Chapter

The Chaotic Behavior of ICT Users

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Abstract

This paper describes how chaos theory was implemented to explain a behavioral aspect in an information system. The chaos theory was developed from the physical sciences and has been widely applied to many fields. However, this theory may also be applied to the social sciences. For certain types of human behavior, the chaos theory could comprehensively explain the phenomena of the use of information and communications technology (ICT). It means that this theory could clarify all the different kinds of human interactions with ICT. When the researchers used the chaos theory integratively, they could explain the distressed behavior of ICT users comprehensively. This theory argues that an individual acts randomly, even though the system is deterministic. When individuals use ICT, they could get technostress due to either the information systems or other users. This paper explains that ICT users could use information systems, with their complicated procedures and outputs. They were also probably disturbed by other users. The users, furthermore, experience chaotic pressures through their experiential values. This paper shows that users' behavior when facing chaotic pressure depends upon their personality dimensions. The authors finally propose a new paradigm that this chaos theory could explain the chaotic actions of ICT users.

Keywords: chaos theory, chaotic situation, technostress, coping strategy, creativity, controlling

1. Introduction

When individuals interact with information and communications technology (ICT) in either an information system or an application, they will relate to its complicated connections. They should try to have collaborative relationships with ICT. This relationship between users and ICT can lead them in either a circular motion or a non-linear direction that depends on the complexity of the problem. Meanwhile, the complexity of the problem is a result of the science used, and technology's progress, which sometimes makes surprising leaps forward. Thus, the problem requires not only the individual user's control and creativity but also his/her subtlety [1] to find alternative answers to the problems. Therefore, it is crucial to appreciate the potential for individuals to continue the interaction and influence the organizational direction and innovation. These individual are the people who can overcome an administration's dissolution and create workflow systems procedurally [2].

The chaos theory attempts to explain the complex and unexpected movements or system dynamics that depend on the initial condition. Wheatley [3] suggested that chaotic situations occurred when an organization left its ICT users to perceive the information system's devices themselves. The ICT users will usually follow inherent patterns and structures, based on their perceived procedures and

rules. The users continue to stay within a particular gap, to define and shape their direction. Thus, chaos can become an ally when the information system requires to integrate its quality into the organizational workflows [4]. It means that the organization strives to find someone to innovate and develop this system's workflows [4].

Both an accounting information system (AIS) and other applications are dynamic workflows. Complex interactions and collaborations between the systems' elements can cause unexpected and dramatic changes that create chaos. In other words, complex interactions and collaborations between users and ICTs in an AIS cause chaos (among others, i.e. technostress). In this condition, if the users cannot adapt to this technological progress and complexity, they will feel frustrated and depressed, experiencing what is called technostress. Then, this technostress will have an impact on decreasing the users' satisfaction with this ICT [5–12], their performance [5, 13–15], productivity [16–18], innovation [12, 13], commitment to the organization [11, 12], and role conflicts [12, 16]. They could survive in these chaotic conditions if their organizations facilitate the users with flexibility and adaptability in the ICT systems [19]. Briggs and Peat [1] described that chaos would not reoccur in organizations when the ICT users have three techniques, which are: control, creativity and subtlety.

The chaos theory could be used to highlight the initial use of an information system and its complexity by organizations. These complexities could destroy the user experience because these information systems could produce some unexpected consequences for the ICT users in their organizational environment. This paper takes into account that a user will interpret the information he/she obtains in different ways to the other users, due to the dominant characteristics of their personality traits. It means that each user personality triggers various complex responses [20]. Thus, individuals with different personality traits will evaluate and assess the destructive events caused by ICT in different ways. Unequal evaluations and assessments are due to the various intrinsic and extrinsic needs of each user.

The authors argue that an ICT user could make either a positive or negative evaluation. We noted that ICT users when facing technostress creators, would be influenced by their extrinsic needs since those are the situational factors. ICT users will continuously choose available mitigating strategies. From another side, the ICT users are affected by their intrinsic conditions, which are the dimensions of their personalities [21]. Finally, the chaos theory suggests that an individual could act randomly, although the systems are deterministic. These random actions are profoundly possible because of an individual's creativity or innovative capability, personality traits, or how well he/she can control him/herself.

From another perspective of the mobile internet, the authors explain that an ICT user probably faces technostress creators that are from other users. We took into account that the other users could either deface the infrastructure of the ICT [22] or act in an iconoclastic manner, [23] that could hurt some individuals. However, the authors define the defacement and iconoclasm are in the context of ICT users' communication, either orally or written. We accentuate that the other users utilize linguistic communications that destroy an individual's cognition. In other words, different users employ sarcastic messages that destroy a person's cognitive flow. This means the victimized user will suffer from technostress because of what the other users did. Consequently, this user will, most probably, stop working with the other users and the information system or application. The authors, moreover, argue that whether or not the user continues using the mobile internet depends upon his/her personality's dimensions.

