at the level of creativity and research phase of the ideas that will be at the origin of the next disruptive innovations. We believe that at this level, the signals that can be associated with the appearance of these innovations can be of two kinds: weak signals [5] and routine signals [6].

In fact, we propose with this paper to contribute to the problem of identifying design trends for the design of a new product. One way to do this is to bring together a group of people who collect information and identify potential weak signals through trends that seem to emerge from various elements retained in the form of keywords, images, textures, etc [7]. The group will then be able to identify the most appropriate signals for the product design. This is the almost "traditional" approach of designers who use a variety of techniques to create trends or mood boards [8]. These approaches can integrate, as in the case of joint trend analysis, the crossing of certain elements which, through visualization and discussion about the result obtained, can lead to the emergence of other weak signals of product design [9][10]. However, in these cases, the signals identified, although always inspiring, remain weak signals that are inherently uncertain [11]. This is why we have searched for another method of anticipation of design transformation, at least from an aesthetic point of view, based on strong signals [12].

2. THEORETICAL FRAMEWORK

The method we present here links indicators to shapes and components identified on drawings or photographs. This method consists of two main parts. The first concerns the highlighting weak and routine signals. It requires a certain amount of well-targeted, indexed, and sorted data. In general, if this task cannot be automated, its implementation is quite tedious [13].

The second part is the formatting of the data via calculations and graphs from the sorting done during the previous step. Therefore, to make this process more dynamic and less tedious, the first part of the method takes the form of a data collection set [14]. This serious game was developed on the principle of Gin Rummy, the well known card game. It is in fact a kind of goal-oriented game that does not require the use of a very large number of people unlike models of the genre [15]. As an illustration of its potential, we use here an example based on the research of design indicators for the controllers of the main video game consoles between 1972 and 2017.

3. LITERATURE REVIEW

3.1 Innovation categories and knowledge acquisition

The notion of innovation can be perceived and understood in different ways. As a general rule, when the term is used, it is in reference to the work of J. Schumpeter at the beginning of the 20th century. This amounts to considering innovation on the basis of two characteristics. The first is based on the fact that innovation aims to develop a "new thing", which can be: a concept, a model, an object, an organization, a service, a system, etc. The second is based on the fact that innovation is a process of change [16]. The second reflects the fact that for there to be innovation, there must be acceptance of this "new thing" by the users who are associated with it and thought of as such [17]. From this point of view, it is the acceptance of the novelty that is more important than the novelty itself. The "new thing" may have already been proposed elsewhere, but its designers have not been able to implement it successfully, or the success of its implementation is already old and almost forgotten [18]. In the latter case, its revamping, if it takes place, will require some adaptation.

Thus, innovation must be understood as an interesting novelty and be perceived as such by the individuals to whom it is dedicated [19]. To be accepted, it must be associated with a dissemination process whose goal is to communicate it appropriately in order to gain acceptance [20]. Diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system [19]. This process is not without consequences, since its implementation provides clues to follow the transformation of a "new thing" into true innovation [18]. The study of this process and its variations has made it possible to identify different categories of innovation. Thus, innovations can now be classified into three categories: incremental innovations, radical innovations, and disruptive innovations. Incremental innovation, as its name suggests, refers to continuous research and improvement of the "new thing" under consideration; it follows current trends and is linked to many determinants that are mastered by the company in charge, such as market knowledge, the costs of changing suppliers, network effects and complementary assets market [21] In contrast, radical innovation involves truly new or largely rethought production [22]. In this way, the changes made may be a technological or architectural leap (the arrangement or constitution of the components of the rethought "thing"), which will produce a surprise that cannot be anticipated by monitoring the work leading to incremental improvement [23]. Finally, disruptive innovation (unfortunately also sometimes called radical innovation) refers to the use of alternative technologies to a technology considered as the "main" technology on which the new thing to be produced and assimilated to the innovation depends [24]. These substitute technologies are cheaper and less efficient than the main technology, but end up,

through improvements, corresponding to the needs of a significant part of the users of the main technology [25]. Disruptive innovations can also surprise industry-leading companies by first originating in new market footholds before reaching sector mainstream customers [26].

3.2 Knowledge acquisition and indicator signals for future innovations

From the point of view of strategic intelligence, the research and monitoring of signals related to innovation can be named in different ways: environmental intelligence, technological intelligence, product intelligence, trend intelligence, aesthetic intelligence, innovation intelligence, creative intelligence / creative watch, etc [27]. These watches have in common research, identification and monitoring of signals indicating potential or developing innovations and creations. This research can take place throughout the diffusion process to which the developed innovation is linked. After decades of information monitoring and competitive intelligence practices, we can assume that the identification and monitoring of continuous improvements is now a "classic" practice for organizations [28]. In general, these methods involve monitoring the reading of specialized literature, visits to trade shows, regular analysis of patent applications, monitoring of specialized websites and terms used, observation of the behavior of clients, analysis of social networks, etc. [29].

In terms of intelligence, the monitoring of current or potential innovations and their translation, in terms of opportunities and threats for the organization concerned, are associated with the notion of weak signal. This goes back at least to the work of Igor Ansoff [11] and consists of identifying signs of change that are fairly weak, but which are, in fact, early warning signs of important changes that will take place and could have significant consequences. There are several ways of approaching the search for these signals. One of them treats weak signals according to the pattern management approach. But in fact, in this case, the interpretation of the weak signals is very subjective or late (the signals gain in intensity now they are identified and are therefore quickly perceived as strong signals) [30]. Another solution is to develop scenarios of credible futures and to associate a human network to identify indicators (weak signals) correlated to such or such scenarios [31]. Some other solutions are the computation and semantic analysis of the appearance of new terms as a function of time [32] and the analysis of their co-occurrences in the form of matrix representations [33]. A different and complementary approach consists in discussing possible weak signals between the people concerned, which can take the form of a call to a Delphi group of experts [34][35] by integrating them into the monitoring process [31], predictive scenarios or[36] by translating the signals and their possible consequences with the help of visual elements [35].

Although these different means and methods allow the recognition of weak signals in incremental innovations, when looking at radical innovations, it may be necessary to complement

them. An interesting means can be the monitoring of the evolution of sectors related to the technology and production sectors of the organization concerned. In order to recognize these complementary weak signals, it is necessary to observe the sectors that influence the trends in the sector concerned by monitoring innovations. This consists of identifying where new trends come from in terms of sectors [37] and the socio-cultural environment [38]. The search for weak signals is then partly shifted to other sectors, but the methods remain the same. When the analysis of these signals takes place in relation to design issues, the trends can then be translated into the form of cartograms [39] or maps and post-its allowing sorting and discussion around weak signals [40]. However, while these monitoring methods seem to be mastered, monitoring innovations for disruptions poses the problem of identifying relevant influential sectors. In this respect, it shares the same problem as monitoring radical innovations: the collection and sorting of data in order to identify certain variations over time that can be interpreted as weak signals.

3.3 Routine signal

In addition to the weak signals, it is possible to look at some stronger signals, but which are generally not or only slightly taken into account. These are the routine signals. In fact, these signals reflect the progressive evolution of trends and innovations, especially with regard to their stagnation in terms of patterns. Routine signals should warn about trends that no longer surprise anyone in their field [6]. One of the advantages of these signals is that once the effort is made to look for them, they are much easier to spot than weak signals. In contrast to weak signals, the questioning that accompanies them is based on proven predictions that can be identified in reverse to highlight certain elements or decisions that are too predictable. Once identified as weak signals, they express evolutionary and decision-making constants which, like weak signals, can be translated into threats or opportunities for the organization concerned. For example, if the sale of a product in a particular line always follows the same process and is made under roughly the same conditions, there is an opportunity to do things differently and thus surprise other market players. If nothing is done, one player will end up taking the initiative for this type of change.

We can cite a few known examples that have impacted a market following an important change in practices or product design: Nintendo with the Wii, Nestlé and the Nespresso, Dyson and its bagless vacuum cleaner, RedBull and the energy drink for the general public, and so on. Very often, signals of routines can be indicators of risks or opportunities for implementing a Blue Ocean strategy. This is a strategy of using other attributes and targeting other customers to ensure significant development when a market begins to become saturated [41]. The fact that entry into a market becomes very difficult and that the market is subject to a price war is an important indication of the need for a Blue Ocean Strategy for the players taking part in this price war. Weak

signals will therefore make it possible to identify the fact that a market tends to become saturated and routine signals will also make it possible to identify a certain number of constant attributes on which most players no longer innovate or only innovate in an incremental and therefore relatively predictable manner [14].

3.4 Research Gap and Problem Statement

The recognition of certain routine signals allows questioning the existence of particular weak signals and vice versa. To search for routine signals, it is simply necessary to identify redundancies over time as well as repeating cycles. In the field of design, the detection of these redundancies and cycles can be done by image analysis [41]. However, this usually means identifying and distinguishing attributes and shapes manually, which is very time-consuming. Recently, however, solutions have been developed to solve data acquisition problems in order to index images more efficiently. These new solutions use gaming.

3.5 Hypothesis

H_{O1}: Routine signals do not warn about trends that no longer surprise anyone in their field.

H_{O2}: Gamification is not transforming the way companies do market research.

4. RESEARCH METHODOLOGY

In recent years, when the usual data collection techniques reach their limits, a new solution can be considered: the development of a game with a purpose (GWAP). In fact, these are "games through which the playful activity makes it possible to collect data or to solve problems that are too complex, or too costly in terms of human and material resources to be solved by machines" [42]. These "games" are also associated with the recent trend of gamification [43][44][45][46]. To speak of gamification means to report a transformation of a task, an environment, or a tool in order to make it a bit playful and more fun to use or create by exploiting design principles from the gaming domain [47]. Gamification is transforming the way companies can approach many tasks including data collection, business intelligence or market research [48] or to involve the user in the idea generation process [49]. Thus, gamification, serious games and GWAP could play an important role in a knowledge management process [49][50] including knowledge acquisition and knowledge creation step. The contributions of gamification are not insignificant. Some works, notably [51], have shown that gamification improves the quality of generated ideas in terms of fluency, flexibility and originality, and revealed significant differences with tests without gamification. GWAPs are thus a way to stimulate more people to solve a previously tedious task. Thus, the game is an interesting solution to collect data. Because, if the game is well done, it focuses the attention of its participants. In fact, it seems that crowdsourcing exhibits a strong dependence on attention [52].

4.1 Research model

Currently, it seems that the greatest success among gamification and GWAPs is the Foldit software [42]. It was originally software for simulating the folding of molecules in three dimensions and has been redesigned in the manner of a casual game (a small occasional video game of which Candy Crush Saga is one of the best-known representatives). The objective of this software gamification was to discover realistic bending configurations of molecules from the point of view of maintaining energy bonds and which would prevent viruses such as AIDS from attaching themselves to the molecules concerned. Exploration by computer simulations alone did not give convincing results, so the idea of a bending game proposed to a very large number of people was developed. Foldit was proposed as a puzzle game to a crowd of players in a crowdsourcing perspective [53]. With this serious game, which is still available, protein folding problems are presented, one by one and in order of increasing difficulty, to people who wish to take up the challenge. As in the majority of current casual games, sound effects accompany the player's configurations, who receives badges as a reward in addition to the display of his or her score, which he or she can post on social networks [54]. Once a certain level is reached, Foldit offers a folding feature whose solution is unknown to everyone but can be verified with the software. After several tens of thousands of people have played the Foldit game, one of them understood through gaming experience how to solve the final problem whose solution was unknown. The solution was found within a few weeks of playing the game when years of "classic" research had failed [55].

Foldit is not the only success story of gambling or goal-oriented gambling (GWAP), but its success has inspired many people to try to solve problems through gambling. Thus, since the emergence of GWAP and even more so since Foldit's success, there have been a significant number of relative data acquisition successes through gaming. Among these, there are many games whose objective is to have relevant words for indexing or labeling images [46][54][56]. In the vast majority of these games, including the representative Google Image Labeler developed by the father of GWAP Luis Von Ahn [57], two players try to find the keywords used by another player to define an image. If a player finds a keyword already referenced, he scores points. In order to work well, these games require a large number of indexing players, which constrains their design. However, from a strategic intelligence perspective, we found it difficult to call upon a very large number of players, since discretion is required [58]. Therefore, our objective in designing a game associated with a monitoring system was limited to the motivation of a few dozen people, which corresponds to people that can be solicited within a company or a sufficiently small group that can, if necessary, sign an explicit confidentiality clause.

This is why, in order to mark, in particular, this difference with gamification and GWAP, we

have preferred to use the term disengagement. This is a development process that works in contrast to gamification. With gamification, it is a question of imagining how tools, tasks, or environments can be transformed using elements that make video games a success [59]. With the disengagement approach, the reasoning is reversed. First, of course, we identify a problem and try to understand it (in our case, it is a need for data acquisition). Then, we look for a game that, a priori, has the potential to solve the problem. Once we have found the game, we then imagine how to transform it into a tool to solve the problem. In order to do this, the chosen game must therefore have characteristics that correspond to the needs of visualization, sorting, knowledge sharing, etc., which would make it possible to solve the problem under consideration. The GWAPs can be developed based on existing games, including board games or card games [60].

As previously mentioned with the Google Image Labeler, indexing images using a form of GWAP is not new. From the point of view of designing a set of cards dedicated to this purpose, previous experiences are a little more rare [53][61], but some can be found, some of which can be associated with a monitoring system [62]. However, we have not found any case of GWAP intended for a design trend monitoring. This is for us the main originality of our proposal completed by the fact that it does not require to solicit a large number of people which makes it a discreet monitoring solution [63].

4.2 Data collection

As mentioned above, our work focuses on highlighting signals related to product design. The aim is to solve a problem of data and information acquisition concerning the shape of objects from image observation. As far as our application case is concerned, we already had a corpus of about fifty images showing as many "standard" controllers (i.e. supplied with the console in its most basic packaging) of video game consoles between 1972 and 2017. Our objective is to highlight several design routines before 2017, combined with a gradual reduction in the number of players on the market. Our hypothesis considers that these routines and market saturation are at the origin of the introduction of the Wii Nunchuk controller since Nintendo's CEO has himself confirmed the implementation of a Blue Ocean strategy for the development of this console [64]. Similarly, we suppose that the update in terms of controller design for the Playstation (3 and 4) consoles (PS move system), as well as the proximity of the Wii U and Nintendo Switch controllers can also be easily deduced with this solution [65].

4.3 Research methodology

A possible solution to highlight weak and routine design signals of these controllers was to establish a list of questions in order to have a description of their shape and visible components (for example the number of buttons and their positioning). However, this solution was very tedious and

could quickly reach its limits in terms of the time spent describing the images. This task is not very fun and therefore the volunteers were hard to find and convince despite the design sector involved. That's why we looked for an alternative solution based on games. We needed a quick and simple game that would be suitable to make this image description task more user-friendly. So, we started by running the image description process that we needed:

Images of controllers are collected, referenced with the name of the console and the year it was released on the market.

Images are selected and formatted to present the controllers in an equivalent manner and with a similar size.

The images are analyzed and described from an orientation (main face, top/bottom of the joystick, right/left side) in the form of a list of attributes (example: the shell is made of a single block, it is crescent-shaped, it has a directional cross on the left side of the main face, etc.)

The referenced attributes are analyzed according to their number of appearances per year.

Potential weak signals and routine signals are identified and prepared for discussion with experts or sent directly as an alert.

Following the feedback from the discussion or alert, new image collections and analyses are made.

After reflection, we considered that certain stages of this process were part of a "classic" monitoring approach and did not pose any problem. The gambling research, therefore, did not focus on these steps. However, we felt it was important to associate the stage and problem of collecting data from image descriptions with gambling. This problem translated into the form of a game was like finding a game in which one tries to describe objects that one then tries to group together. This is how we identified Gin rummy as a game to be transformed. In this card game, each player tries to get rid of the cards in his or her hand by trying to establish sequences of at least three cards of different values, but of the same suit, or groups of cards of the same value, but of different suits [66]. A game consists of several rounds, in each of which players start with 10 cards in hand and must make groups of cards in order to be the first to run out of cards in hand. When this is the case, the other players then have pointed penalties depending on the cards they have left [67].

5. DATA ANALYSIS

We named the transformation of this game that would be dedicated to the highlighting of attributes from images: Rummy of attributes. It is a game for recognizing the commonalities between images offered on a support in the form of a map [68]. It requires a map development

phase before it can be played. Each of the cards made up presents a photograph of a joystick with the name of the corresponding console, its year of release, and a number identifying the card (figure 1).

Figure 1. Example of a card group with some common attributes.

5.1 Population sampling

The game itself is played according to the following rules:

- 2 to 8 players are brought together
- Each player receives, to start a round, 8 cards that form his hand and that he hides from the other players (each player ignores the cards that the others have in their hands, but can know the number of cards in their possession).
- The rest of the cards are placed on the table (face down) as a draw pile, next to which the first card of the draw pile is placed face up as the first card of the stockpile.
- The first player may either take the card face up from the stockpile and then turn over a new card to occupy that position, or take the top card from the deck.
- The same player may:
    - announce the constitution of a group of cards and place it in full view of everyone on the table (this group must include at least 4 cards with a common point corresponding to the name given to the group, for example 1 directional cross on the left ;
    - complete with at least 1 card, 1 or more groups of cards placed on the table;
    - draw from any group of cards already formed to form another group, provided that no group consisting of less than 4 cards remains on the table.
- Each player may create as many groups of cards as he can in his turn, provided that it takes less than one minute.

- The player scores 1 point per card added to an already created group or as many points as the new group he has created contains cards (the announcement of a new common point between the cards of the same group automatically changes the name of the group).
- Before finishing his turn, the player must make sure that he has less than 10 cards in his hand, if this is not the case, he must discard a card that he places on the discard pile.
- When a player has completed his turn, it is up to the next player to play (clockwise).
- If the draw pile is empty, the discard pile is taken, shuffled, and the deck is replaced to form a new draw pile by turning over the first card face up.
- The round ends when you have finished the draw pile and you have already redistributed the deck twice or once there is no more draw pile.
- The points scored by each player are added up by removing 1 point for each card still in his hand.
- The player with the highest point total wins the game (if the game is played in one set, but you can also decide the winner in 3 sets).

At the end of one play, the players have created a set of group names, which allows a set of descriptive attributes to stand out from the images.

6. DISCUSSION

6.1 Game integration in a monitoring system

Once the game has been designed and tested, its integration into the knowledge acquisition system is simple to achieve (figure 2). The game acts as a complementary source of information and data for human resources. It requires only an initial phase of image indexing followed by a phase of card creation, which itself ends with the printing and cutting of the cards. At the data collection level, we used post-its that are placed next to the groups created. It is, therefore, necessary to write the common attribute or name of the group of cards in a very legible way on the corresponding post-it [69]. The person designated as secretary notes, during the play, the names of the proposed groups on the post-its with the numbers of the corresponding cards [70]. At the end of one or more games, the knowledge acquisition specialist collects the post-its and may index all the attributes found in a database [71][72]. All that remains then is the problem of possible synonyms to manage before moving on to the processing and analysis of the collected data. Certain analyses will then allow the identification of cycles and constants in product design, i.e. signals of potential routines, or recent, slight changes, i.e. potential weak signals [20].

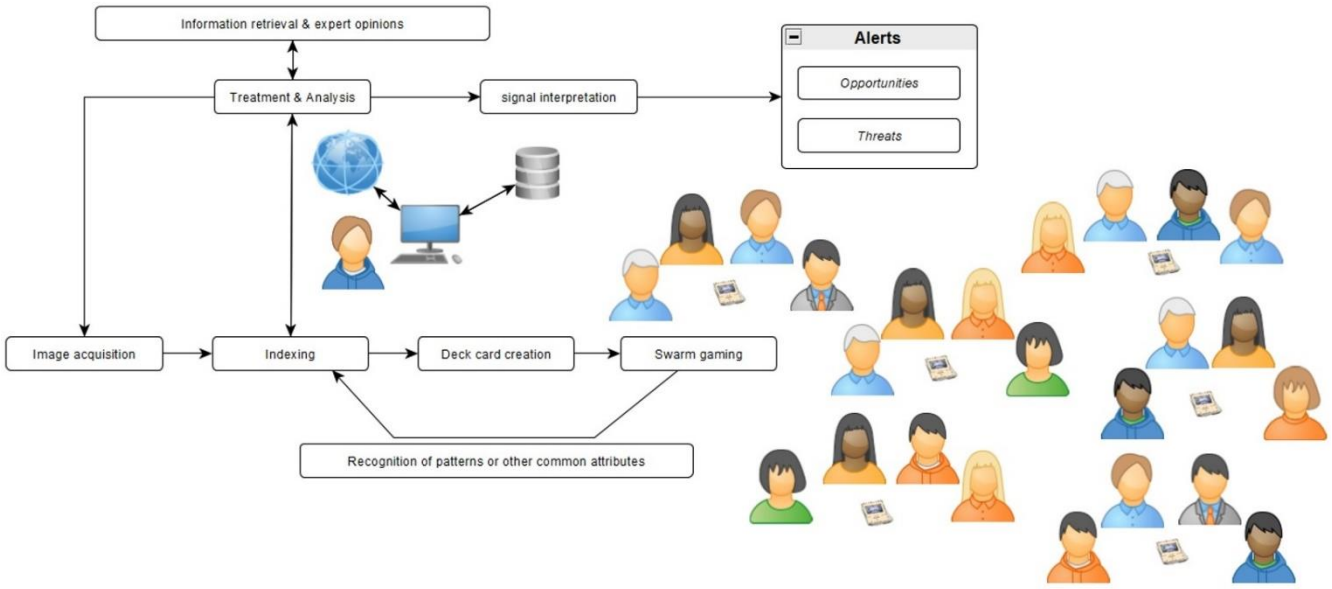

Figure 2. Design schema of a knowledge acquisition system using the rummy of attributes.

In order to consolidate the collected data, not to bore the voluntary players, and to vary the profiles of the participants the swarm gaming format is advised. The principle is simple, the idea is to offer several plays of the game to different people [73]. After several plays, verification, cross-checking, or calling on a group of experts, the information monitoring specialist then translates the signals thus identified into warning signals associated with opportunities and threats to disseminate them in the most appropriate form to the decision-makers concerned [74].

7. RESULTS AND CONCLUSION

For the moment we have been able to test the Rummy of attributes with 81 people (from the second year of the Bachelor's degree to the first year of the Master's degree). They are 6 male students in the second year of a computer science degree, 24 students in a professional computer science degree including one woman, 51 students in the first year of a master's degree in library science including 39 women. After many play, the results are very encouraging. After an invitation all but 9 students played a game again [75].

People enjoy the game and quickly understand the usefulness of the collected data. All participants easily understood the rules and were able to play within minutes. A simple two minutes demonstration was enough to understand how the play works. We did not have to do anything more. Just remember to index the cards and don't just play and forget the purpose of the game. 24 students did not wait for an invitation to play a new round when the first game ended. After invitation [76].

The rounds take, for a set of 62 cards, from 10 to 15 minutes. A test with a set of 40 cards was also carried out with recipe images. This also seems to work well. It is in fact the notation of

attributes on the post-its that slows down the game. It seems to us that a completely digital version of this game could speed up the indexing of the revealed attributes, but we also assume that this will have an impact on the participants as well as certain modalities for starting the game (several players must be able to access the game at the same time) [77]. We have not yet been able to have a digital prototype made that would easily allow for networked multiplayer play, map design, and indexing of the data collected. This remains a project we would like to see completed. For example, we would like to know if when the people asked to play are decision-makers concerned by this monitoring, the user-friendliness, and discussions made possible by the card game continues in digital form. However, on the basis of our first experiences, we make the hypothesis that GWAP in the form of card games (digital or paper) seems to be a solution that can be easily adapted to various contexts according to the preferences of the designers, the specificities of the data to be collected and the means made available to those in charge of the knowledge acquisition or competitive intelligence [78][60].

Another possibility that seems interesting to us concerns the exploitation of the cards already made from a new game, i.e. from the development of new rules. In particular, we are thinking of collecting data about the advantages and disadvantages of products, which would be a good complement to the identification of trends in product design [72].

Finally, another perspective that this system offers is that of its exploitation as a captcha tool to improve automatic shape (design) recognition [79]. Thus, the play help to identify shapes and trends, while the tool, in addition to stocking and graphically shaping the data, learns to recognize shapes and improves its possibilities of automating a monitoring in this way.

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IMPACTS OF CYBER SECURITY AND SUPPLY CHAIN RISK ON DIGITAL OPERATIONS: EVIDENCE FROM THE UAE PHARMACEUTICAL INDUSTRY

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ABSTRACT

The research explored empirical evidence to assess the impact of cyber security and supply chain risk on digital operations in the UAE pharmaceutical industry. Based on responses from 243 personnel working at 14 pharmaceutical manufacturing companies in Dubai, data were examined for normality, instrument validity and regression analysis. Cyber security and SC risk on digital operations were explored by applying convenient sampling and descriptive and analytical research design. The findings validated the significant positive association between cyber security and supply chain risk with digital operations. The research model was developed with three variables evaluated only on the pharmaceutical industry in Dubai. Future research should focus on multiple manufacturing industries by covering a larger geographic area. When suppliers are highly concentrated, customer-focused organizations with uncertain levels of digital transformation could improve their ability to manage supply chain risk by diversifying their clients. Pharmaceutical firms may require a greater focus on technology-based manufacturing firms to build and maintain customer trust. To illustrate how the pharmaceutical industry has explored the relationship between cyber security, supply chain risk and digital operations, the research highlights the significant and convoluted consequences of the relationship model that have not been previously considered.

Keywords: Cyber Security, Supply Chain Risk, Digital Operations, UAE Pharmaceutical Industry.

1. INTRODUCTION

The Internet has played a significant role in international communication for over 20 years and has become an integral part of people's daily lives. The availability, usage, and performance of the Internet have substantially improved due to innovations and low costs in this sector. The estimated number of users of the Internet is 3 billion globally. The increasing use of the Internet has increased security risks. Therefore, the issue of computer security has been around for decades and

is as old as computers [1]. As the access to a computing resource evolved from an individual to a resource distributed across a network, it became important to talk about computer security. IT security issues can affect any network architecture, from peer-to-peer to client-server. The term "cybersecurity" has recently been used to describe the collection of practices and approaches used to protect electronic systems, networks, computers, servers, mobile devices, and data from malicious intrusions [2].

The supply chain risk also exists while dealing with cyber security risks. Additionally, as people became increasingly aware of the effects of sustainable goals, sustainable supply chain management became important [3]. The supply chain of the organization was subject to greater uncertainties and threats due to increasing competition, the effects of globalization, the diversity of technical solutions, and limitless client demands [4].

The organization benefits in multiple ways from sustainable supply chain risk management, including avoiding resource consumption and cutting costs by identifying safeguards, responding quickly to an unexpected event, satisfying customers, and ensuring the successful continuity of the business [5]. All this is possible with digitization and digital operations in the firm. Digital operations are the main concern for most manufacturing organizations and their supply chains. Many people are suffering from the transition and feel overwhelmed, often approaching it primarily from a technological perspective [6].

The advent of digital operations compels us to think about how pharmaceutical operations and regulations can change in a fully digital and autonomous production environment. Digitalization, automation, and real-time data integration will lead to new operational paradigms that should enable pharmaceutical manufacturing to achieve better than six sigma quality for both small and large-molecule pharma products [7]. Therefore, this research examines the impact of cyber security and supply chain risk on digital operations [8]. Three constructs were proposed to measure the relationship between the independent and dependent variables. The impact of cyber security and supply chain risk needs to be identified by examining the relationship with digital operations in the UAE pharmaceutical manufacturing industry [9].

2. THEORETICAL FRAMEWORK

2.1 Cyber Security

It is the application of technological methods and controls to protect systems, networks, programs, devices, and information, besides building a shield for the confidentiality, integrity, and availableness of laptop systems from cyber-attacks or unauthorized access [10]. Here we aim to minimize the risk of cyber-attacks and protect systems, technologies and networks from illegal use

[11]. In addition, it protects all structure resources from external and internal attacks and natural disaster-related distractions [12]. Since the structure consists of several different systems, a good and proficient cyber security position requires organized measures for all information systems of the organization. Thus, cyber security is composed of different sub-domains, which include:

- *Network security*
- *Cloud security*
- *Identity Management & Data Security*
- *Mobile security*
- *Application security*
- *User education*

Based on current trends, the rate of cyberattacks is not slowing down. Every day, hackers are targeting businesses large and small, hoping to gain access to critical data or disrupt services [13]. The sensitive user data of these organizations is gone, causing lasting harm to their finances and reputations [14]. The changing technological world makes implementing an effective cyber security plan challenging. With updates and alterations, the software is constantly changing, creating new flaws and weaknesses, and making it susceptible to numerous cyber-attacks [15].

2.2 Supply Chain Risk

The technique of identifying, studying, and managing risks in an organization's supply chain is called supply chain risk management (SCRM). It implements worldwide supply chain risk management approaches that enable Associates in the Nursing business to run more quickly, save costs, and improve the customer experience. Supply chain management indicates how enterprises succeed in running their products and all the procedures used to transform raw materials into finished goods or services [16]. It contains devising and implementing sourcing, transformation, procurement, and supply management strategies. One of the most common ways businesses use international supply chain management methods is to boost their competitive edge. However, the globalization of supply chains risks compromising the value, safety, and endurance of the business and brand reputation. These issues also need to be considered [17].

If anything threatens a company's financial health, such as increasing part prices eating into profit margins, the company may see a monetary threat in the supply chain. If a vendor engages in destructive behavior, such as crime, child labor, or something that reflects adversely on the firm, the company's image may be at risk [18]. Of course, a supplier's social media behavior might be detrimental to a business [19]. Artificial intelligence and sophisticated analytics in various tools

allow the creation of more accurate forecasts about the availability of offers, supply bottlenecks, and related issues. Thanks to these insights, one can identify threats early on before they become a serious issue [20].

2.3 Digital Operations

Digital Operations is the idea of blending corporate procedures with ease and automation to make operational models that please customers and boost performance. A firm's most crucial business activities are controlled, re-engineered [21], updated, and carried out through digital operations to reduce operational costs, enhance user experiences, offer better results, and achieve top-line growth [22]. A company can establish more practical operational models and achieve method excellence by creating automated, data-driven platforms and trade utilities. To ensure the best digital involvement, the Digital Operations Manager is liable for the entire digital platform's stability and accessibility (counting the administration of our vendors and allies) [23]. The Digital Operations crew also controls the processes and actions that lead to changes on these platforms to minimize incidents and operational risks while maintaining the ease required to be first in the market [24].

Nowadays, the digital economy offers a brand-new opportunity to explore and develop advanced new goods, services, and practices tailored to changing consumer demands. On the other hand, old-fashioned operational models stymie a company's transformation efforts, limiting its capacity to keep pace with customer and market expectations [25]. Only corporations built on flexible, digitally, and smart connected processes can provide additional humanized transactions and practices that surpass clients' expectations [24]. Digital operations may help businesses rethink and create digital ways to improve performance and bridge method gaps between customers, dealers, and partners using method platforms, automation, and intelligence.

2.4 Operational Definitions

Variables	Definition	Reference
Cyber Security	*Cybersecurity protects internet-connected systems, including their hardware, software, and data, from cyber-attacks. This method prevents unauthorized access to data centers and other digital systems by individuals and companies.*	[26]
Supply Chain Risk	*The risk of harm or compromise posed by suppliers' supply networks, products, or services, as well as those of those suppliers.*	[27]

Digital Operations	*The idea of incorporating agility, intelligence, and automation into corporate processes to provide operational models that delight consumers and boost productivity is known as "digital operations."*	[28]

2.5 UAE Pharmaceutical Manufacturing Industry

The UAE, one of the world's fastest-growing economies, has continued to build on the thriving history of its ancestors. The UAE's economy has expanded significantly since gaining independence in 1971 due to the sector-specific expansion of numerous sectors. However, the pharmaceutical industry still largely supports the UAE's GDP [29].

Between 2021 and 2025, the UAE pharmaceutical market is forecasted to expand by 27% as the government works to turn the country into a regional industry hub. As a result, the local pharmaceutical market is anticipated to triple to $4.7 billion between 2011 and 2025. The need for digitization and cyber security is becoming increasingly evident [30], necessitating research on this industry that will incorporate the significance of cyber security and supply chain risks and their impact on Digital operations in the industry [31].

3. LITERATURE REVIEW

3.1 Relationship and impact of Cyber Security on Digital Operations

Even before a global pandemic, executive teams had to work in a challenging and dynamic environment as they attempted to protect their organisations against cyberattacks without compromising their capacity for innovation and getting the most out of technology investments [32]. The public health emergency triggered by COVID-19 has highlighted the need for production methods that can adapt to rapidly changing demand and minimise reliance on human intervention. For instance, automated and robotic procedures may be required when faced with obstacles that prevent people from working closely together [33]. Previous studies investigated pharmaceutical products and some potential legal, technological, and logistical issues that must be solved if society is to fully benefit from digital operations [34]. The demand for technological factors has increased security concerns, making cyber security a module for managing security risks through digitization. Literature mentions the significance of implementing cyber security for digital operations [35].

Based on the above discussion, we develop the following hypothesis:

H_{o1}: Cybersecurity has a significant impact on digital operations

3.2 Relationship and impact of Supply Chain Risk on Digital Operations

[36] argued that supply chain risk encourages businesses to collaborate closely with key suppliers to understand the supply market and adapt supply functions to emerging technology. The advanced use of the Internet and technology enables businesses to incorporate supply chain methods with smart technology and eliminate supply chain risks by identifying security concerns.

The integration of cutting-edge manufacturing technology during the fourth industrial revolution paved the way for integrated, autonomous, and self-organizing production systems that operate without human intervention [33]. Manufacturing pharmaceuticals has been transformed by digital operations and the experiences gained in the automated and digital environment of the supply chain. Supply chain risk can be efficiently managed by applying advanced technologies to evaluate the risk factors and ways to protect against the risk. Previous studies have examined the significant impact of SC risk on digital operations [37]. Increasing supply chain resilience is key for businesses to improve their ability to respond to supply chain threats. The digital operations of businesses can help businesses increase the visibility of their supply chains and their ability to anticipate problems, enabling them to better develop risk management plans and increase supply chain resilience [38].