The latest discussion of this paper is that technostress causes variations in the ICT users' behavior through the state of their cognitive flow. In other words, technostress's creators influence ICT users' experiential values. The authors argue

that chaotic pressure, due to the complicated information systems and applications, affects the users' enjoyment, entertainment, social affiliations, visual appeal, and escapism [24–26]. ICT users experiencing a technostress creator find it affects their motivation to achieve task-related performance levels and satisfaction. Ultimately, we re-emphasize that the chaotic experiential values of ICT users could be from a complicated interconnection and collaboration with the information systems, or the systems' defacement, or iconoclastic actions. The authors, in other words, propose that the technostress creators could support the users' continued use of, or abandonment of, information systems and applications. However, this continued use of ICT is related to each user's personality dimensions.

The remains of this paper will discuss the chaotic behavior of ICT users in four subsections. SubSection 2 presents a resume of chaos theory. The chaos theory, chaotic situations, and usefulness of this theory as an idea in explaining ICT users will be explored in subsections 3 and 4 consecutively. The last subsection has a conclusion.

2. The resume of chaos theory

In 1961, the meteorologist Edward Lorenz was the first to introduce the chaos theory. This theory tried to find a form of uniformity from seemingly random data [27]. Lorenz discovered this theory accidentally. He was looking for a reason why the weather was unpredictable. He used computer assistance and 12 formulation models. He created a program which could not predict the weather but can illustrate what the weather will be like if its starting point is known. One time Lorenz wanted to see the results of the weather model's sequence.

He started from the middle, not from the beginning. For simplicity, Lorenz entered a value consisting of three decimal numbers (0.506), while the number of the sequence was 0.506127. Because the rounding was correct, then the pattern formed by the two numbers should be similar, but it turned out that the design which appeared was more and more different from before. Based on this discovery, Lorenz re-experimented, this time using a simpler model with only three formulations. The result of the data, when displayed, again appeared to be random, but when the data were entered in graphical form, a phenomenon called the butterfly effect was created. A small difference at the starting point (only 0.000127 difference) changed the overall pattern.

The chaos theory refers to the tendency of dynamic, non-linear systems toward disorder or chaos, sometimes behaving unexpectedly, but always deterministically [27]. This theory also refers to the underlying linkages, which exist in random events, which are calculated from the initial conditions [1, 28, 29]. Chaos science focuses on hidden patterns, nuances, sensitivity to things, and rules about how something that cannot be predicted leads to human behaviors.

This theory is not only applied to exact sciences but also social ones, such as the social sciences, psychology, finance, decision making, management and behavioral or information systems. McBride [29] was the first researcher to use a framework based on the chaos theory in the field of information systems. This framework consisted of interaction domains, initial conditions, foreign attractors, events and choices, peak clutter, bifurcation, looping, and connectivity. The focus of this interpretive model was on the value of building descriptions of information systems' interactions in organizations.

Levy [19] applied the chaos theory when making theoretical frameworks to understand the dynamics of the industrial evolution and the complex interactions among industry players. An industry can be conceptualized and modeled as a

complex and dynamic system, which shows both uncertainty and underlying order. Levy created a simulation model to illustrate the interactions between computer manufacturers, their suppliers, and their markets. The simulation's results showed how managers might underestimate the costs of international production. He concluded that, by understanding that any industry is a complex system, managers could improve their decision making and find innovative solutions.

Meanwhile, Ayers [28] mentioned that, in the field of psychology, the concept of chaos had been explored extensively. This concept is primarily in the area of psychoanalysis, on a symbolic level. Outside of psychoanalysis, the chaos theory has been applied to a variety of clinical subjects to varying degrees. Still, almost all of its applications appear metaphorical (although one cannot always make this statement explicitly). This theory was also used for psychological processes through the practical application of chaos methodology, e.g. [30, 31]. It showed that, even though the application of metaphors is useful in providing appropriate ways of looking at psychological disorders, the successful application of future psychopathological changes depends on whether it is validated by practical work demonstrating chaos in the associated psychological phenomena.