Based on the above discussion, we develop the following hypothesis:

H_{o2}: Supply chain risk has a significant impact on digital operations

3.3 Relationship and impact of Cyber Security and Supply Chain Risk on Digital Operations

The advent of smart gadgets and ever-changing consumer demands have accelerated global digital transformation. Consequently, firms are increasingly identifying opportunities and developing high-end capabilities to gain a competitive edge and flourish. Organizations were obliged to transition to remote work due to the epidemic, which accelerated the introduction of new technology [35]. This was where digital transformation became a reality from a long-term goal. The understanding of cyber security has changed with the increasing acceptance of digital transformation. This is due to the increase in cyberattacks, data breaches, and other incidents as the threats continue to grow, and businesses use more digital technologies across various company functions to create new business models and enhance consumer experiences [39].

Most security organizations report that their corporate executives are unaware of the harm unprotected digital assets pose to their entire portfolio. Eighty-two per cent of IT security and C-level executives reported at least one data breach following the integration of new technologies and the expansion of the supply chain, based on a Digital Transformation and Cyber Risk survey [32]. This is why the risk management function at large is so important: they design an organisation-wide cybersecurity plan that coincides with a company's objectives [40]. They must effectively

communicate to ensure that all digital assets are protected while improving cooperation at both the senior and operational levels [26].

Based on the above discussion, we develop the following hypothesis:

H_{o3}: Cyber security and supply chain risk have a significant impact on digital operations

3.4 Problem Statement & Research Gap

Previous research has demonstrated the link between digital operations and supply chain risks [36]. However, there is no evidence to support the interaction between cyber security and supply chain risk to improve or assess digital operations. Although supply chain diversity increases the risk tolerance of a supply chain, it also often leads to a more complicated supply network, which reduces the transparency of the supply chain. To manage a more complicated supply chain, digital operations can enhance the transparency of information flow through cyber security and SC activities.

3.5 General Research Model

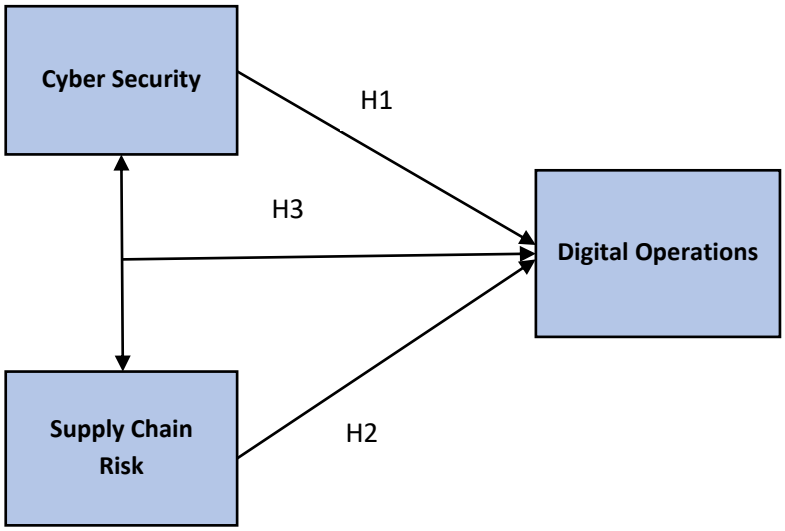

Figure1: Conceptual Research Model

3.6 Research Hypothesis

H_{O1}: Cyber Security has no statistical impact on Digital Operations in the UAE Pharmaceutical manufacturing Industry at ($\alpha \leq 0.05$) level.

H_{O2}: Supply Chain Risk has no statistical impact on Digital Operations in the UAE Pharmaceutical Manufacturing Industry at ($\alpha \leq 0.05$) level.

H_{O3}: Cyber Security and Supply Chain Risk have no statistical impact on Digital Operations in the UAE Pharmaceutical Manufacturing Industry at ($\alpha \leq 0.05$) level.

3.7 Research Methodology and Design

Descriptive and analytical research designs were used in the proposed quantitative research. A self-administered questionnaire was developed, data was gathered via an online survey for a primary purpose, and secondary data was collected by consulting scientific literature. An appropriate cluster sampling technique was used to gather data from a specified population area.

3.8 Population, Sample & Unit of Analysis

Data collected from 14 pharmaceutical companies based in Dubai, UAE, were the main sources of information from which the sample for this study was drawn. The most crucial component of this research was data collection from the employees of pharmaceutical manufacturing companies. Thus, a survey questionnaire was sent by email to 500 employees, of which 243 were used for analysis after screening. The questionnaire was developed on a five-point Likert scale (1=strongly disagree to 5=strongly agree). To assess the research variables, 25 items were used, respectively. The "Gender" and "Designation" were evaluated to obtain the demographic data.

4. DATA ANALYSIS

4.1 Demographic Analysis

To evaluate the demographic data, data were collected from male and female respondents with a high frequency of male respondents=163 and female=80. The respondents were specified by their job title, with the highest number of Manager IT & Development=78, HR manager=67, SC Officer=63 and Cyber Security Manager=35. Table 1 shows the summary of the data.

Table 1: Summary of Demographic Data

Items	**Description**	***f***	**%**
Gender	Male	163	67.1
	Female	80	32.9
Job Status	Manager IT & Development	78	32.1
	SC Officer	63	25.9
	Cyber Security Manager	35	14.4
	HR Manager	67	27.6

(N=243)

4.2 Reliability, Descriptive and Correlation

The data reliability was measured using Cronbach's5 Alpha, showing high reliability of the results. The summary of the data showed α=.89 for Cyber Security 10 items. A=.85 for Supply Chain Risk 7 items and α=.88 is for Digital Operations 8 items. Additionally, the descriptive statistics demonstrated the accepted mean and standard deviation values. M=3.12 & SD=.75 for Cyber Security. M=2.83 & SD=.68 accepted values to the benchmark for Supply Chain Risk [37]. The Mean value for Digital operations showed M=2.74 & SD=.67 as accepted values.

Table 2 illustrates the correlation coefficients depicting the relationship between Cyber Security and Supply Chain Risk r=.816 at a significance level of P<0.05**. Cyber Security and Digital Operations showed a high correlation r=.919 at a significance level of 0.05**. Finally, the correlation of Supply Chain Risk and Digital Operations was identified as highly correlated r=.842 and significant at level 0.05**. The summary of all tests is demonstrated in Table 2.

Table 2: Data Reliability, Descriptive Statistics and Correlation Coefficients

Construct	No of items	Cronbach's Alpha	Mean	SD	Cyber Security	Supply Chain Risk	Digital Operations
Cyber Security	10	.89	3.12	.75	1		
Supply Chain Risk	7	.85	2.83	.68	.816**	1	
Digital Operations	8	.88	2.74	.67	.919**	.842**	1

*Cyber Security (M=3.10, SD=74%, Supply Chain Risk (M=2.71, SD=53%), Digital Operations M=3.34, SD=69%. -Level of significance at P<0.05***

4.3 Regression Analysis and Hypothesis Testing

Table 3 illustrates the hypothesis tests for the proposed research model that shows a significant positive relationship between Cyber Security and Digital Operations β=.74, p=0.00, t=17.3, p=0.00, R^2=.845, resulting in a positive t-value and a change in relationship dependability of 84%, which is high. H1 is accepted. H2 demonstrated a significant positive relationship between Supply Chain Risk and Digital Operations β =.84, t=6.83, p=0.00, R^2=.709. A high variance showed the high dependence of SCR on Digital Operations with 70%. Thus, H2 is supported. H3 is identified with β=.933, t=2.38, p=0.00, R^2=.87 that showed a significant positive relationship and a high variance level of 87% of both variables (cyber security and supply chain risk) on Digital

Operations. Therefore, H3 is also supported in this research. Table 3 illustrate the summary of the data.

Table 3: Regression and Hypothesis Testing through ANOVA

Hypothesis	Regression Weights	Standardized Coefficients					
		β	R^2	df	Sig	t-value	Hypothesis Supported
H_1	CS→DO	.919	.845	1	.000	17.3	Yes
H_2	SCR→DO	.842	.709	242	.000	6.83	Yes
H_3	CS*SCR→DO	.933	.871	.243	.000	2.38	Yes

*Dependent Variable=Digital Operations, Independent Variable= Cyber Security & Supply Chain risk *Level of Significance ($\alpha \leq 0.05$***

***Critical t-value (df/p) = 1.64*

5. DISCUSSION OF THE RESULTS

In the proposed research model, a regression analysis was performed to test the significant positive relationship between cyber security and digital operations. Our findings suggest that a strong focus on cyber security can enhance digital operations. Previous research is consistent with our findings that cyber security now offers the opportunity to digitise security risk management due to increasing security issues caused by technical elements. Implementing cyber security in digital activities enhances the work efficiency of firms [11]. The second research hypothesis has confirmed the significant positive relationship between supply chain risk and a digital operation that greatly matches previous studies [41]. Our research findings also show that businesses need to improve their ability to respond to supply chain risks by strengthening their supply chains. Businesses can improve the visibility of their supply networks and their ability to foresee issues using digital operations, which will help them develop better risk management strategies and strengthen the resilience of their supply chains [39].

The third hypothesis mentioned a positive relationship between cyber security and supply chain risk in digital operations, which verifies the findings and authenticates the previous research findings with similar findings. The understanding of cybersecurity has changed with the increasing acceptance of digital transformation. Businesses are increasingly using digital technologies in various company functions to develop new business models and improve consumer experiences to provide safe medical products, which has led to increased cyberattacks, data breaches, and other cyber disasters.

6. CONCLUSION

Based on the research findings, adopting digital processes can help control supply chain risks. Increased adoption of digital technologies can help pharmaceutical manufacturing companies share data and information more effectively, secure formulas, better manage various business processes, and predict potential risks in the future [42]. These improvements can help enhance the company's risk management and address cyber security issues. Therefore, large businesses looking to strengthen their SC resilience can organize a variety of digital improvements by aggressively implementing cyber security and putting a greater emphasis on managing supply chain risks [43].

7. RECOMMENDATIONS/LIMITATIONS

Some noted limitations of this research include the pharmaceutical manufacturing firm chosen for the research purpose limits the generalizability. However, future research can include other manufacturing firms [44]. Thus, a future perspective could use the same model to analyze the relationship in different industries and provide a more thorough explanation.

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EXPERIMENTAL INVESTIGATION ON THE THERMAL EFFICIENCY OF A FOLDED PLATE SOLAR AIR HEATER

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ABSTRACT

The purpose of this research is to carry out an experimental investigation of folded and flat plate solar air heaters. The current experimental investigation was carried out in Ismailia, Egypt. Ismailia is located at 30.60˚ N latitude, 32.27˚ E longitude, and has an average elevation of 0 m from the sea level. The experimental run began from 8:00 am to 9 pm, with three air mass flow rates of 0.0068 ,0.048 and 0.0021 kg/ s. The parameters affecting the thermal performance of the flat and folded plate solar air heater. These parameters include solar radiation, the temperature difference of air across the heater, instantaneous thermal efficiency, and daily average efficiency. From the experimental results, it was found that the outlet temperature of the folded plate solar air heater was higher than ambient temperature by 19 ˚C during 5 h after sunset compared with 2 ˚C

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during 1 h after sunset for flat plate solar air heater when the mass flow rate was 0.0021 kg/s. It was also concluded that the daily efficiency of the folded solar heater was 38% higher than the corresponding values when the flat plate when the mass flow rate was 0.0068 kg/s.

***Keywords*:** Solar air heater, Energy Storage, Flat Plate, PCM, Folded plate, Experimental study, Thermal performance.

1. INTRODUCTION

Due to increased energy demand and environmental issues brought on by burning fossil fuels, several countries now adopt renewable and sustainable energy sources. Solar energy, the most favorable and economical renewable energy source, has drawn a lot of attention [1,2]. This renewable energy source, however, is not usable at night or on days when it is cloudy or raining. At first, many efforts were made to improve the thermal performance of solar air heaters without any storage medium by increasing the heat transfer area, as well as improving the turbulence in the air duct by adding fins [3-5] or corrugated surfaces with various patterns [6–8]. Flat plate, finned, and v-corrugated air heaters were studied experimentally and conceptually by Karim and Hawlader [9]. In comparison to flat and finned plate collectors, they indicated that the v-corrugated collector is 10-15% and 5-11% more efficient, respectively, when m = 0.04 kg/s. El-Sebaii et al. investigated the double pass flat heater and the double pass v-corrugated [10] and finned plate [11] solar heaters experimentally and conceptually in forced convection mode. They indicated that, when m = 0.02 kg/s, the v-corrugated plate is 9.3-11% and 11-14% more efficient than the flat and finned solar air collectors, respectively.

In this work, the flat and folded plate solar air heaters are tested. The flat and folded plate solar air heaters are also tested at a wide range of mass flow rates (0.0021–0.068 kg/s). The factors influencing the thermal performance of both solar air heaters were investigated, including the temperature difference of air in the heater, the instantaneous thermal efficiency, and the daily efficiency. In this work, the folded plate solar air heaters are tested for the first time.

1.1 Thermal performance parameters

In this section, the governing equations of the thermal performance parameters of the solar air heater are evaluated as below. The useful thermal heat energy of the air across the heater (Q_u) is given by;

$$Q_u = \dot{m}C_p\,(T_{out}-T_{in}) \quad (1)$$

Where $\dot{m}$ is flow rate of air (kg/s), C_p is specific heat (J/kg K), Tout is outlet air temperature (°C), Tin is inlet air temperature (°C).

The instantaneous thermal efficiency of the heater (gins) is given by [12];

$$\eta_{ins}=\frac{Qu}{I*Ap} \quad (2)$$

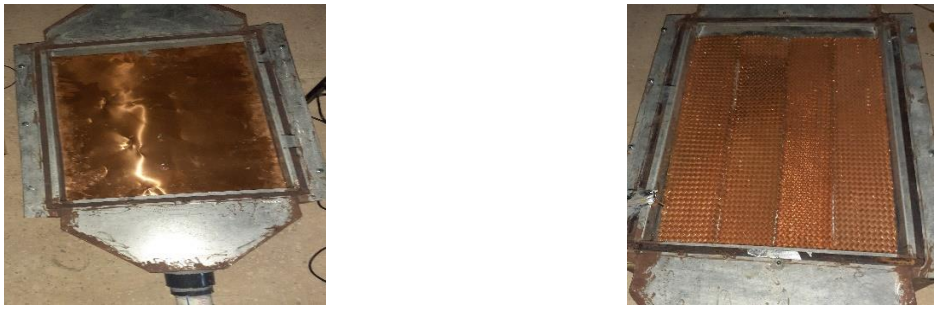
where A_p is the heater projected area (m^2) and I is the total solar radiation incident on the heater (W/m^2). The daily efficiency of the collector. (η_{da}) is defined as the accumulative heat gain by the air to the cumulative input solar heat that incident on the heater surface throughout the day which is given by [12];

$$\eta_{da}=\frac{\sum Qu}{\sum I*A} \quad (3)$$

2. EXPERIMENTAL ANALYSIS

2.1. Experimental setup for modified SAH & Conventional flat SAH

The photographic view of the experimental setup constructed for a conventional flat plate SAH and another modified SAH, as shown in Fig. 1(a) and (b). The experimental setup, essentially for each SAH, consists of a centrifugal blower, PVC connection pipe, solar air heater. The centrifugal blower was attached to an air collector inlet with a PVC connection pipe inserted with a gate valve used to control the air mass flow rate. each of the solar air heater was designed and fabricated using an available locally material according to the guidelines of ASHRAE recommendations 93–77 [13]. Both consist of a copper plate as an absorber plate. The top of each collector was covered with commercial glass plate that was coated with black mat paint to increase the absorbed heat. It was installed 5 cm above the absorber plate. The glass plate protected the hot absorber plate from the ambient environment and reduced the convective heat. The lower box of air heater were insulated with a 5 cm height foam layer.



(a) (b)

Fig. 1. Photograph for the solar air heater system (a) A conventional flat plate SAH, (b) modified SAH

2.2. Experimental setup sensors

The experimental setup was equipped with several sensors to detect and track the dynamic thermal response SAHs. Input air temperature, output air temperature, ambient air temperature, airflow velocity, and sun irradiation were all measured variables [14]. The temperatures of the moving air and the absorber surface were measured using calibrated DS-digital temperature sensors (temperature range from 10 to 125 °C and accuracy 0.5 °C). At the intake (T_{in}) and outlet, the temperatures of the air flow are measured (T_{out}). T_1, T_2, and T_3 are the surface temperatures of the absorber along its centerline, respectively. To gauge the temperatures of the glass coverings, DS-digital temperature sensors were fitted to their upper surfaces [15-19]. Additionally, a thermometer with a temperature range of 0 to 100 ◦C and an accuracy of 1 ◦C was used to measure the ambient temperature. The solar intensity was measured using the Pyranometer (TM-207) Solar Meter.

2.3. Test conditions

The current experimental investigation was carried out in Ismailia, Egypt. Ismailia is located at 30.60˚ N latitude, 32.27˚ E longitude, and has an average elevation of 0 m from the sea level. The experimental runs began from 8 am to 9 pm, from 28th June11th and 12th July 2022. The pyranometer and digital temperature sensors related to a microcontroller (ARDUINO) board coupled to a PC-Lap to observe and record the solar radiation and the different temperatures at the

same time every minute automatically and accurately [20]. After that, the recorded values from ARDUINO board they were imported to the Excel sheet and saved for any predetermined data sampling rate [21-24]. A two-phase induction motor was used to blow the air through the solar air heater. The air flow rate was measured by the mean of a calibrated anemometer, with of range 0.2–10 m/s and accuracy of ±0.2 m/s, which measures the air exit velocity at ten positions of the exit pipe diameter, then the average velocity was determined to get the mass flow rate by knowing the cross section exit area and air density. The mass flow rate was (0.0068,0.0048,0.0021) kg/s.

2.4. Uncertainty analysis

Uncertainties often occur due to the errors, methodology, experimental conditions, and instrumentation during an experimental run. Hence the uncertainty analysis offers the chance to assess the errors in the measured and calculated parameters in an experimental test [25-28]. The uncertainties in the experimental results were affected by the errors in the primary measurements [29]. Experimental error analysis was checked according to Holman [30-31]. Let the result R is a given function of the independent variables.

$X_1, X_2, X_3, ..., X_n$.

$R = R (X_1; X_2; X_3; \dots ; X_n)$

Let W_R be the uncertainty in the result and $W_1, W_2, W_3,.., W_n$ be the uncertainties in the independent variables X1, X2, X3,..., Xn, respectively. WR can be calculated from the following equation [14,27]

$$W_R = [(W_1 \partial R/\partial X_1)^2 + (W_2 \partial R/\partial X_2)^2 + \dots + (W_n \partial R/\partial X_n)^2]^{0.5} \quad (4)$$

The uncertainties and relative errors in measurements of solar adiation intensity, air temperature difference across the heater, mass flow rate, useful heat gain by air and the thermal efficiency of the solar air heater are summarized in Table1.

Table 1

The uncertainties and relative errors in measurements are shown in Table 1 below.

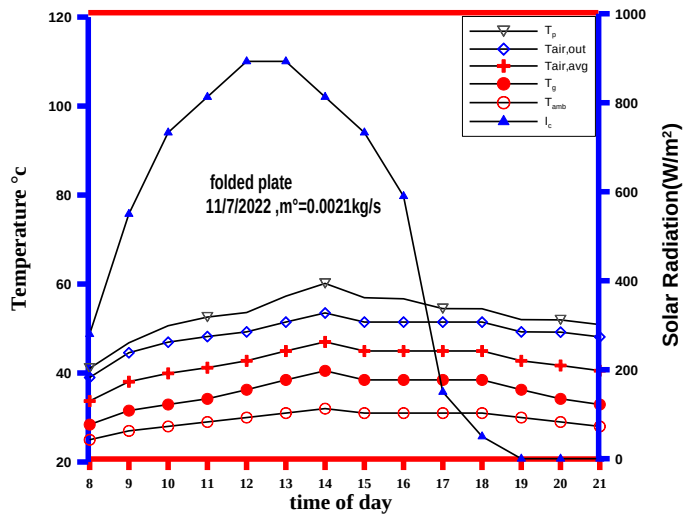
S. No.	Parameter	Uncertainty	Relative error (%)
1	Solar radiation (W/m^2)	±6	0.63
2	Temperature difference across the heater (˚C)	±0.1414	0.58
3	Mass flow rate (kg/s)	$\pm 1.039 / 10^{-3}$	1.675
4	Useful heat gain by the air (W)	±8.8106	1.2855
5	Thermal efficiency (%)	±0.01	0.0143

3. RESULTS AND DISCUSSION

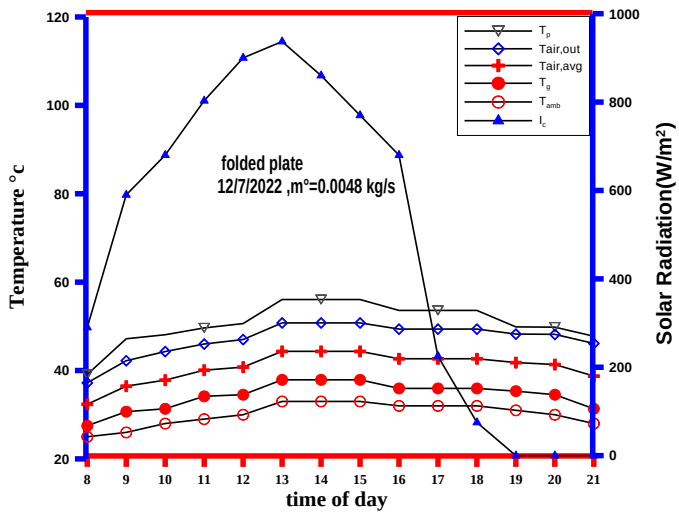
3.1 The Folded Plate Effect on Solar Air Heater

The thermal performance of the folded plate solar air heater is investigated on a wide range of mass flow rates (0.0021 -0,0048- 0.0068 kg/s). the air heater is tested with the folded plate on consecutives clear sky days of 11th of July 2022 when m˚= 0.0021kg/s, 12th of July 2022 when m˚= 0.0048 kg/s and 28th of June 2022 when m˚=0.0068 kg/s, respectively. The results are plotted in Fig. 2 (a), (b) and(c), shows measured temperatures of the different elements of the folded plate solar air heater, vs. time.

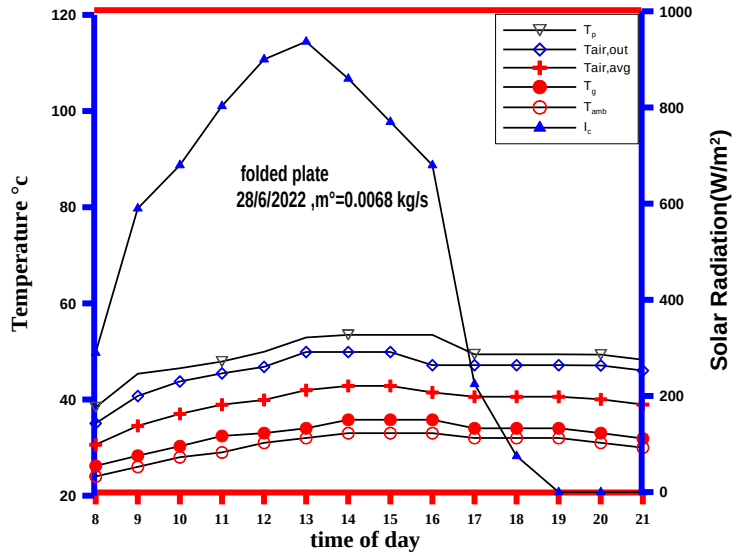
The results show that the temperatures of the various elements increase with time as the solar radiation increases but decreases by increasing in air flow rates. The maximum measured values of T_p, $T_{air,out}$, $T_{a,avg}$ are found for all mass flow rates occurs at 14:00 pm. As shown in Fig.2(a). The maximum measured values of Tp, $T_{air,out}$, $T_{a,avg}$ are found to be 60.00 , 53.37, 47.00 ˚C, respectively. It is also found that maximum measured solar intensity is 893 W/m^2 at 13.00 am and the ambient temperature varies between 25 and 32˚C. For Fig.2(b). The maximum measured values of T_p, $T_{air,out}$, $T_{a,avg}$ are found to be 56.06,50.77, 44.33˚C, respectively. It is also found that maximum measured solar intensity is 937 W/m^2 at 13.00 pm the ambient temperature varies between 25 and 33˚C. For Fig.2(c). The maximum measured values of T_p, $T_{air,out}$, $T_{a,avg}$ are found to be 53.45,49.88,42.83˚C, respectively. It is also found that maximum measured solar intensity is 937 W/m^2 at 13.00 pm the ambient temperature varies between 24 and 33 ˚C. Table 2 is summary for The maximum measured values of T_p, $T_{air,out}$, $T_{a,avg}$.



(a)



(b)



(c)

Fig.2 Measured temperatures of the different elements of the folded plate solar air heater, vs. time, when (a) m˚= 0.0021kg/s, (b) m˚= 0.0048kg/s and(c) m˚= 0.0068kg/s.

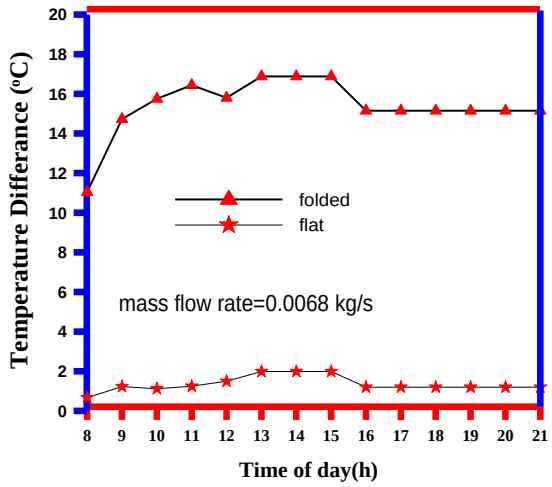
Table 2

The summary for the maximum measured values for folded plate.

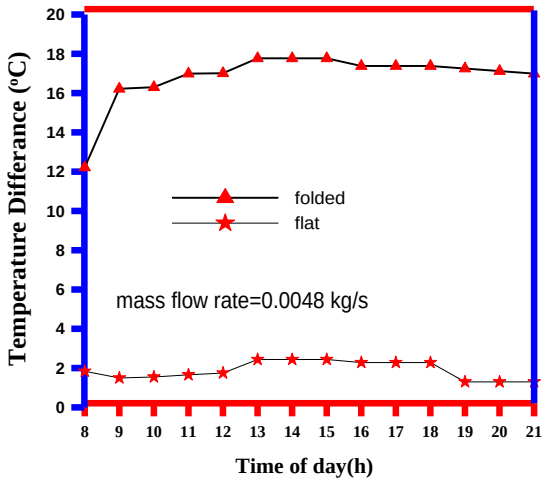
DATE	Flow rate kg/s	time for max temperature's	T_p	$Tair_{,out}$	Ta_{avg}
11/7/2022	0.0021	14 pm	60.13	53.50	47.00
12/7/2022	0.0048	14 pm	56.06	50.77	44.33
28/6/2022	0.0068	14pm	53.45	49.88	42.83

The thermal performance of the flat and folded plates arrangement solar air heater is investigated on a wide range of mass flow rates (0.0068, 0.0048 and 0.0021 kg/s). As seen in Fig. 3, the air heater is tested for the flat and folded plates when the mass flow rates are 0.0068, 0.0048and 0.0021 kg/s on consecutives clear sky days of July 2022, from 8 am to 21pm for 13 h As seen in Fig. 3(a),(b) and (c). A comparison of the temperature difference of air across solar air heaters when the mass flow rates are (0.0068 ,0.048 and 0.0021 kg/ s) is presented in Fig. 3(a),(b) and (c). According to the results obtained from Fig. 3(a),(b) and (c) and based on the temperature difference of air across the heater, it is concluded that the folded plate is more efficient than flat plate. The later result is due to the increment of heat transfer area of the folded plate compared with flat plate. Besides the folded plate increases the turbulence inside the air channel which enhances the convective heat transfer coefficient between the absorber plate and the flowing air.

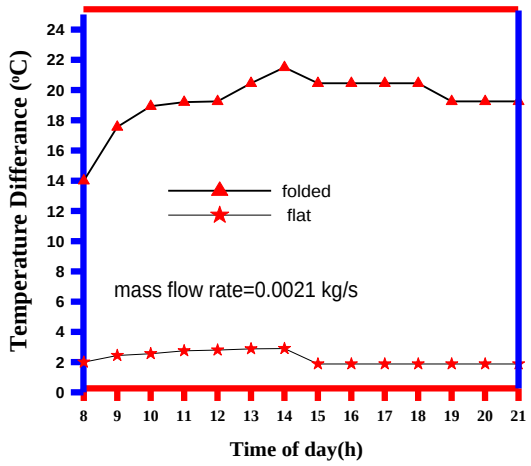
The temperature differences across the heaters increases when the mass flow rate decreases as seen in Fig. 3. (a), (b) and (c). The peak values of temperature differences across the solar heater for different types of absorber plates individually named folded and flat plate) after sunset are found to be 19and 2 ◦C, respectively m◦=0.0021 kg/s. It is also found that the temperature differences across the solar heater go down to be zero after sunset by 5 and 1h, respectively.



(a)



(b)



(c)

Fig. 3. A comparison of the measured temperature difference of the air between folded and flat plate solar air heater when (a) m. = 0.068 kg/s, (b) m. = 0.048 kg/s and (c) m. = 0.021 kg/

3.2 Accumulated heat gains evaluation

The accumulated heat gains were calculated based on equation. (1) The total accumulated heat gains are shown in Table 3. Making an objective assessment of the dynamic thermal response and efficiency at various points during the trial run is made easier by contrasting the solar energy that was collected with the heat gains produced by the SAHs.

Table 3

Accumulated heat gains for SAHs demonstrated in Table 3 below.

Type of SAH	Air Mass Flow Rate kg/ s		
	0.0068	0.048	0.0021
Folded plate SAH	2964 KJ	2485 KJ	1303 KJ
Flat plate SAH	165 KJ	131 KJ	115 KJ

3.3. Thermal Performance Evaluation

An insightful method for evaluating energy systems with varied designs and features is energy analysis. Equation (3) was used to compute the thermal performance, which is shown in Fig. 4 . Using the specified equivalent thermal ratio, as shown in Fig. 4. With respect to the air mass flow rate, Fig. 4 compares the daily average efficiency of flat and folded plate solar air heaters. It has been found that the folded plate solar air heater has a greater daily efficiency than the flat plate solar air heater. Due to the high useful heat acquisition by air and the lower heat losses by the heater at high flow rates, all heaters become more efficient everyday as m. grows. the daily efficiency of the folded solar heater was 38% ,32% and 16% higher than the corresponding values when the flat plate when the mass flow rate was 0.0068 ,0.0048 and 0.0021kg/s , respectively.

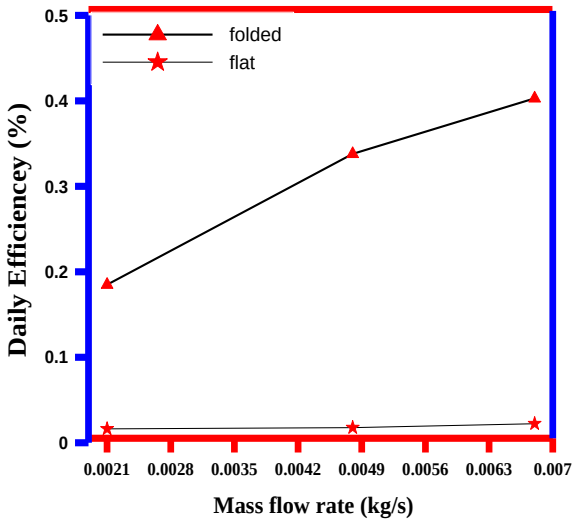


Fig. 4. A comparison of daily efficiency of flat and folded plate solar air heaters

4. CONCLUSION

Experimental research on the solar air heater was conducted for two absorber plate designs, flat and folded. On a wide variety of air mass flow rates and operating conditions, the thermal performance parameters of the folded heater are typically significantly greater than those of the flat heater. The following inferences are taken from the experimentally obtained results.

- The folded plate is more efficient than flat plate. The later result is due to the increment of heat transfer area of the folded plate compared with flat plate. Besides the folded plate increases the turbulence inside the air channel which enhances the convective heat transfer coefficient between the absorber plate and the flowing air.
- The outlet temperature of the folded plate solar air heater was higher than ambient temperature by 19 ˚C during 5 h after sunset compared with 2 ˚C during 1 h after sunset for flat plate solar air heater when the mass flow rate was 0.0021 kg/s.
- The daily efficiency of the folded solar air heater using PCM is 41% higher than the corresponding values when flat plate is used with PCM, when the mass flow rate is 0.0068 kg/s.

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APPENDIX 1

Nomenclature		Greek symbols	
p	projected cross section area of the plate (m^2)		
s	total surface area of the plate (m^2)	*ins*	instantaneous thermal efficiency of the heater
p	specific heat of the flowing air (kJ/kg ˚C)	*da*	daily average efficiency of the heater
	the total solar radiation on horizontal surface (W/m^2)	**Subscripts**	
∘	mass flow rate of air (kg/s)	v	average
u	useful thermal heat energy of the air across the heater (kJ)	mb	ambient
amb	ambient temperature (˚C)		absorber
a; out	outlet temperature of air from the heater (˚C)	a	daily
am	average temperature of air inside the heater (˚C)	ns	instantaneous
p	absorber plate temperature (˚C)		inlet
pm	average value of the absorber plate temperatures (˚C)		outlet
pcm	average value of the PCM temperatures (˚C)	**Abbreviations**	
g	glass cover temperature (˚C)	CM	phase change material

ARTIFICIAL INTELLIGENCE INCIDENTS & ETHICS: A NARRATIVE REVIEW

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ABSTRACT

There has been a lot of media debate about "Artificial Intelligence (AI) Ethics" nowadays and many scientists and researchers have shared their views on this topic. As technology is evolving, security issues are also emerging in new forms. Machines should be ethical, and the "Build and Design" of such machines should be based on ethics. Infact, AI must have Ethics as a part of design within the software code, just like security measures are encoded within. In this review paper, statistics of AI incidents and areas are presented along with the social impact. Using the online AI Incident Database, some areas of AI applications have been identified, which shows unethical use of AI. Applications like Language and Computer vision models, intelligent robots and autonomous driving are in top ranking. Ethical issues also appear in various forms like incorrect use of technology, racism, non-safety and malicious algorithms with biasness. Data collection has helped to identify the AI ethical issues based on Time, Geographic Locations, Application Areas, and Classifications.