Moreover, Radu et al. [32] presented the application of chaos theory in management. Also, they explained the positive and negative sides of this theory in a company's current strategic management, in organizational change projects or the management of highly dynamic projects. Furthermore, Klioutchnikov et al. [33] explained that the chaos theory is very suitable for understanding financial perspectives because several circumstances determine the behavior of the financial markets, which are relative to the needs, and internal and external reasons can cause those circumstances to arise. They tried to clarify several points related to the possibility of using chaos theory in finance. Its mechanism of implementation in finance was in macro- and micro-processes. This mechanism also used specific methods and instruments, such as fractal and stochastic processes and predictions.

The latest work by Sauermann [34] involved chaos theorems drawn from the social choice theory and used to investigate the relationship between the indeterminacy of majority rule leads and voting cycles and to make democratic decisions. The study's results contradicted Riker's interpretation of the chaos theorems' implications. This core exhibited less attraction than generally assumed. Then, an empty core is not associated with majority rule's increased instability. Instead, conflicting preferences lead to more instability irrespective of the existence of an equilibrium.

3. Chaos theory and the chaotic situation

3.1 Technostress

Brod [35] introduced technostress as a disease caused by a person's inability to adapt to new computer technology. This paper argues that ICT users feel unhealthy and have little or no motivation to use information systems or applications anymore. This technostress could be manifested by ICT users getting either excessive fear or computer anxiety. Ragu-Nathan et al. [11] suggested that information technology created many problems which ICT users cannot overcome. In other words, ICT users feel that they cannot become familiar with the information systems or applications and what is required for them to follow the procedural tasks.

Srivastava et al. [36] suggested that technostress occurred when the requirements for using ICT exceeded a user's capabilities to cope with or mediate such stress. Moreover, Stich et al. [37] also concluded that technostress is impaired experiential cognition experienced by users because of the complicated ICT. Stich

et al. [37] constructed two main concepts: stressors (the creators of technostress) and strains (the results of technostress). Finally, Tarafdar et al. [10, 16] conceptualized five main categories of techno-creators, which are:

1. Techno-overload describes situations where ICT users are forced to accomplish their work in the allotted time. Otherwise, there would be a massive workload placed on the information systems.

2. Techno-invasion refers to the information systems which could probably invade ICT users' privacy. This technostress also illustrates the effect of ICT's invasion in creating insufficient motivation, where ICT users have to continue or stop, using the information systems or applications.

3. Techno-complexity describes a situation where the complicated tasks associated with ICT users makes them feel inadequate. Thus, this technostress forces them to spend more time and effort. It could also be explained that these tasks need ICT users to learn and understand various aspects of the information technologies they use.

4. Techno-insecurity refers to conditions where ICT users feel threatened with losing their jobs due to the presence of new information systems and applications. This technostress is caused by the ability of ICT to replace human working processes. It also applies to ICT users that do not have a great deal of knowledge.

5. Techno-uncertainty describes situations where new information systems or applications disturb the users due to the needs of their additional capabilities. This technostress would probably occur during the implementation of a new ICT system, for which the users have to learn new things.

From another perspective, Tarafdar et al., [10, 16], and Ayyagari et al. [38] identified and then clustered five technostress triggers, which are:

1. Work-home conflict - ICT users perceived their intra-personal conflict to be between their work and family needs.

2. Invasion of privacy - information systems would probably not protect ICT users' privacy. The users perceive that internet systems must not compromise their privacy due to their data being saved by a third party.

3. Work overload - ICT users think that their capabilities and competencies do not match with the requirements of the information systems. In other words, ICT users feel that their abilities or skill levels are not skilled enough to operate this ICT.

4. Role ambiguity - many users say that they feel uncertainty when accomplishing their work using information systems. They do not know a procedurally work order or its consequences on their performance. This paper also explains that ICT users suffer from a lack of information when they want to expedite their roles and authority.

5. Job insecurity - the presence of ICT means the ICT users may lose their jobs because the information technology could replace them and do their job.

Ayyagari et al. [38] classified three technological characteristics that could influence techno-stressors, which are: usability, dynamic features, and intrusive features. Usability, complexity, and reliability are generally associated with the use of information technology. These three characteristics of information technology are part of its usability features. The rate and frequency of technological changes relate to the nature of ICT, which are dynamic features. The ICT feature refers to the extent to which a person feels a shift in the technological environment is happening quickly. In contrast, the presentism and anonymity of the invasion by ICT represent the intrusion feature. Presentation's characteristics describe the extent to which technology allows users to either reach it or not. In contrast, anonymity describes the times when ICT users feel that they could not identify or trace the work they produced using ICT.

As mention earlier, some previous studies showed that technostress had harmed ICT users' outcomes, including reducing their satisfaction and performance [5–12, 14, 15, 18, 39]. ICT users, moreover, could not survive in these technostress conditions, which organizations must have facilitated using all the aspects of their skill, flexibility and adaptability [19]. Hwang and Cha [40] showed that security-related technostress creators in organizations negatively affect employees' organizational commitments, both indirectly and directly. This technostress occurred through their complex role and then reduced their intentions to comply with the information system's security. From another perspective, employee-focused promotions could moderate the relationship between technostress creators and role stress. Employees with a focus on gaining promotion are more resistant to the adverse effects of technostress creators, because they experienced lower role stress. Nimrod [41] made a new scale to measure technostress levels between younger and older workers. Technostress, moreover, must be considered a particular threat to the future well-being of ICT users.

Qi (2019), developed a theoretical framework to investigate the double-edged effects of using mobile devices. It used the sampling design of mobile devices among college students. This framework argued that positive results (an improvement in their academic performance) were investigated from their use, while adverse effects triggered technostress. This paper takes into account that Qi's study was based on the person-technology fit model (P–T fit model). It explained that the educational use of mobile devices by students does not lead to technostress. This use, however, could improve academic performance due to their high usage of ICT. The paper argued that students' self-efficiency and their skill level in using cellular technology affected their high-low technostress.

Human-technology interactions, especially during the development of information systems, are complex. To portrait this complex phenomenon, McBride [29] adopted the chaos theory to make a framework for interpreting the success of information systems' implementations in organizations. McBride's paper suggested that the chaos theory could explain the complicated phenomenon and the nonlinear and dynamic systems [19] such as the technostress creators in the implementation of an information system's development. The chaos theory means there is an underlying interconnectedness that exists in random events; hence the ICT users are concerned with the initial conditions [1, 28].

Through the chaos theory, the authors portray the phenomena of technostress holistically. We noted that developments to information systems are the domain of human-computer interactions, in what is probably a chaotic space between humans and information technology. The implementation of new information systems and complex ICT by organizations could be regarded as destructive events, resulting in some unexpected and unpredictable consequences for the users' environments [20]. When humans and information technology interact, individuals have to learn the

new processes that are required. These processes will flow according to the respective ICT users' methods. However, when ICT users encounter a disturbance, it will cause various impacts depending on their motivation to respond to it. Likewise, what happens when ICT users are facing technostress is also a chaotic situation.

3.2 Defacement and inconoclasm

The authors state in this paper that the interaction between humans and information technology is complex. Individuals could not deny this complexity is all around them, as a result of the increasingly digitalized world. The authors show some pieces of evidence about the destructive nature of technology, such as is found in the global digital infrastructure, social media, the Internet of Things, robotic processes' automation, digital business platforms, algorithmic decision making, and other digitally-enabled networks and ecosystems; all of which also fuel the complexity people feel around them [42]. Building up hyper-connections and mutual dependencies among the human actors, technical artifacts, processes, organizations, and institutions caused this complexity; which affects human experiences within their cognitive state in all magnitudes. Both organizations and individuals turn to digitally enabled solutions to cope with the problems arising from computerized digitalization.

In the digital world, complexity and digital solutions present new opportunities and challenges for research into the information systems. Systems-wide changes in natural open systems reveal how unorganized entities in a given system, subjected to an externally imposed tension, could engage in far-from-equilibrium dynamic actions. The entities, therefore, could self-organize into distinct phase transitions leading to new higher-level orders [43]. Defacing the machinery and sending out iconoclastic messages, for instance, could drive and hamper these changes in a chaotic situation.

A defacement is a physical act of vandalism or the destruction of a material thing. In the IT field, defacement has been bastardized to mean website destruction. Romagna and Hout [44] defined defacement as a kind of electronic graffiti and, like other forms of vandalism, it has been used to spread messages by "cyber protesters" or politically motivated hackers. Davanzo et al. [22] defined defacement as destruction in the form of a general attack on a website. In this case, the site's content is partially or entirely replaced, by the attacker, with content that is embarrassing to the site owner, for example, disturbing images, political messages, the attacker's signature form, and so on [22]. Meanwhile, Bellman [45] defined defacement as enlightenment. In short, defacement implies causing damage to something which, in this paper, is the ICT users' communication.

In behavioral research, defacement means as an attack aimed at changing users' behavior. Thompson et al. [46] explained that defacers try to make some changes in users' behavior, by manipulating their perceptions of reality. Criminals cannot achieve the desired results from their attack unless the users change their behavior in some way [46]. It is this modification of the users' actions that is an essential link in the cognitive attack sequence. In the case of the multiplayer online battle arena (MOBA) game player, we defined defacement as a communication breakdown that causes someone to decide to deface or vandalize something. In other words, the vandalism of communications equipment aims to destroy the recipient. This paper argues that defacement behavior causes damage that results in behavioral or cognitive changes in MOBA game players. In a game, defacement behavior occurs when a player deliberately throws out bad words to lure other players in and interfere with the game. A user could create chaos among the players so that the other players do not focus on playing the game and do not intend to play it again.