Keywords*: AI Ethics, Ethical Principles, Ethical Behavior, Machine Ethics, AI Guidelines*

1. INTRODUCTION

AI offers many benefits and opportunities for society, including the potential to improve healthcare, finance, education, and surveillance. However, AI also poses risks of harm if misused or deployed without careful consideration. Assessing the risks and benefits of AI is challenging, since it is difficult to determine the extent to which impacts are caused by AI systems. Several AI principles have been set up by national and international bodies, worldwide. These consist of generic and contextual [1]. Recent observations show that AI is becoming an essential part in almost every technological advancement, particularly in areas

like Banking, Data Analytics, Autonomous Systems (AS), Manufacturing Industries, etc [2]. Hence AI is also facing the same challenges in terms of Safety, Security, Ethics and Privacy [3]. For instance, Banking Chatbots can be manipulated or exploited in such a way that the hackers may try to impersonate a banking officer and get the details of a customer and do fraud. Autonomous weapons are another example, where decisions are being made by these AI based weapons without having human intervention [4].

This review paper is based on the statistics taken from AI incident Database – A catalog of failures in AI. The AI ethical issues have been classified based on the data processed. 13 application areas are identified where AI ethics issues have occurred the most. Results are then discussed with respect to Time [5], Geographical Distributions, Application Areas and Taxonomy of AI issues [6]. Following which discussion on AI guidelines and principles are presented. Finally, a conclusion is made showing the importance of machine and AI ethics in design and implementation.

2. THEORETICAL FRAMEWORK

Mengyi Wei et al. collected AI ethics incidents mainly from the AI Incident Database [1]. 150 AI ethics incidents with detailed information were chosen [7]. After content analysis, below four descriptive attributes were identified namely:

- Time,
- Geographic Locations,
- Application Areas,
- Classification of AI Ethics Issues.

These four attributes cover the critical information of each AI ethics incident.

Time: This attribute refers to the time the AI ethical issue took place.

Geographic locations: Refers to the geographical distribution of AI ethics incidents which took place around the world [8].

Application areas: This attribute provides information about the areas of AI which are most susceptible to ethical issues.

Taxonomy of AI ethics issues: This classifies AI ethical incidents, which comprehensively show the unethical behavior of AI technology and the impacts on society [9].

2.1 Objectives:

1. Develop mechanisms to benefit AI more for human society and to reduce harm.
2. Improve the ability to evaluate the impacts and risks associated with AI.

3. Able to decide in events when there is disagreement and uncertainty.

2.2 Research Questions

There are many questions that are raised for deciding the AI ethics and regulations for the framework. For instance:

1. Copyright ownership of AI Algorithms has been developed.
2. How much AI has the potential to make discriminations, privacy violations and war crimes?
3. To what extent AI can be compromised to fool someone?
4. Design rules for AI regulations
5. Drafting of AI regulations by those judiciary officials who are not technical experts on this domain.
6. How much AI technology is risky in a particular domain?
7. What areas are of low risks where AI can be easily deployed.
8. Ability to produce false and misleading information generated by BigGAN and GPT-3 models.
9. What ethical principles should AI researchers follow?
10. What is the best way to design AI that aligns with human values?
11. Is it possible or desirable to build moral principles into AI systems?
12. When AI systems cause benefits or harm, who is morally responsible?

Can I determine a person's act for doing crime? Infact most recently there has been a case in which researchers at the Chicago University, have developed an algorithm that predicts crimes a week prior to their occurrence with 90% accuracy [10].

3. LITERATURE REVIEW

Presently there are no defined legitimate processes to develop and deploy AI in the human community. Most of the self- decisions or rules are already established in technology-based companies like Google. Facebook, Microsoft, AWS, etc [11]. But there is no procedure to scrutinize those decisions or rules by a central government entity at national or international level. Also, the public is not aware about the rules. Those rules can have a great impact on society, but they are not accountable [12]. A proper understanding of AI impacts on society needs to be done before assessing risks and benefits of AI. Furthermore, if those risks or benefits would have a high impact on society. Unsafe and insecure AI systems is on

the rise which can become more severe in near future [13]. Take for example, "Autonomous Drone Swarms", an autonomous lethal weapon is an instrument of mass destruction.

To properly assess risks and benefits, we need a thorough understanding of how AI is already impacting society, and how those impacts are likely to evolve in future [14]. Despite these many real and potential benefits, we are already beginning to see harms arise from the use of AI systems, which could become much more severe with more widespread application of increasingly capable systems [15]. For instance, there is a strong case that "armed fully autonomous drone swarms", one type of lethal autonomous weapon, qualify as a weapon of mass destruction [16].

There is a strong need to develop a regulatory framework for AI before it gets too late [17]. Technology companies and government bodies should form a consortium to build the regulations for this framework. There is a need for governance in AI which should at least cover three objectives [18].

3.1 Content Categorization

Mengyi Wei and his team were not aware of the categories of AI ethical issues, nor was there enough relevant research available. Categories were left to be discovered during the analysis. The reliability of the data was calculated using Krippedorff's alpha [18], which is regularly used by researchers in the field of content analysis. Krippedorff's alpha (α) is a reliability coefficient developed to measure the agreement among observers [19], coders, judges, raters, or measuring instruments and helps in how much the resulting data can be trusted to represent something real [20].

A lot of efforts were put in by the research team who continuously tried their best to refine the methodology. They reached a high agreement with Krippedorff's Alpha larger than 0.8 on most variables and averaged 0.94 on all variables.

The agreement of the identified thirteen application areas and eight AI ethics issues is summarized in Table 1.

Content Category	Krippendorff's Alpha
AI supervision	0.79
AI recruitment	0.44
Identity Authentication	1
Language/vision model	0.98
Intelligent recommendation	0.96
Autonomous Driving	1
Intelligent Service Robots	1
Smart Healthcare	1
AI Education	1

Predictive policing	1
Smart Home	1
AI Game	1
Smart Finance	1
Privacy	1
Inappropriate Use (Bad Performance)	0.9
Unethical Use (illegal Use)	0.97
Racial Discrimination	1
Gender Discrimination	0.98
Unfair Algorithm (Evaluation)	0.94
Mental Health	0.86
Physical Safety	1
Average	**0.94**

Table 1: Krippedorff's alpha for each variable. The upper part corresponds to application areas, and the lower part corresponds to AI ethics issues.

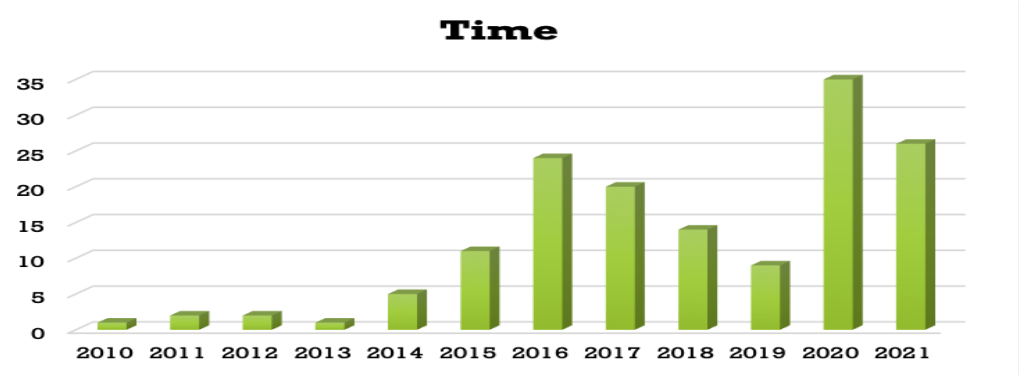

Figure 1: Yearly based AI ethics incidents

3.2 Time-based Evolution of AI Incidents

Figure 1 depicts 150 AI ethics ranging from 2010 to 2021. The incidents annually increased from 2010 to 2016. This was because there were many AI advancements during these years. A decline in the years 2017 to 2019 can be well noticed [21], probably due to a more cautious approach in AI design and implementations. But again, in the year 2020 and 2021, the incidents broke the previous records [22].

3.3 Geographic Distribution of AI Incidents

The AI companies which are in certain developed countries happen to have more AI ethics incidents more in that region than any other part of the world. It was discovered that technology-based organizations are the key players in the development of AI technology and are also the ones who create the technology that causes ethical incidents [23]. Countries like

the USA, UK and China where most AI based companies are located have 80 out of 150 incidents.

Another type of location category is Global, depicting those ethical issues which occurred globally, rather than just in a particular specific geographical location or a country [24] as defined here in Figure 2. For example, an incident that happens in a news company is classified into the news and media industry which occurred globally. Another example is the incident of gender bias embedded in NLP, all over the world [25].

Figure 2: Geographic distribution of AI ethics incidents

4. DATA ANALYSIS

4.1 Application Areas of AI Incidents

Table 2 depicts thirteen areas in which applications of AI were discovered having ethical issues. Following are the areas, according to the number of incidents that took place.

S. No	Fields / Areas of AI	Number of Incidents by Year 2021
1	Intelligent Service Robots	31
2	Language / Vision Models	27
3	Autonomous Cars	17
4	Recommendation Systems	14
5	Identity Authentication	14
6	Supervision / Monitoring under AI	14
7	Smart Health	10
8	AI based recruitment,	10
9	Predictive Policing	8

10	Smart Finance	4
11	AI based Games	2
12	Smart Homes	2
13	AI based Education	2

Table 2: Application Areas of AI ethics incidents

Here in Figure 3 last seven fields, have the occurrences of AI ethics incidents relatively rare, yet these issues have emerged and cannot be ignored in any case.

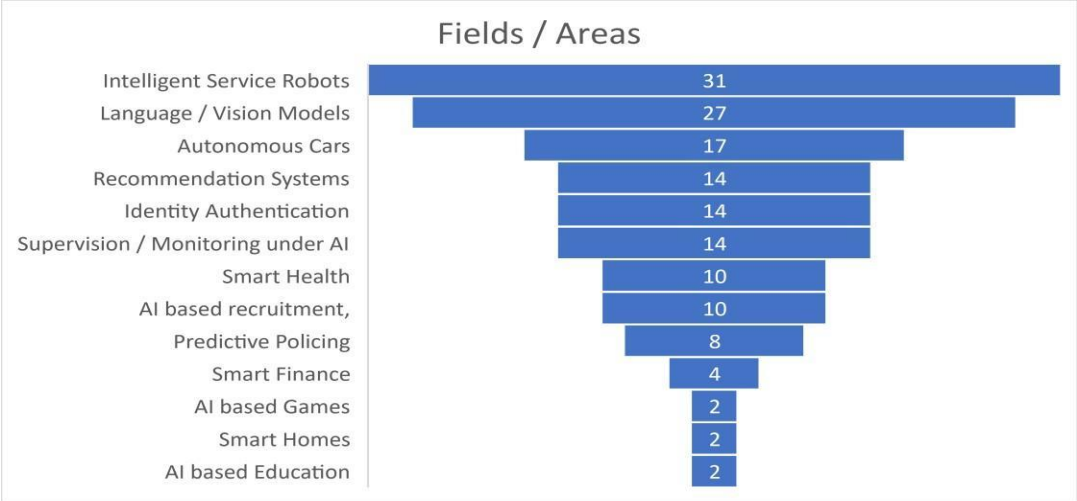

Figure 3: Application fields of AI ethics incidents

4.2 Taxonomy of AI Ethics Issues

Among 150 AI ethical issues, eight categories were discovered during the content analysis. They have been shown here in table 3 in accordance with their respective frequencies.

S. No	Taxonomy of AI ethics issues	Frequency of Events
1	Inappropriate Use (Bad Performance)	48
2	Racial Discrimination	38
3	Physical Safety	32
4	Unfair Algorithm (Evaluation)	22
5	Gender Discrimination	19

6	Privacy	12
7	Unethical (Illegal Use)	11
8	Mental Health	4

Table 3: Taxonomy of AI ethics Issues

It may be the case that an AI application may have more than one ethical issue as classified here in Figure 4 as well. It is worth noticing that one AI application may have multiple AI ethics issues. For example, a chatbot can contain gender discrimination and cause privacy leakage. This exhibits a complex nature of the AI itself.

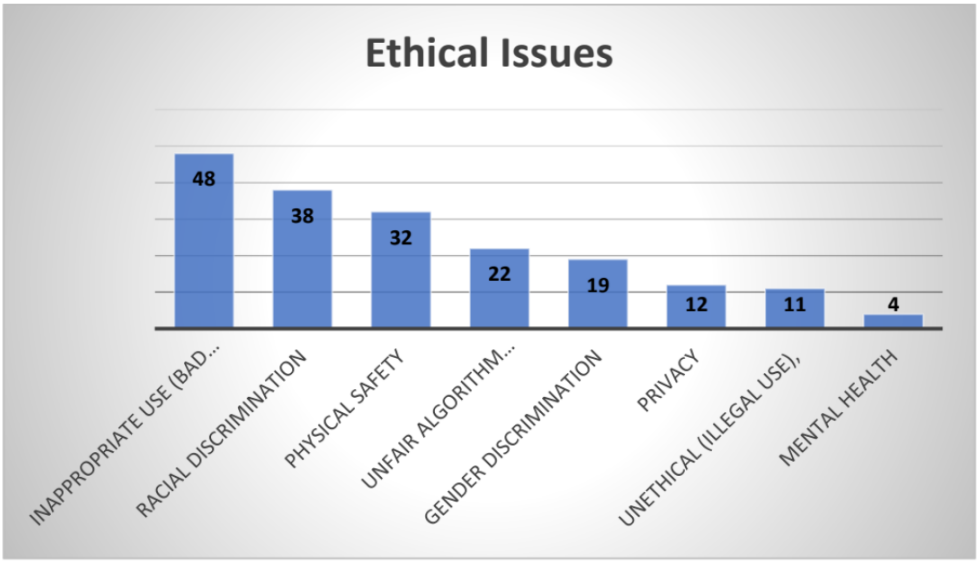

Figure 4: Classification of AI ethics incidents

5. DISCUSSION ON RESULTS

Four attributes, “Time, Geographic Locations, Application Areas and AI Ethic Issues" were discussed. The incidents of AI have increased over time. Developed countries like China, UK and USA have more accidents than other places in the world as the amount of AI work is done is more in these countries than anywhere else. Then Application areas were divided in 13 categories in which Intelligent service robots, language and vision models and autonomous drivers have the most incidents [26]. Lastly, eight categories were identified having AI ethical issues. The most obvious one is “bad performance, which is caused by the consequences due to the limitations in current AI practices [27]. People safety and racism is also the primary concern, the latter being somehow embedded in the designed algorithm, which can have a

negative impact for certain groups of people. Incidents have been there where people have been put into risk by robots [28], which were designed for service and manufacturing.

Jobin et al. compiled 84 AI guidelines and presented an overview. Considering the highest frequency, three principles are addressed below [29]:

1. Transparency: Many AI incidents occurred due to lack of transparency. Developers and practitioners were not able to explain the real mechanisms working behind a black-box algorithm. The consequence and performance are not predictable and guaranteed, thus leading to various AI incidents [30].
2. Justice and Fairness: It relates to non-discrimination, non-biased and impartiality. Racism, gender biasness is found to be common on many incidents. Most of these occur in language or computer vision models. This should be a very focused area for the AI experts while designing and deployment [31].
3. Non-maleficence: The principle of nonmaleficence holds that there is an obligation not to inflict harm on others. It is closely associated with the ***maxim primum non nocere*** (first do no harm) [32]. This principle relates to Safety, harm, security and protection concerns. This is the third most common issue in the ethical guidelines. Very less-frequent efforts have been made in developing AI algorithms safe for human society [33].

In general, people do know about the rules and theories behind the ethics, but do not know the ways to implement them in AI. Neither they know about the impact it may create if the ethics are not followed. This review paper helps to understand the incidents which are occurring due to the lack of importance in AI ethics and a point to start thinking to design some operable regulatory framework based on ethics [34].

6. CONCLUSION AND RECOMMENDATIONS

As human decisions are not perfect, so do AI systems as well. We need to foresee if the inherent risks are greater or less than the risks of not using AI. Is it tolerable as well? Terms like “Trustworthy AI”, “Beneficial AI” should come into practice in every walk of life [35]. Many have tried to find ways to compute Ethics and add an ethical component in the design of AI. AI has the advantage of improving human life in many ways, but also has the risks of developing dangerous technologies that can be very harmful to humans. We need to design and apply this technology with care and wisdom [36]. Finally, it is the need of the

time that research should be made in machine ethics and applied in a lawful and safe manner. Means are required to integrate values concerning morality, society, and legality in technological developments in the field of AI both in design and implementation.

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IMPROVE SERVICE QUALITY: EMPIRICAL EVIDENCE FROM DUBAI RETAIL INDUSTRYIMPACT OF PROCESS VISIBILITY AND WORK STRESS TO IMPROVE SERVICE QUALITY: EMPIRICAL EVIDENCE FROM DUBAI RETAIL INDUSTRY," *Int. J. Technol. Innov. Manag.*, vol. 2, no. 1, 2022.