Iconoclasm is the social belief in the importance of destroying icons, images and monuments [47–49]. Latour [23] defined iconoclasm as an act of destruction, where the intention to do damage is apparent. Besides, Clapperton et al. [50] defined iconoclasm as the use of a strategy that represents a logical and instrumental means for using violence to achieve political goals. Furthermore, Clay [49] stated that they used iconoclasm to show domination and control over a group. During research into the field of communication, Smith [51] used iconoclasm via internet memes as a tool to display fake news to damage or reduce the image of a public institution.

In the MOBA game, it described iconoclasm as the destruction of an icon. In this case, it was the "hero." In this game, icons which describe the identity of the game players represent heroes [52]. Iconoclasm tends to harm or destroy the players. It usually occurs when a player chooses a hero that iconoclasts do not like. Iconoclastic players will insult the person because they feel that the hero is not suitable for use in the game. This incident will result in the players' fighting each other, which may also be carried over into the game. This paper argues that when people insult someone else's favorite heroes, the players could lose their cognition. The player is less motivated to play, and he/she stops playing, or continues playing, but not in a serious manner. This chapter also posits that the destruction of communications, either through defacement or iconoclastic actions, is a form of destruction in the MOBA game's communication channel. Both defacement or iconoclasm could destroy the players' cognition and cause chaos in the game.

3.3 Experiential value

The authors recall that chaos theory is supposed to explain complex, non-linear dynamic systems. From a theoretical perspective, this theory is also equivalent to the postmodern paradigm. This paradigm questions deterministic positivism because it recognizes the complexity and diversity of experience. Boccaletti et al. [53] suggested that advocates of the chaos theory enthusiastically highlight signs everywhere. These signs are pointing to the complex dynamic systems which are ubiquitous in the social world, and the similarities between the patterns produced by simulating non-linear systems and sequences. For example, this paper presents how share prices in the stock market and commodity prices fluctuated abruptly because these reactions always change seconds per second.

The diversity of experiential values of ICT users could be characterized by their optimal behavior [24], such as is seen in their flow experience [25]. Experiential values could also be explained as a result of sophisticated learning. Moreover, Moneta and Csikszentmihalyi [26] demonstrated that experiential values require total concentration and a great deal of interest in the activities characterized by optimal experience. The attributes of the experiential values of ICT users are as follows:

a. Escapism - escapism is a behavioral view related to the personal activities undertaken to avoid the realities that are challenging, impossible or un attainable [54]. Running away occurs when a person finds his/her life is spent in unsatisfactory conditions, which cause him/her to become detached from reality, and is done to reduce his/her anxiety [55]. Thus, the impact of chaos is felt when the individual cannot optimally realize the value of his/his experiences. The individual then experiences confusion which can act on his/her cognitive processes and causes the formation of affective disorders in the user.

b. Enjoyment - enjoyment is the pleasure that an individual feels objective when doing certain activities [56]. Based on the flow theory, Csikszentmihalyi [24]

stated that enjoyment occurs when a person not only fulfills the expectations that occur before or satisfies his/her desires but also achieves unexpected needs, which may have been previously unimaginable. Enjoyment occurs when a person feels involved in pleasure from within. This condition, therefore, causes people to tend to experience flow processes that form their cognitive and affective processes. It means that if an individual does not experience an optimal level of enjoyment, he/she will tend to have a chaotic pattern.

c. Social affiliation - it is through his/her social affiliations that a person feels interested in society, these are usually generated by his/her employer's company services, as an efficient approach to marketing [57]. Social collaboration occurs automatically and experiences a flow when the feelings of the individuals affect each other. The presence of an individual's flow in a social affiliation does not create an optimal experience. There will be a pattern of chaos in the individual's cognitive and affective flow so that it will harm the interaction socially.

d. Visual appeal - the visual appeal is a reactive source of esthetic value [58]. Visual appeal is a dominant matter to attract consumers' attention. From a marketing perspective, the attractiveness refers to the selection of data and information, and their transformation and presentation. Most companies usually facilitate customers'explorations and understanding [59, 60]. It means that a person's visual attractiveness shapes his/her experiences in condemning his/her affective and cognitive flow through data and information's selection, transformation, and presentation. Therefore, the experiential values are an essential source for the optimal experience to avoid cluttering the visual power.

e. Entertainment - entertainment involves observing the customers in a performance which leads to a relaxed reaction [61, 62]. This entertainment is an attribute of the ICT users' experiential values because their pleasured responses that make the results optimally. Thus, if it is not in the optimal joy, the chaotic patterns emerge in the ICT users' affective and cognitive flows.

The constructivist theory of learning [63] may be aligned with experiential values in which the outcomes of the learning process are varied and often unpredictable. This paper argues that an individual plays a critical role in assessing his/her learning outputs. An individual receives his/her experiential values from use or appreciation of a product or service [60] as like as information systems or an application. In this assessment process, everyone will respond differently depending on their self-control, activity and subtlety [1]. This process will always follow inherent patterns and structures, based on intrinsic values and rules, i.e. experiential values. In other words, this process always stays within certain boundaries to define and shape the direction of ICT users; otherwise, chaotic situations could occur [3].

4. Inducing the chaos theory to explain behavioral phenomena

Generally, many organizations use ICT to improve their competitive advantage so that this could transform their organizational efficiency, productivity, and effectiveness. From another point of view, they intend to use ICT to change their social and corporate environments [39]. However, if they cannot manage their ICT correctly, they are shadowed by the adverse effects due to their low use of it [40]. This paper recalls the implementation of a new ICT system that consisted of

complex and collaborative relationships. This implementation led to stress for the users as they could not cope with their organization's demand that they use the new ICT system. Brod [35] introduced technostress as an illness resulting from a person's inability to adapt to new computer technology. It is typified by over-identification or computer anxiety. Ragu-Nathan et al. [11] described technostress as a problem because the users could not overcome the difficulties with the new ICT system, or they could not become familiar with the new system. Technostress can affect the individual's orientation regarding the time he/she spends doing something, his/her communication mode, and his/her interpersonal relationships as well as his/her job outcomes, i.e., performance or satisfaction.

To explain this phenomenon, researchers into information systems conduct studies in various disciplines, including psychology, sociology, philosophy, and organizational studies. These disciplines explain the stress phenomenon as a source of contextual paradigms, and previous researchers often used the person-environment fit model to describe technostress [5, 39, 40]. This theory stated that when the relationship between people and their environment is beyond the equilibrium condition, it will create stress [41], i.e., technostress. This theory also portraits technostress as a linear system, while the interaction between humans and technology (i.e. computers) is problematic for the development of information systems.

This paper argues that ICT users have specific conditions with which they can interpret and understand the environmental conditions through their capabilities. ICT users' power triggers them to find various and complex responses. Thus, chaos can be an ally or a desired quality when integrated into an organizational system, especially when the ICT users try to innovate and develop [4]. This theory showed that the users' chaotic cognition triggers the relationship of their stressed transactions. ICT users, furthermore, must have strategies to deal with the chaos. Coping is a thing that individuals do, which sometimes allows them to solve problems and adapt to changes.

The inducement of the chaos theory in explaining the ICT users' behavior is not deniable. The authors demonstrate the chaotic behavior from two sides, which are complex interactions and the collaboration of the ICT system's elements [5–18], and both defacement [22] and iconoclastic methods [23]. These two sides affect ICT users' behavior when they have to face the technostress's creators. By these means, these sides influence the ICT users' performances and satisfaction when they are in a chaotic situation. Although the ICT users could mitigate this chaos, they may choose to face it, depending on how mature their personalities are. In other words, the ICT users have to cope with the complicated uncertainty or technostress creators by relying upon their personalities and emotions to overcome the chaotic problems.

This paper supports the undeniable inducement of the chaos theory to explain the ICT users' mitigation of the harmful effects of technostress. It argues that the technostress's creators at first settled on the ICT users' cognitive states. In other words, the ICT users got their experiential values, which are enjoyment, escapism, visual appeal, social affiliation, and entertainment, when they faced situations with technostress. From the perspective of learning, the authors propose that chaos theory relates to the ICT users' learning processes [63]. We take into account that chaotic mitigation affects the ICT users and may prevent them from dealing with the technostress efficiently and effectively. We recommend that information systems or applications must be developed with consideration given to facilitating the ICT users' experiential values. It means that the information systems and applications make the ICT users increase their enjoyment, entertainment, social affiliation and visual appeal as well as decreasing their escapism. The authors argue that technostress for ICT users would otherwise have occurred.