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BEHAVIOUR OF INVESTMENT RETURNS IN THE DISINVESTMENT ENVIRONMENT: THE CASE OF POWER INDUSTRY IN INDIAN CPSEs

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ABSTRACT

Investment return may be defined as a recital gauge through which profitability of an investment is evaluated. It helps to assess the effectiveness of dissimilar investments at a particular point of time. Hence, return on investment is an attempt to straightforwardly compute the income of a fastidious investment with respect to its investment cost. The CPSEs in India were set up to serve the extensive macro-economic objectives of fiscal augmentation, independence in manufacturing, surfeit equilibrium of payments, and managing the inflationary and deflationary situations. In the backdrop of our earlier research published in IJSSP, USA, vol.10, no.10, 2022, the present study is an attempt to assess the behavior of investment returns with a view to assess their impact in the disinvestment environment with reference to power industry in Indian CPSEs during 2010-11 to 2019-20. Overall, both the industries (i.e., power generation industry and power transmission industry) have generated optimistic earnings on their investment in all the years under cram. Thus, power industry notably drives the Indian economy. Though mean investment earnings of power generation industry have decreased marginally, there has been enhancement in mean investment earnings of power transmission industry in vocabulary of ROCE and ROE. For further enhancement in investment returns of power industry, steps should be taken to ensure best likely use of installed capacity, minimization of interest cost and effectual utilization of inner resources produced by the power industry. The study is based on secondary statistics at aggregate level. Besides, the study considered only accounting based measures of investment returns. Hence, future research may be carried out at micro level i.e., at company-wise level within each power industry in Indian CPSEs.

***Keywords**: CPSEs, Disinvestment, Investment Returns, Power Industry, ROA, ROCE, ROE.*

1. INTRODUCTION

Investment refers to an asset through which the price of currency grows over time. Thus, investment is the method of distributing money to generate revenue. The overall objectives of investment are conservation of capital, steady income, tax advantages, etc. The various objectives of investment are conservation of capital, steady returns, capital appreciation, tariff advantages, and accomplishment of economic goals. In this context, investment return may be defined as a recital gauge through which profitability of an investment is evaluated. It helps to assess the effectiveness of dissimilar investments at a particular point of time. Hence, return on investment is an attempt to straightforwardly compute the income of a fastidious investment with respect to its investment cost [1].

The Central Public Sector Enterprises (CPSEs) in India were set up to serve the extensive macro-economic objectives of fiscal augmentation, independence in manufacturing, surfeit equilibrium of payments, and managing the inflationary and deflationary situations [2]. The CPSEs are considered as a contrivance for change of the economic structure with impartiality and social righteousness. The CPSEs started their journey with a capital cost of Rs. 29 Cr. only, while the total capital costs of the CPSEs stood at Rs. 16,40,628 Cr. as on 31.12. 2019 [3]. The CPSEs act as tactical players towards the formation of an economy. They supply indispensable products and services as well as play a noteworthy role in essential sectors like petroleum, electricity, steel, mining, telecommunications, hospitality, etc [4]. The CPSEs were established with a view to reduce poverty, achieve self-sufficiency, employment augmentation, elimination of inequalities, etc [5]. But these goals could not be achieved up to the desired level. As a result, the Govt. of India initiated the process of disinvesting its equity shares in selected CPSEs from the year 1991-92 [6].

Disinvestment is the process in which Government's equity is withdrawn (either in portion or in totality). The basic rule of disinvestment is to boost capital, encourage civic participation on a wider basis and to achieve improved marketplace answerability [7]. Thus, disinvestment seeks to ensure optimal use of nationalized capital and to boost industrious effectiveness of the CPSEs [8].

2. THEORETICAL FRAMEWORK

CPSEs occupy a significant position and perform a crucial role in the development process of Indian economy. They are the assets of the nation. Furthermore, enormous funds are invested by the Government [9].

In this backdrop, our earlier research (published in IJSSP, online academic press, USA, vol.10, no.10, 2022), investigated the influence of industry-wise investment returns on the aggregate investment returns in Indian CPSEs. The study results indicated that among the selected industries, investment returns in power industry have foremost influence on aggregate investment returns of the CPSEs [10]. These empirical results inspire us to carry out further research on the behavior of investment returns with a view to assess their impact in the disinvestment environment with reference to power industry in Indian CPSEs [11].

2.1 Research Questions

In the context of rationale of the study, the subsequent pertinent research questions have emerged out to demeanor experiential research on the behavior of investment returns in the disinvestment backdrop with reference to power industry in Indian CPSEs [12] during the period under study:

How are the investment returns of power generation industry measured?

How the impact of investment returns in power generation industry is measured?

3. LITERATURE REVIEW

A moribund trend is found in investment of the CPSEs in the state of Kerala with a low use of capacity. The study revealed that by increasing capacity use, profitability could be improved. Overall, the study stated that reform measures that were adopted had brought preferred outcomes in the CPSEs [13]. To achieve efficiency, the study further recommended that privatization is a short-range measure rather than a lasting measure [14]. Privatization cannot be held responsible for the problems associated with transition process. Furthermore, fiscal recital indicated improvement in profitability and sales competency [11] and profitability recital had amplified by twenty four percent points. Further, profitability increased due to improvement in productivity [15]. The study further revealed that profitability was higher in competitive markets as compared to the non-competitive markets [10].

The CPSEs in India had recorded better performance in the post-reform phase as compared to the pre-reform phase in relation to sales, revenue, market capitalization, etc. The study further stated that in spite of desired results, more efforts are required to augment the

effectiveness of the CPSEs in India [16]. Monopoly firms were competent in profitability recital, while operating performance in respect of profitability and sales of the competitive firms had declined after the disinvestment stage [17].

Most of the recital indicators did not perform well after disinvestment. The reasons that could be ascribed towards the reduced recital were Govt. intervention in the functioning of the CPSEs, incompetent industrial composition, milieu limitations, and diminutive percentage of disinvestment [12]. Similarly, disinvestment had enhanced the profitability recital of the loss creation CPSEs. The investigator recommended that staff and civic of the profit creation CPSEs should be offered divested equity shares of the CPSEs [18].

Some recital indicators like net worth, EPS, debt, etc. showed meager performance, while some recital indicators like net profit, operational profit, etc. revealed better recital after disinvestment [19]. Overall, at least forty one percent of the sample selected in the study showed enhancement in monetary and operational recital during the study epoch [15] and the performance of the CPSEs in the sectors represented by mining, service, electricity, and manufacturing [20]. The study revealed momentous augment in the overall operational effectiveness in relation to sales and net income [21]. On the other hand, profitability recital showed unimportant results [8].

The collision of disinvestment on fiscal recital of the chosen Maharatna and Navratna companies. The study results showed that due to disinvestment, Maharatna companies had momentous collision, while no noteworthy collision was observed in the Navratna companies [16]. The profit velocity recital of the CPSEs at macro level [22]. The study found a decreasing trend in ROCE and RONW, although no considerable deviations were found between the trend values and real values of ROCE and RONW [23]. In the collision of disinvestment on the monetary performance of twenty CPSEs [24]. The study found positive collision on monetary recital of the Indian CPSEs in relation to dividend, value, liquidity, and size, while operational efficacy, leverage, and profitability of the CPSEs did not modify considerably [25].

3.1 Research Gap

From the findings of prior literature as stated above, the following research gaps are identified: No study is found with respect to investment takings of power industry (comprising of generation and transmission segment) in Indian CPSEs. No study is found to assess the impact of investment profits in power industry in Indian CPSEs.

3.2 Objectives

Against the backdrop of research gap, the primary objective of the study is to examine the investment returns of power industry in Indian CPSEs. To accomplish this major intent, the following resultant objectives are required to be achieved:

- To examine the behavior of investment returns based on investment ratios.
- To examine the impact of investment returns in the disinvestment ambiance.
-

4. Methodology

The cram applied quantitative approach to assess the behavior of investment takings of power industry in Indian CPSEs. Hence, the study betrothed resultant pecuniary statistics which is gathered from obtainable yearly information of Public Enterprise Survey of Govt. of India [1]. In addition, aggregate data of both the industries (i.e., power generation industry and power transmission industry) are used in the cram to arrive at a significant conclusion [26]. The applicable data are collected, tabulated, and analyzed according to the requirements of the cram. Further, the outcomes are calculated through SPSS 19 version software package.

4.1. Research Model

The sample of our study comprises of power generation industry and power transmission industry in Indian CPSEs.

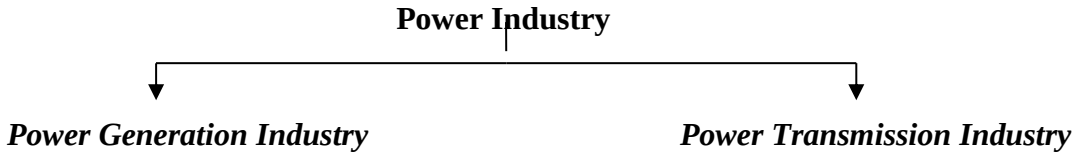

Figure 1: Proposed Research Model

4.2. Variables Identification

A length of 10 years ranging from 2010-11 to 2019-20 forms the study phase of our research. The reason for selecting this specific time is because disinvestment in the Indian CPSEs took place on an unremitting annual basis. Further, the fiscal year 2020-21 has not been taken into consideration due to the consequence of Covid-19 pandemic and due to the non-availability of data [27]. To study the behavior of investment returns with a view to appraise their impact in power industry, the whole study period is broken down into two sub-periods, namely:

1st sub-period: 2010-11 to 2014-15, and 2nd sub-period: 2015-16 to 2019-20.

4.3. Research Hypothesis

In compliance with the research objective of the study, the research assumption is framed as follows:

H_0: There is no considerable change in the behavior of investment returns.

4.4. Research Methodology

Explanatory Statistics

To measure overtime changes and to make comparison between the two sub-periods, explanatory statistics that comprises of average, S.D., and Coefficient of Variation (C.V.) are applied in the study [28]. Further, to appraise the reliability of investment returns in power industry at aggregate level, it has been arbitrarily estranged into comparatively steady (C.V. ≤ 25%), fairly fluctuating (25.1% ≤ C.V. ≤ 50.0%), highly fluctuating (50.1% ≤ C.V. ≤ 75.0%), and intermittently fluctuating (C.V. > 75.0%) [14].

Accounting and Statistical Methods

Based on the past literatures reviewed above, the ratios that are selected in the study to examine and analyze investment returns of power industry in Indian CPSEs are outlined below [15] [16]:

ROA = Net Profit after Taxes ÷ Total Assets.

ROCE = EBIT ÷ Capital Employed.

ROE = Net Profit after Taxes ÷ Shareholders' Equity

To examine the behavior of investment returns with a view to assess their impact in power industry, paired 't' test is applied in the study. The paired 't' test is shown below [17]:

$$t = (\bar{d}) \div (s \div \sqrt{n-1})$$

Where: $\bar{d}$ = average and 's' = S.D. of the differences d_i i.e., $d = (\Sigma d_i \div n)$ and $s = \sqrt{\Sigma d_i^2 \div n - (\Sigma d_i \div n)^2}$.

The paired 't' statistic follows t distribution with (n – 1) d.f.

4. DATA ANALYSIS

Investment Returns of Power Generation Industry in Indian CPSEs

ROA**:** From Table 1 and Figure 1, it is observed that ROA of power generation industry varies from 0.04 to 0.06 with an average of 0.05 and C.V. at 20.00% (i.e., relatively stable) during the whole period. From the sub-period analysis, we found that average performance of ROA has decreased from 0.06 in the 1st half to 0.04 in the 2nd half. The ratio moves from 0.05

to 0.06 in the 1st half, while the same moves from 0.04 to 0.05 in the 2nd half. Both the sub-periods have shown relatively stable performance in ROA.

ROCE: Table 1 and Figure 1 further reveals that ROCE varies from 0.07 to 0.11 with an average of 0.09 and it is relatively stable (C.V. 11.11%) during the whole period. The average performance of ROCE has gone down from 0.10 in the 1st half to 0.08 in the 2nd half. The ratio ranges from 0.08 to 0.11 in the 1st half, while it ranges from 0.07 to 0.09 in the 2nd half. Both the halves have shown relatively stable performance in ROCE.

ROE: Finally, from Table 1 and Figure 1, it is observed that ROE of power generation industry in Indian CPSEs moves from 0.09 to 0.12 with an average of 0.10 and it is relatively stable (C.V. 10.00%) during the entire period. In terms of sub-period analysis, the average performance of ROE has marginally decreased from 0.11 in the 1st half to 0.10 in the 2nd half. ROE varies from 0.10 to 0.12 in the 1st half, while it varies from 0.09 to 0.10 in the 2nd half. A relatively stable performance has been observed during both halves of the study period.

Table 1: Investment Returns of Power Generation Industry in Indian CPSEs

Years	**ROA**	**ROCE**	**ROE**
2010-11	0.06	0.10	0.11
2011-12	0.06	0.10	0.11
2012-13	0.06	0.11	0.12
2013-14	0.05	0.09	0.10
2014-15	0.05	0.08	0.10
2015-16	0.05	0.08	0.09
2016-17	0.05	0.08	0.10
2017-18	0.04	0.09	0.10
2018-19	0.04	0.07	0.10
2019-20	0.04	0.09	0.10
Whole Period:			
Average	0.05	0.09	0.10
S.D.	0.01	0.01	0.01
C.V.	20.00%	11.11%	10.00%
1st Sub-Period:			
Average	0.06	0.10	0.11
S.D.	0.01	0.01	0.01
C.V.	16.67%	10.00%	9.09%
2nd Sub-Period:			
Average	0.04	0.08	0.10
S.D.	0.01	0.01	0.01
C.V.	25.00%	12.50%	10.00%

Source: *Author's Calculation.*

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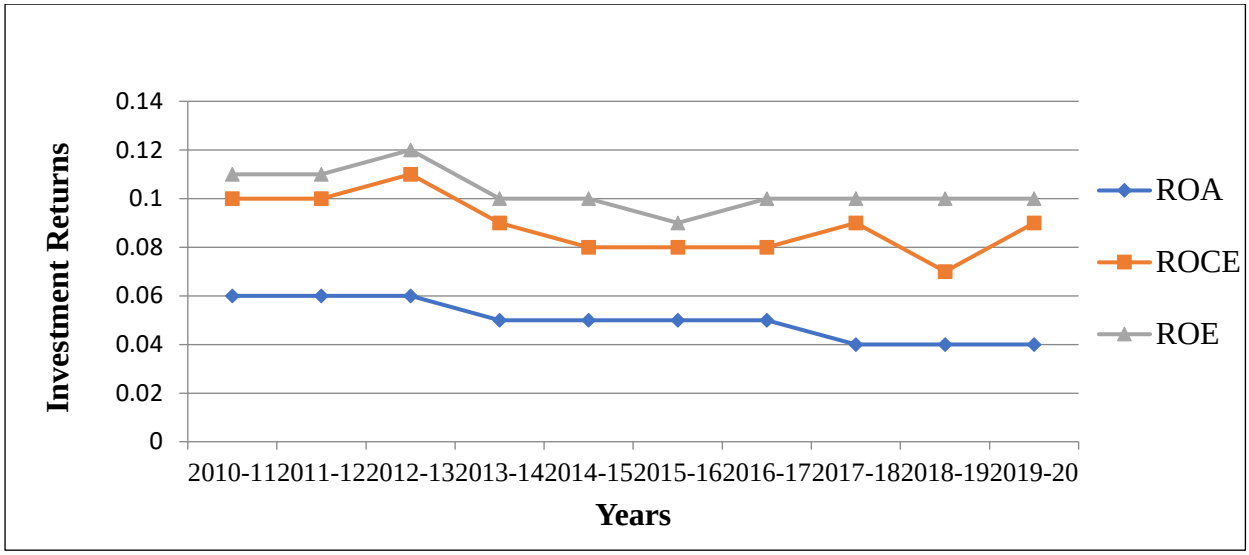

Figure 1: Investment Returns of Power Generation Industry

Paired 't' Test for Investment Returns in Power Generation Industry

Paired 't' test (Table 2) reveal significant result at 1% level for ROA (t = 6.00). However, we found insignificant results for ROCE (t = 2.33) and ROE (t = 2.24). The above analysis leads to the rejection of null supposition of the study for ROA. This indicates that average performance of ROA has significantly decreased (i.e., negative impact) during the study period. However, the same hypothesis (i.e., null supposition) has been accepted for ROCE and ROE.

Table 2: Paired 't' Test for Investment Returns in Power Generation Industry

Particulars	**ROA**	**ROCE**	**ROE**
Average (1st Sub-Period)	0.06	0.10	0.11
Average (2nd Sub-Period)	0.04	0.08	0.10
Calculated value of t	6.00***	2.33 [i]	2.24 [i]
Impact	Negative Impact	No Impact	No Impact

Notes:
*** marked value indicates significant at 1% level (2-tailed).
[i] marked values indicate insignificant.

Source: *Author's Calculation.*

Investment Returns of Power Transmission Industry in Indian CPSEs

ROA: Table 3 and Figure 2 shows that ROA of power transmission industry in Indian CPSEs ranges from 0.03 to 0.04 with a C.V. at 25.00% (i.e., relatively stable performance) during the entire period. The whole period average is observed to be 0.04.

The average performance of ROA has remained same (i.e., 0.04) during both halves of the study [29]. In terms of movement of the ratio, it varies from 0.03 to 0.04 during both halves of the study. Further, ROA of PTI has remained relatively stable (i.e., 25.00%) during both the sub-periods.

ROCE: As observed from Table 3 and Figure 2, ROCE is relatively stable (C.V. 11.11%) and it varies from 0.08 to 0.10 during the entire period. The whole period average of ROCE is observed to be 0.09. From the sub-period analysis, we found that average investment returns in

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terms of ROCE have marginally improved from 0.08 the 1st sub-period to 0.09 in the 2nd sub-period. The ratio has remained constant at 0.08 in the 1st half, while the ratio varies from 0.08 to 0.10 in the 2nd half. A relatively stable performance (C.V. 11.11%) is observed in the 2nd half, while there has been no fluctuation (C.V. 0.00%) in the 1st half.

ROE: From Table 3 and Figure 2, we found that ROE varies from 0.13 to 0.17 with an average of 0.15 and C.V. at 13.33% (i.e., relatively stable) during the entire study period. In terms of sub-period analysis, the average performance of ROE has improved from 0.14 in the 1st half to 0.16 in the 2nd half. The ROE of PTI moves from 0.13 to 0.16 in the 1st half, while the same moves from 0.14 to 0.17 in the 2nd half. Both the sub-periods have shown relatively stable performance with respect to ROE.

Table 3: Investment Returns of Power Transmission Industry in Indian CPSEs

Years	**ROA**	**ROCE**	**ROE**
2010-11	0.04	0.08	0.13
2011-12	0.04	0.08	0.14
2012-13	0.04	0.08	0.16
2013-14	0.03	0.08	0.13
2014-15	0.03	0.08	0.13
2015-16	0.03	0.08	0.14
2016-17	0.04	0.09	0.15
2017-18	0.04	0.09	0.15
2018-19	0.04	0.10	0.17
2019-20	0.04	0.10	0.17
Whole Period:			
Average	0.04	0.09	0.15
S.D.	0.01	0.01	0.02
C.V.	25.00%	11.11%	13.33%
1st Sub-Period:			
Average	0.04	0.08	0.14
S.D.	0.01	0.00	0.01

C.V.	25.00%	0.00%	7.14%
2nd Sub-Period:			
Average	0.04	0.09	0.16
S.D.	0.01	0.01	0.01
C.V.	25.00%	11.11%	6.25%

Source: *Author's Calculation.*

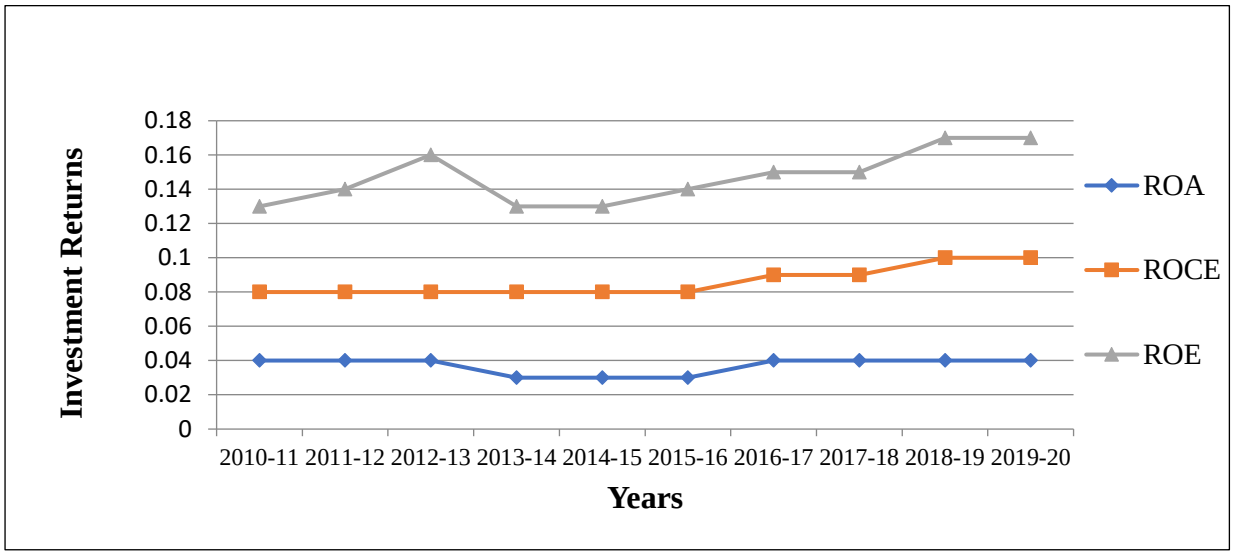

Figure 2: Investment Returns in Power Transmission Industry

Paired 't' Test for Investment Returns in Power Transmission Industry

Table 4 shows insignificant results for ROA (t = -0.54) and ROE (-1.86). However, ROCE (t = -3.21) shows significant result at 5% level of significance. The above analysis leads to the acceptance of null supposition of the study for ROA and ROE. For ROCE, the null supposition has been rejected in the study. This indicates that there has been significant improvement (i.e., positive impact) in the average performance of ROCE from 1st half to 2nd half of the study.

Table 4: Paired 't' Test for Investment Returns in Power Transmission Industry

Particulars	**ROA**	**ROCE**	**ROE**
Average (1st Sub-Period)	0.04	0.08	0.14
Average (2nd Sub-Period)	0.04	0.09	0.16
Calculated value of t	-0.54 [i]	-3.21**	-1.86 [i]
Impact	No Impact	Positive Impact	No Impact

Notes:
** marked value indicates significant at 5% level (2-tailed).
[i] marked values indicate insignificant.

Source: *Author's Calculation.*

5. DISCUSSION ON RESULTS

The mean ROA of power generation industry is marginally higher as compared to the mean ROA of power transmission industry all through the entire stage. Sub-period investigation discloses no change in mean ROA for transmission industry [30], while the same decreases from first half to second half in power generation industry [31].

So far overall profitability (i.e., mean ROCE) is concerned, both the industries have parallel recital during the entire phase under study. However, sub-period examination discloses development in overall profitability recital by the power transmission industry, whereas power generation industry shows a decrease in profitability recital from first half to second half of the study [32]. In vocabulary of mean ROE, power transmission industry has elevated level of efficiency as compared to that of power generation industry throughout the entire epoch. Further, mean ROE examination between the two sub-periods discloses [33] an enhancement in power transmission industry, whereas the same decreases in power generation industry [34].

From the above discussion, it can be affirmed that there is an improvement in mean investment takings in power transmission industry (except ROA). On the other hand, power generation industry has exposed a moribund recital in mean investment profits throughout the epoch under study [35]. As a result, power transmission industry has brought optimistic outcomes in the disinvestment environment as compared to the power generation industry. The outcome of paired 't' test shows pessimistic impact in ROA of power generation industry, although power transmission industry shows affirmative impact in overall profitability (i.e., ROCE) [36]. Thus, it implies that power transmission industry has considerably enhanced their overall investment income [37], whereas return on assets in power generation industry has appreciably decreased in the disinvestment environment.

The above deliberations escort to the succeeding comments:

- Both power generation and power transmission industry generate positive takings on their investment.
- Both the industries reveal relatively stable recital in investment takings during the entire period and the two sub-periods of the cram.
- ROA of power generation industry shows pessimistic impact, although ROCE of power transmission industry disclose optimistic impact as indicated by paired 't' test. The remaining cases disclose immaterial outcomes.

6. CONCLUSION AND RECOMMENDATIONS

In finale, it may be concluded that both the industries (i.e., power generation industry and power transmission industry) have generated positive takings on their investment in all the years under cram. Accordingly, power industry considerably drives the Indian economy to a prime degree [38]. Though average investment profits of power generation industry have decreased marginally, there has been enhancement in average investment profits of power transmission industry in vocabulary of ROCE and ROE [39]. In terms of uniformity in investment profits, power industry in Indian CPSEs has shown relatively stable recital during all the periods under cram [40].

Though both the segments of power industry disclose affirmative profits in Indian CPSEs, the study has shown mixed impact in investment returns of power industry during the study epoch. Hence, further research is necessary at firm level to identify whether firm specific factors play an important role in determining their profitability performance. Further, to optimize investment profits in power industry, steps should be taken to guarantee best possible utilization of installed capacity, minimization of interest cost and effective use of internal funds fashioned by the power industry [41].

The findings of the study contribute theoretically and practically. Theoretically, the study contributes to the presented literature on investment income in Indian CPSEs. Moreover, findings of the cram will be helpful to the potential researchers for additional exploration. Practically, the behavior of investment income is assessed in power industry [42]. Hence, this cram might act as an indicator to the Government for framing suitable strategies to attain more growth [43]. In investment profits of power industry in Indian CPSEs by adopting necessary measures like best possible utilization of installed capability, minimization of interest cost requirement and effectual use of inner resources generated by the power industry. Further, it will help the Government to frame appropriate strategies related to divestment of their equity in the competitive liberal economic scenario [44]. The study is based on resultant data at aggregate echelon. Besides, the cram considered simply accounting based measures of investment profits. Moreover, margin ratios and market-based measures of profitability are not considered in this study. Hence additional research might be carried out with other important measures of profitability at micro level i.e., at company-wise level within each power industry in Indian CPSEs.

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EXTREME PROGRAMMING VS SCRUM: A COMPARISON OF AGILE MODELS

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ABSTRACT

For past couple of years agile software methods have been quite popular among the researchers. Agile models are known as light weight in contrast with conventional software development methodologies, due to their casual, versatile, and adaptable style. Agile frameworks became heartily accepted by the software society in view of their concentration towards timely software conveyance, product quality and user satisfaction. For the fulfillment of requirements and needs of different software projects multiple agile frameworks are present to choose from. Out of these models Extreme Programming and Scrum are the most recognizable and generally utilized frameworks. This research contributes by investigating these two frameworks thoroughly. This paper conducts a comprehensive comparison between Scrum and Extreme programming to track down their commonalities, dissimilarities and investigate those attributes which complement each other.

Keywords*: Extreme Programming, XP, Scrum, XP vs Scrum*

1. INTRODUCTION

Software development methodologies are utilized for creating all kinds of projects whether small and easy or big and complex. These methodologies minimize the risks of project failure. They are very helpful in developing software in sectors like academic and industries [1]. There are different software development methods present like waterfall, spiral and agile [2][3][4][5]. Due to the benefits and the attributes presented by agile methodologies, agile frameworks have taken the place of traditional models in the software community [6][7][8][9]. These attributes tackle the necessities of present-day development of software. The scholars, analysts and software practitioners blended the best practices and features to conquer the

downfalls of traditional models [10]. To produce good quality product, agile frameworks deliver the software considerably fast [11]. Agile frameworks are iterative and incremental in nature hence user's requirements are fulfilled by constantly delivering fragmentary and partly done software [12][13][14]. Any change in client's requirements is also easily handled during any phase of development. These models have proven effective for handling the changing business environment [15][16][17][18]. Agile methodologies have been getting admired for quite some time now as they are simple, adaptable, and perfectly suitable for today's requirements of software development. They have proved to be quite resourceful in various fields like business and education system [18]. Feature driven development [19], Adaptive software development, Dynamic system development method, Lean software development, Scrum and Extreme programming [2] are the examples of agile models. These different agile methods also include a variety of techniques like test-driven development [20].

The most utilized agile frameworks are Scrum and Extreme Programming particularly for limited scope projects. Extreme programming has 6 phases in the development process. 12 best practices of Software engineering are used during these phases. Extreme programming utilizes these practices to achieve better quality software [21]. Change in requirements can be easily managed due to its adaptable, lightweight and iterative nature even in the last stages of development [22][13]. A great interest has been observed as well in customizing XP as it is simple and flexible [23]. An example of such customization is Scaled Extreme Programming [24] XP also assists the developers to consistently recognize and get work done on the software artifacts with higher priorities [15]. Scrum is an iterative project management model which gives a straightforward 'inspect and adapt' system [25]. In this model the delivery of the software is in increments known as Sprints. The scrum model is very useful for projects that are complex especially the ones with requirements and essential technology that is still immature [26] and out of all the agile models, Scrum is the most frequently used [27][5][28][29]. It is a very popular model and adopted all around the world. Scrum was also found to be widely used at Microsoft [30]. Like XP, Scrum can also be customized [10]. Many hybrid models of scrum have been developed within the agile family [6]. These two agile frameworks, XP, and Scrum have quite a few similarities and differences. This study is directed to investigate and analyze them thoroughly. This examination gives a profound understanding of these two approaches that will significantly be quite useful for developers and analysts.

A systematic research process is performed in this paper for the comparison study of XP and Scrum. To perform a successful systematic research process, an appropriate research method is required which can assist in accomplishing all the research objectives. Multiple

studies have been conducted which provide a guideline for the systematic research process [10][23][31]. A systematic search strategy was formed based on these studies which was adopted in this paper. Generally, Systematic research process consists of 3 fundamental steps; plan, conduct and document. The steps which are included in our research methodology are as follows; Research questions are defined, keywords are stated to form the query string, research space is specified to collect data, inclusion and exclusion criteria for articles and studies is defined, literature is extracted based on this criteria, quality of the study is assessed, required data is synthesized and lastly the results are documented [32].

The remaining paper is divided into following sections: Section 2 explains Scrum, Section 3 describes Extreme programming extensively and Section 4 presents the comparison of both models in detail.

2. THEORETICAL FRAMEWORK

In 1995 Sutherland and Ken Schwaber came up with an iteration-based software development framework. Later, it began to be known as Scrum when Ken Schwaber and Mike Beedle released a book called "Agile Development Software with Scrum" in year 2001. Scrum tackles loopholes of previous frameworks effectively and its every release is as per the changing customer demands. The overall process is completely transparent, well-inspected and easily adaptable. This strong check and balance system assures quick elimination of anomalies and timely results [33]. The product is released in phases called Sprints. The duration of sprints is 30 days or less. This model consists of 3 roles, 4 ceremonies and 3 artifacts.

2.1 *Scrum Phases*

There is Pregame, Game and Post game [34].

Pregame: Pregame defines the tentative vision based on customer expectations and market demand. This vision is continuously modified throughout the process later. The main purpose in this initial phase is to create a Product Backlog which has a list of functional and non-functional requirements [33]. Other form of data which needs to be reported is time and cost estimation plus the number of releases and the expected delivery date. For all these things, you need people, tools and funds [35]. So, the backlog contains this information as well. It has the names of members, the required development tools and the minimum number of finances needed to carry out each step of the plan. Fig. 1. Shows framework of scrum.

Game: Game happens in Sprints. Sprint is a one to four weeks period-based process in which you create, wrap, check and modify the product in question [34].

Post-game: In this phase, the final product is released, and the integration test is performed. Of course, this is after ascertaining that all the established requirements have been met. The user manual and training materials are also prepared to facilitate the user.

2.2 Sprint Cycle

The product backlog sets guidelines for the software [34]. The Scrum Master guides the team in its development phase and before the actual delivery of the product. The following steps are taken in the overall process

Sprint Planning and Daily Scrum: First, the scrum master and the product owner decide on the requirements. The priority tasks are filtered and guidelines for understanding the user needs are established. Next, the mission is handed to the team members after clearly communicating the requirements [36]. The self-driven, self-organizing and highly trained professionals, who despite having zero involvement from the outside, are expected to answer the following questions on almost a routinely basis [37].

- What is the progress so far?
- Are there any deviations from the established sprint goals?
- Are there any nuisances in the process?

Of course, the goal is to keep a tight check on the over-all performance without disrupting anybody's personal space for quick and efficient results.

3. LITERATURE REVIEW

Each sprint is developed and tested as per the guidelines and established priority, as communicated by the master. Now the sprints are reviewed by the boss and the owner. A detailed inspection is carried out to check whether the product is in line with the customer requirements. Next, a meeting is held where thoughts and opinions between the two parties are shared in detail. Based on this discussion, the next course of action is decided. The team members might have to completely re-think and design the sprint if the owner deems it necessary. For a 1-month sprint, the maximum duration of a sprint review is 4 hours [38]. Having established the basic plan, the next meeting is all about the improvements that could be made. The two parties check for any loopholes and decide on the remedial measures. Scrum is the team established for product development. It consists of one, the product owner, two, the scrum master and three, the team members [37]. The product owner is the master of all trades.

He creates the project schedules, manages finances, negotiates with the shareholders, and communicates their needs to the team. He has a fairly good idea of market's strengths and

weaknesses and understands his team [39]. Therefore, it is imperative that he has strong grip on both the management and engineering fields. He stays in touch with the changing market dynamics and keeps his team informed about all the rising opportunities that can be beneficial for the project [40]. The scrum master is the team's master. He establishes some ground rules and makes sure everybody follows them [41]. Also, he keeps in check the over-all working environment, protects the team from any outside intervention and takes care of the interests of his members. He holds scrum meetings daily where work-related issues are discussed, and practical solutions are offered [42].

The team has generally 3 to 9 members. Although the team size depends on the area of operations, but most studies suggest that a team size of 7 +/- 2 has more success rate [38]. Each member is highly qualified and trained for the task assigned [43]. While each member has the freedom to choose his own task, the team must ensure smooth execution of the process from initial phase to its final practical implementation in the market [44].