4.1 Technostress and a proactive personality

Personality is a characteristic of an individual, and this determines the person's thinking and behavior. Every individual has a unique personality, which differs from that of other people. Bateman and Crant [64] defined a proactive personality as someone who is relatively unrestricted by the situational forces which influence environmental change. Someone with a proactive nature identifies opportunities and demonstrates initiative, takes action when appropriate, and persists until meaningful change occurs. Parker and Sprigg [65] explained that proactive personalities usually engage in activities that affect themselves and their environment.

From the perspective of the chaos theory, whenever individuals face technostress, they are either in a chaotic situation or not. It means that the users' performance and satisfaction would be explained when both the chaos and technostress theories work concurrently. To overcome this chaotic situation, the user has to be creative [1, 4, 66], because his/her behavior will vary based on experiences. Personal innovativeness means that individual traits have a role in technology's adoption. This innovativeness entails the implementation of creativity or the generation of novel and useful ideas for the development of new products and processes [67]. Thus, in the implementation of advanced ICT systems, a proactive personality can boost the creativity of the users. Therefore, we posit that a proactive personality can play a role in mitigating the harmful technostress to a user's satisfaction.

Based on the chaos theory, Sumiyana and Sriwidharmanely [68] demonstrated that individuals work randomly or differently because of their creativity or personal innovations [1, 69, 70]. They can mitigate the adverse effect of technostress on ICT users' performance by inducing their proactive personalities. This study shows that when users interact with new technologies, and the users feel there is a mismatch (cognitive impairment) between their abilities and the requirements of the latest technology, this condition creates discomfort during their interactions (a chaotic situation, known as technostress). However, this sense of discomfort will be minimized if they have the creativity to use technology to help them complete their tasks. So, in the end, they can maintain their performance levels. In other words, they can turn a threat into an opportunity.

Specifically, this study's result shows that proactive-transform personalities maintained their performance better than proactive-conform personalities did when the ICT users experienced high technostress. It meant that the creativity of the users was more active when they faced high levels of technostress than low levels, which offered significantly more benefits for the proactive-transform personalities. The ICT users can take advantage of the work overload and deadline times in the system, so they can still maintain their performance. Even for the same proactive-transform personalities, the user faced with high levels of technostress performed better than the user who experienced the lower levels.

4.2 Technostress and positive emotions

ICT users probably feel that their capabilities are not compatible with the requirements of the new ICT and that they have limited control over them. They then feel uncomfortable because this creates technostress. So they will implement strategies to overcome these painful experiences (mitigation), whether they are related to the users' psychological expectations, rejection or wishful thinking (inward), or related to realizing and seeking support that affects their emotions directly (outward), or not. This strategy is called emotion-focused coping [71].

This strategy mainly focuses on the effort to restore emotional stability and reduce the tension caused by the implementation of a new ICT system. This paper

highlights that cognitive dynamic instability results in the ICT users' adverse impacts. For instance, we infer that the users' coping strategies are based on the control theory [1, 72], which was mentioned earlier, and these can cope with a chaotic situation or technostress. We argue that users' self-control (inward) and feedback on the assigned task's performance (outward) are the types of strategies which have a direct impact.

Self-control gives ICT users the belief that they could implement the system successfully. It takes into account the users' self-control because the system's development process is complex, and needs intensive involvement and the interaction of various agents [73]. Meanwhile, feedback is a communication process that involves a source (sender) and destination (receiver) [74]. Concerning the performance aspects or understanding the system, the ICT itself could provide feedback to the users who search for answers and solutions, so that they can evaluate whether they have the correct response or not [75].

By applying a contrast analysis, we confirmed that the broaden-and-build theory [76] explains that positive emotions can improve ICT users' capabilities to cope with their technostress. Positive emotions are affective components which ICT users typically find pleasurable to experience. Positive emotions could help ICT users to broaden their horizons, and then widen the scope of their focus [77]. Positive emotions could also increase the users' performance of a cognitive task by lifting their spirits without distracting them [78].

Expressly, we undertook a study which indicated that positive task performance feedback could boost the positive feelings of ICT users. It documented that the users who have low self-control also perform their tasks poorly. If they receive some form of therapy and positive feedback, their understanding is better than that of the ICT users who receive negative feedback. Our study, furthermore, showed that positive emotions play an essential role when ICT users face the harmful effects of technostress on their performance [76, 79]. Moreover, this study found that positive emotions affect both those with low and high self-control. It found that ICT users' task performances, for those with both low and high levels of self-control, were not different. It means that positive emotions have a more profound effect on mitigating the adverse impacts of technostress. The authors, therefore, argue that positive feedback could enhance the users' self-efficacy and individual innovativeness.