3.2. Research Model

In our research, we have developed the following model for the better understanding of the concept used in the research.

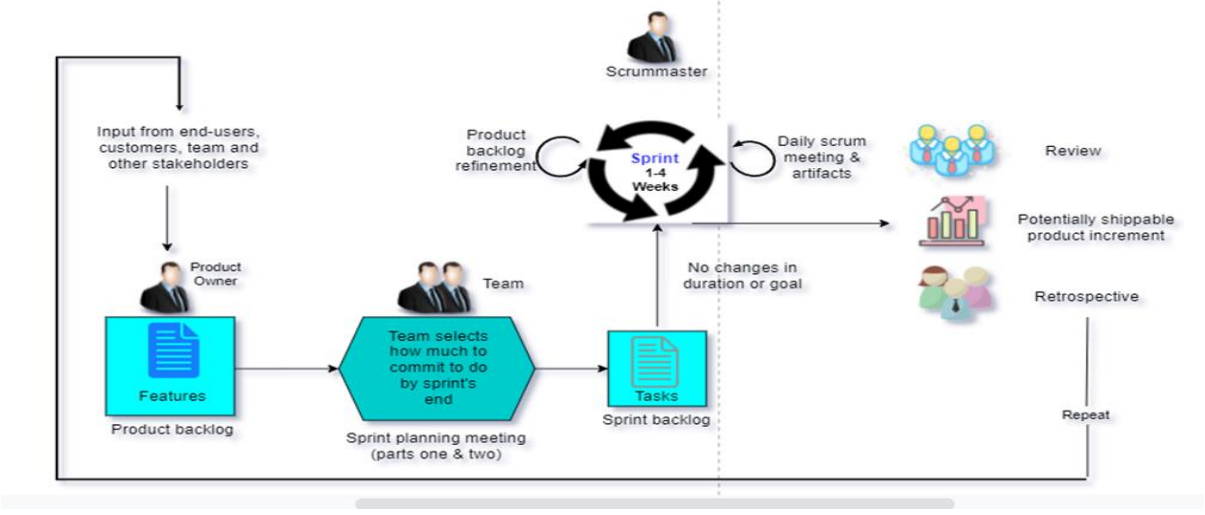

Figure 1: Scrum Framework

3.3. Variables Identification

Extreme Programming:

Extreme programming, an agile model, was invented by Kent Beck in the year of 1996. He then introduced his work on Extreme programming in a much sophisticated and advanced form in the shape of a book known as "Extreme Programming Explained". It is quite simple, uncomplicated, and more adaptable methodology of development with the capacity to oversee unclear, ambiguous, or quickly varying requirements [26]. This model is well suited for teams of small or medium size [45]. Extreme Programming is a set of values, principles and practices which are implemented in an orderly fashion [46]. Such practices that proved useful in creating a high-quality software were taken to extreme hence the name Extreme programming. This agile model greatly emphasizes on user satisfaction. To tackle the defects and errors at early stages, frequent reports and partially done software releases are necessary. Lesser number of defects bring down the development cost and expenses and produce high quality product at such a low cost. Extreme programming overview is given in Fig. 2.

XP Phases:

There are six phases in Extreme Programming development process: Exploration, Planning, Iteration to release phase, Production, Maintenance and Death phase.

Exploration Phase:

This stage is the first step of Extreme Programming life cycle that manages product's architectural development and requirements of the product. This stage describes client's requirements, design and architecture, tools and software used. To schedule the release, a meetup is organized between client and the developer. The story cards are used by clients to compose user stories to present software requirements. The user story cards consist of story's priority, a brief name and one to two paragraphs of non-technical text [47]. The user stories are supposed to be comprehensive and very much in detail to assist the developer to better grasp and comprehend system requirements and help furthermore with estimations. The time that is needed to execute a story is known as time estimation [48]. In case a story takes more time to execute then the customer can break that story down into rather small fragments of stories. During architectural spike metaphors are formed for the purpose of modeling architecture [49]. A Metaphor does not fulfill all the criteria of a whole architecture rather it is just a structure containing objects and their interfaces. Exploration stage has a duration of several weeks to several months.

Planning Phase:

Planning stage begins right after the exploration stage has completed and this second phase looks for the responses of two inquiries fundamentally:

Which parts can be formed within the deadline that consist of a business value?

What would be the strategy for the upcoming iteration?

Planning stage requires merely one or two days to finish if the exploration stage went well. Utilizing the user stories tasks are drawn and composed on task cards during Planning. In Extreme programming planning is knowns as "Planning game" which is additionally carried out in two sections i.e., Iteration planning and Release planning [50].

Release Planning:

The main target of release planning is to discover the attributes required by the system and delivery plan of those attributes. In the meeting held for Release planning both the client and the developer take part. Release Planning is further sub divided into three stages: "exploration phase, commitment phase and steering phase" [47]. Story cards are written by the clients to find out the much-needed system attributes [51]. Then all these required attributes are arranged by their significance and for the latest release a smaller group of story cards is chosen. This is a continuous procedure that can be modified and changed by adding, erasing, combining, or breaking up a few stories [52].

Iteration Planning:

Every iteration usually begins with iteration planning. A plan is devised by developers of the tasks which implement required attributes of the latest release at this stage. During this phase the developer choses the activities that are to be carried out and evaluates the needed expense, time, and effort for the chosen activity [53]. These activities might be shared between the programmers to stabilize and adjust the load of the work.

Iteration to Release Phase:

This stage includes the fundamental development tasks like designing, coding, testing and integration. Every iteration may take 1-4 weeks. In the very first iteration those stories are chosen that design and consist of the architecture of the product. A pair of developers execute the activities chosen for the recent iteration. The developers choose an activity and then create a basic design to code it [54]. Functional testing is the next step after the completion of coding. In case the programmed code does not satisfy the needs then code refactoring is implied. Multiple iterations might be required for development to end. To monitor development process or to discuss any problems that may arise, standup meetings are held. The code is set for the next phase after the last iteration [55].

Production Phase:

Extreme programming releases small releases of the software as it an incremental process. Continuous release system in this model lets the system to be developed in iterations [56]. A cycle of release may contain many iterations and each iteration may be of one to four weeks of duration. This phase focuses on software delivery in small releases [57]. During production phase developers delay the speed of system evolution to avoid any risks.

Maintenance Phase:

Maintenance is a fundamental process for any software framework. In Extreme programming the software is updated and modified continuously for some time span. A new functionality is developed while the previous is still in use at this stage [58]. Those alterations that might hinder or cause issues with the production are terminated.

Death Phase:

Death phase is the last stage of Extreme programming. To arrive at death phase there are two possibilities. In first scenario the software is released when the built software contains all the required functionality, client satisfaction and zero stories. A record is kept in the shape of a short document of 5-10 pages in case it is needed in the future. In the second scenario "entropic death" of the software occurs and it would be wise to cease the development of the software [59].

4. DATA ANALYSIS

4.1 XP Practices

Extreme programming has 12 practices. These practices make Extreme programming unique and stand out as compared to other software frameworks. During the development of the software these twelve practices are applied considering the principles of Extreme programming [60].

Planning Game: For additional planning requirements of the system are gathered on a story card. During planning game roles and size of the team, time and whole plan and agenda is laid out [61]. This practice is carried out in 2 sections i.e., release planning and iteration planning.

Small Releases: In each delivery a bunch of requirements are created that have a little business value [47]. These small releases make the product accessible and in reach of the client for analyzation and inspection.

Metaphor: It is the structural and architectural plan of the system that depicts how system should function. It is a vital method for the understanding of the system for developers [62].

Simple Design: This practice serves to be an incredible way to develop fundamental required functionality of the framework and steer clear of less important information. It centers around latest required attributes.

Continuous Testing: Continuous testing gives a speedy input and response. Unit testing and acceptance testing are utilized by Extreme Programming persistently.

Refactoring: Refactoring is rebuilding the framework without altering its behavior [61]. To improve the code quality, developers use this activity consistently.

Pair Programming: In extreme programming two software engineers code at one same machine. To build best quality software and a cheaper cost [63], pair programming is utilized since many defects are caught and rectified within a short span of time by the second programmer.

Collective Ownership: The concept of collective ownership of the code is such that any developer can have the approach to any piece of code whenever they desire to modify it [64]. By granting this permission of review by multiple programmers boosts the software's quality.

Continuous Integration: By the time each task is finished the system integration is performed along with testing which lowers the chances of any integration issues and further enhances the quality [65].

40-Hour Week: It is a standard defined by Extreme programming that programmers are not allowed to work more than 40 hours a week. Extra working hours for programmers are not appreciated by this agile model as chances are exhausted and fatigued developers will make more errors.

On-Site Customer: A representative of the client is included in Extreme programming team and stays on site during all the process. This representative is a specialized professional who has the power to choose required attributes of the system, respond to the questions, and can lead the development process. Being on site helps to reduce the communication issues.

Coding Standards: There are a few coding standards that need to be followed in this agile model [66]. The ownership of the code is collective and can be approached and modified by any developer due to which coding standards need to be implied.

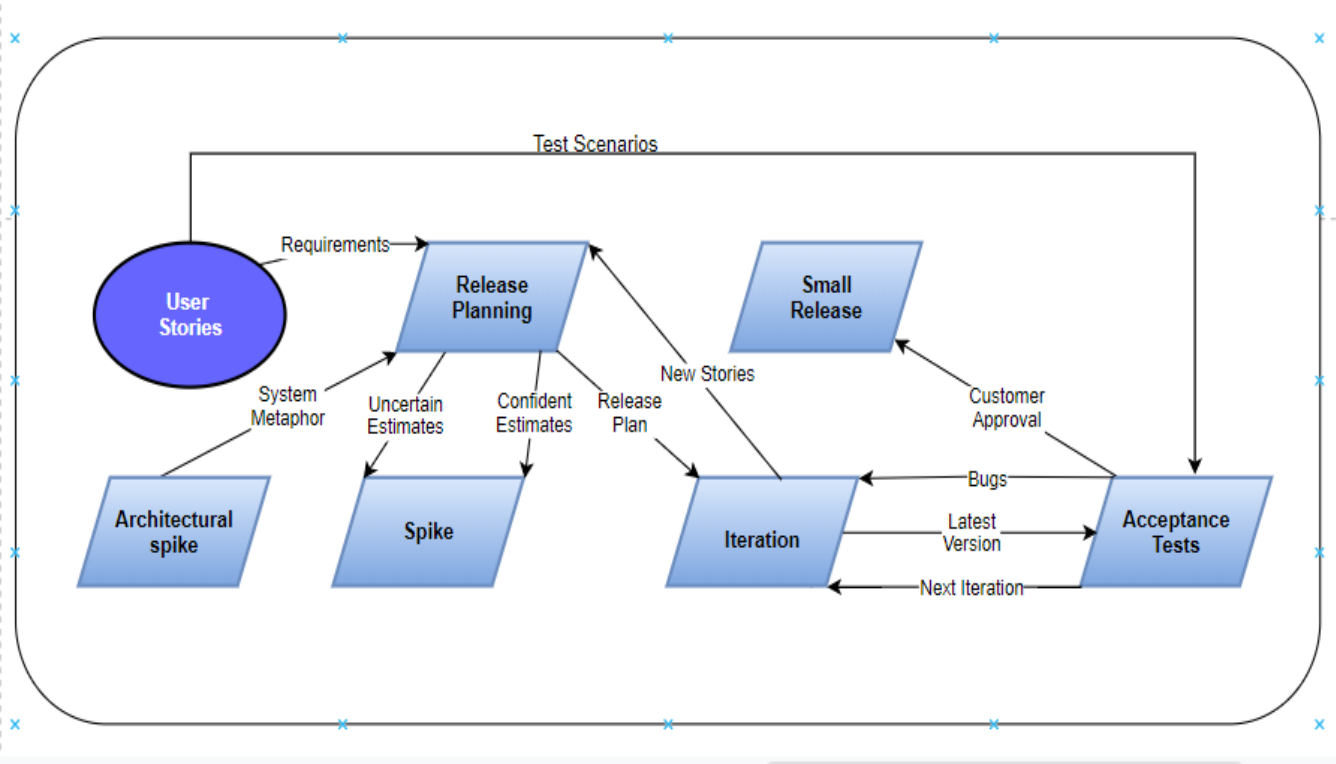

Figure 2: Extreme Programming overview

4.4 Comparison

Extreme programming and Scrum are very popular agile frameworks. To have a different view of these models a thorough comparison is done based on various factors and attributes. For this purpose [67] was considered and consulted. This comparison can be seen in 'Table 1'

Table 1: XP VS Scrum

Extreme Programming	Scrum
It is Iterative and incremental	It is also Iterative and incremental
It has a small project size	Project size: All
The team consists of 2 to 10 members.	More than one team with less than 10 members
It has following team activities: Planning game, Pair programming, Collective code ownership etc.	No Team activities.

1 to 3 weeks is the sprint duration	Sprint duration is 4 weeks
Throughout the process there is stakeholder's involvement	Not Specified
Communication is done Orally, through standup meetings	Also Orally, through Scrum meeting
There is no project management	Project management is present
Co-located teams	Physical Environment is not specified
It focuses more on engineering factors	It focuses on management and productivity.
It has a Quick response towards change	Same as extreme programming
For requirement gathering User stories and on-site customer practices are utilized	Not specified
Difference between different requirements is not specified.	Not specified
Documentation is Less	Same as Extreme programming
There is no upfront design document	Not Specified
Development order is specified by the Customer	Development order is specified by the Scrum Team
The development style is adaptive	It is also adaptive for scrum
The Whole team has the access to code	Not specified
Alteration during iterations is allowed	Alteration during iterations is not allowed
Feedback can be given in minutes to months	Feedback can be delivered in over a month
Unit testing, integration testing and acceptance testing are performed	Not specified
There are no structured review meetings	Same as extreme programming
Functional Testing and Acceptance Testing are performed for validation	Not specified
Test first approach is carried out for QA	Not specified
Coding Standards are properly defined	Coding standards are not defined
Software configuration practices are not defined	Software configuration practices are not defined as well
There is no support for distributed projects	Not defined
No process management	No process management

5. DISCUSSION ON RESULTS

5.1 XP Values

When Extreme programming practices are applied, there are five Extreme programming values that are focused on and they are simplicity, respect, courage, communication, and feedback.

Simplicity: Things are kept simple by this agile model like simple design, simple code and simple plan. Simple solutions are preferred, and no additional functionality is added unless the customer specifies otherwise [68]. Plain and minor repetition of Extreme programming aides in avoiding the risk of project distraction.

Communication: Among the team members, Extreme programming uses continuous and active communication instead of documentation [69]. Meanwhile all the team members and customers continuously communicate on site to find more appropriate and budget-friendly solutions to the problem.

Feedback: The feedback that spans on different time scales is used by Extreme programming. Rapid feedback about the developing software is provided by unit testing and integration testing which are performed daily. The project is kept on the right path by the help of feedback and communication. A distinguishing feature of Extreme programming which is presence of a customer on site aids in getting fast feedback about the developing software.

Courage: Courage is required for Extreme programming practices. It is sometimes required to rewrite the design or code that is completed after substantial effort. It also refers to making decisions that have never been made for the system before.

Respect: Another major value of Extreme programming introduced in [47] is respect. Respect for other members and self-respect is important which makes it possible to execute Extreme programming. The developers can be compelled to do high quality work by showing respect for work [70].

5.2 XP Roles

Seven roles of the team members with their qualities and responsibilities are defined by Extreme programming which they must execute within the team.

Programmer: The most important role in the Extreme programming team is that of a programmer. The main activity in Extreme programming performed by the programmer is coding. All these tasks are to be performed by the programmer hence there is no designer, architect, or analyst in this agile model's team.

Customer: Another major member of the Extreme programming team who takes part in a dynamic role throughout the development process is the customer. He writes stories, derives functional tests, and henceforth verifies those tests.

Coach: A person acting as a coach should have management skills. His decision making and communication skills assist the team members to be on the right path.

Tracker: The tracker's duty is to collect metrics such as load factor and functional test scores regarding the project. After two to three days, the tracker gathers data from all the developers and records the time consumed on a task and the time still required to complete it. It is the tracker's duty to validate the iteration and commitment schedules that are realistic and can be met.

Tester: The tester's responsibility is to conduct and aid the customers in writing functional tests and verifying them [48]. A tester has very less to do as the unit testing is performed by the developers in the Extreme programming.

Consultant: Extreme programming team does not have a specialist however, in some cases when the team needs technical guidance from an expert, a consultant can be hired for a specific period. The solution of the problem is discussed with the consultant by two or more developers in a meeting.

Big Boss: He is a coordinator that has responsibilities of building the team, providing required resources, equipment, and tools of the project. The big boss needs to show determination while supporting the team's decision [49].

6. CONCLUSION AND RECOMMENDATIONS

Extreme Programming and Scrum are well known agile frameworks that are broadly utilized for small scale projects. Best practices of agile industry are utilized by these frameworks for software development. In this research a detailed description of various stages, practices and roles of these models is given. To have a better understanding of these frameworks a comparison is also carried out [53]. This detailed comparison can be extremely useful for all those researchers with an interest in such frameworks of agile. It is uncovered by this comparison that these models have many similarities and differences. A few dissimilar attributes of these models complement each other which can lead to experimentation with combining Scrum and Extreme programming for high quality software development.

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