5. The chaos theory in behavior research as a new paradigm

The chaos theory suggests that an individual could act randomly although the systems are deterministic. The individual acts randomly because of his/her level of self-control, creativity or personal innovativeness and subtlely [1, 69, 70]. If the individual is in a state of technostress, or a chaotic situation, his/her capabilities are shown by the coping strategies that he/she uses to accomplish a complicated task. The authors argue that coping behavior is a transaction carried out by an individual to overcome the various demands (internal and external) of the thing that burdens and interferes with his/her survival. Coping is a cognitive and behavioral effort to manage (reduce, minimize, or tolerate) the internal and external demands of the person-environment transactions that an individual judge to exceed his/her resources [80]. Each individual will have a unique coping strategy for overcoming or hinting at a way to solve his/her problem. It means that when ICT users experience technostress, they should adjust themselves to the system or organizational environment.

When dealing with stress triggers, individuals overcome these disorders by using two main processes that are continuous, and which influence each other [80, 81].

These are also known as cognitive appraisals and coping strategies. First, individuals evaluate the potential consequences of events by making a judgment. The central assessment is one's judgment regarding the significance of an event that is stressful, positive, controlled, challenging, or irrelevant. Subsequent inspections are assessments of the resources and choices of individual mitigation strategies. This second assessment addresses what individuals can do to control the situation. Individuals take different actions to deal with chaotic conditions. It means that their mitigation strategy is to face the harmful effects of technostress. Thus, a mitigation strategy is an adaptive action that individuals do in response to disturbing events that occur in their environment.

More broadly, the interactions between the socio-technical entities produce a lot of the results that appear in the information system. This paper presents an example, which includes the creation of collaborative online orders and technology's capabilities [82]. It demonstrates that the organizations need the information systems to be in alignment [83] and that new configurations between organizational, platform and participant dimensions exist [84]. The emergence perspective offers a lens to understand the many unpredictable socio-technical phenomena that reach the individual, group, organizational and community levels, in the context of expanding digitalization.

In practice, the chaos theory can help accountants, auditors, and educators understand their environment holistically so that they can control or behave creatively to adapt and continue to survive in their environment. Levy [19] suggested the need for innovativeness to be examined. The advantages of the chaos theory are that it can portray industrial phenomena holistically. In a complex system, managers must be creative to improve the quality of their decision making and to help them find innovative solutions. Not all accountants, auditors, or educators have the resources to keep pace with the development of new information systems or applications. The implementation of new information systems enables ICT users to experience technostress. Facing this condition, each individual will have a different coping response or behavior. Holistically, ICT users can utilize their creativity or innovation to mitigate the negative impact of information technology. The ICT users, therefore, would not allow a new ICT system to continue to interfere with them achieving the required performance. Managers can make policies related to their staff's dysfunctional behavior due to complicated information technology. Managers must consider who gets stressed and how it impacts on them and others. Furthermore, managers can accommodate ICT users' innovations for facing technostress. In other words, managers can recommend ICT media that can be used to improve the users' learning of coping strategies.

6. Conclusions

The chaos theory implies that an individual could act randomly although the systems are deterministic. The individual acts randomly because of his/her self-control, creativity or personal innovativeness and subtlely. We can recommend the chaos theory needs further research because this theory could be used to explain the phenomena of technostress. We propose that the chaos theory and its conceptual framework could overcome the weaknesses of some previous approaches that only investigated technostress phenomena from a single side. This paper argues for the proper way to apply the chaos theory so that future researchers could portray the technostress phenomena comprehensively.

Not all ICT users can meet the needs or requirements of new information technology in an organization. It means that coping behavior could occur in the

unit analysis, either for individual or group users. This phenomenon still provides opportunities for further research. On the other hand, some research has also shown that the effects of information technology are not only harmful, just like other stressors, but they also have positive impacts. These positive consequences, due to technostress, also provide an opportunity to conduct further investigations because this impact could be not only linear but also non-linear.

From a different perspective, this chapter proposes the anti-thesis of the ICT users who had been hurt by technostress. It argues the use of the build and broadens theory for mitigating the harmful effects of technostress. When ICT users feel confused, due to the technostress's creators, the developers of information systems and applications could use this theory to facilitate them in coping with chaotic problems. This theory recommends that ICT users could be encouraged by information systems that improve the state of their cognitive flow. It then opens opportunities for future research to investigate the influence of this theory in reducing ICT users' emotional situations. Another future research possibility is the development of materials, tools or knowledge based on the build and broadens approach that could mitigate the negative experiential values of ICT users.

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Conflict of interest

The authors declare no conflict of interest.

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