Résumé

À l'époque de Covid-19, le travail à distance était une réponse nécessaire à cette crise sans précédent. Cependant, dans le monde post-pandémique, l'adoption du télétravail et l'usage effréné des autres technologies de l'information et de la communication (TIC), ne doivent pas être précipités et les décideurs doivent mesurer l'attitude des employés et leur fournir le soutien nécessaire afin d'éviter les effets secondaires du "Technostress".

Cette thèse présente une approche évaluée et répartie pour la gestion du stress technologique capable de personnaliser les stratégies d'adaptation « coping Strategies » (CS) pour chaque organisation spécifique afin de permettre aux technologies d'intelligence artificielle (IA) de gérer ce phénomène. Cependant, le changement et l'évolution rapide des technologies poussent les employés à actualiser continuellement leurs connaissances et à acquérir de nouvelles compétences, qui deviennent avec le temps un fardeau de plus en plus lourd sur leurs épaules. Cette charge entraîne l'apparition d'un autre type de stress appelé "Technostress" (TS).

Les différences existantes entre les organisations en termes d'infrastructures de TIC et de politiques de gestion de ressources humaines rendent très compliquée la tâche de gérer correctement à la fois, le TS et le CS pour le compte des gestionnaires et des professionnels de la santé.

C'est pourquoi, dans cette thèse nous proposons un prototype d'un Système de Gestion de Technostress (SGT) capable de gérer à distance le TS et les CS, conformément aux spécifications et aux politiques internes de l'organisation en matière de TIC. La solution proposée permettra aux organisations d'être plus indépendantes des directives externes non spécifiques, et d'acquérir progressivement un degré élevé de contrôle, de sensibilisation et d'expertise sur les nouvelles apparences des TS à venir.

Le recours à l'intelligence artificielle dans la gestion de la santé mentale est une nouvelle approche dans ce domaine, qui, nous l'espérons, sera utile aux médecins, aux patients et aux organisations dans un avenir proche, en permettant aux organisations d'utiliser plus facilement les mêmes méthodes de diagnostic, mais cette fois en les rendant assistées par ordinateur, et en facilitant la détection, sans que la permanente présence du spécialiste de santé ne soit nécessaire.

Mots-clés : Intelligence Artificielle; Stratégies d'Adaptation; Data Mining; E-santé; Système Expert; Satisfaction au Travail; Interaction Homme-Machine; Technologies de l'Information et de la Communication; Systèmes d'Information; Apprentissage Automatique; Technostress.

Abstract

In the Covid-19 era which is a period of crisis, remote work was a necessary response to this unprecedented crisis. However, in the post-pandemic world, decision-makers and top managers should by no means rush towards the adoption of telecommuting and the other Information and Communication Technologies (ICT), without measuring employees' attitudes and without providing them with necessary support in-order to avoid side effects of Technostress.

This thesis presents an evaluated approach divided for Technostress Management that is capable of customizing the CS for every specific organization towards enabling Artificial Intelligence (AI) Technologies to handle this phenomenon. However, the rapid change and evolution of technologies push employees to continuously update their knowledge and learn new skills, which over time become a burden on their shoulders. This burden leads to the occurrence of a different type of stress called Technostress (TS). Health Care professionals deal with this type of stress by using some strategies called CS.

The existing dissimilarities between organizations in terms of ICTs infrastructures, Management and Human Resource Policies, make the task of properly managing both TS and CSs for Managers and Health care professionals very complicated.

Therefore, we propose in this thesis a prototype for Technostress Management System (TMS) solution that is capable of remotely managing the TS and the CS, accordingly with the organization's own ICT specifications and internal policies. The suggested solution will allow organizations to be more independent of external non-specific guidelines, and to gradually build a high degree of control, awareness and expertise over the new upcoming TS appearances.

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Keywords: Artificial Intelligence; Computer Technology; Coping Strategies; Data Mining; E-health; Expert System; Job Satisfaction; Human-computer Interaction; Information and Communication Technologies; Information Systems; Machine Learning; Technostress.

N° d'ordre

Mohamed SALAH-EDDINE

Technostress Management, Towards The Improvement of The AI Conversational/Human Interaction Pattern

July 2021

UNIVERSITY OF HASSAN 1ST
Center For Doctorale Studies

Faculty of Sciences and Technologies of Settat

DOCTORAL THESIS

FOR OBTAINING THE DEGREE

DOCTOR OF COMPUTER SCIENCE

OF THE HASSAN 1ST UNIVERSITY

Under the topic

Technostress Management, Towards The Improvement of The AI Conversational/Human Interaction Pattern

Presented by :

Mohamed SALAH-EDDINE

Publicly Supported on: 06/07/2021
At The National School of Business And Management of Settat before the review panel composed of:

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Pr. MANSOURI Khalifa	**Professor of Higher Education, University Hassan II, ENSET Mohammedia (P.E.S)**	**Reporter**
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Academic Year: 2021/2022

جامعة الحسن الأول
UNIVERSITÉ HASSAN 1er

UNIVERSITY OF HASSAN 1ST

THE NATIONAL SCHOOL OF BUSINESS AND MANAGEMENT- SETTAT

DSC: MATHEMATICS AND COMPUTER SCIENCES

THESE

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2021/2022

" وَقُل رَّبِّ زِدْنِي عِلْمًا"

سورة طه [114]

" Et dis : Ô Seigneur augmente mon savoir "

[Sôurat Taha : 114]

" And say, My Lord, increase me in knowledge "

[Sôurat Taha : 114]

***A** la mémoire de Mon père*

***A** Ma chère mère*

***A** Mes chères sœurs Karima , Khaddouj,*

Fatouma, Rachida et

Saadia, Malika,Sanaa

***A** Mes deux Nièces d'amour Aya & Maryam*

***A** Mon frère Amine*

***A** Mon frère Mohamed Nabih*

REMERCIEMENTS

Mes premières pensées reviennent tout d'abord à Allah, le Tout Puissant, de m'avoir donné la santé, la force et le courage nécessaires pour aboutir à ce travail.

J'exprime mes sincères remerciements et toute ma gratitude, à Monsieur le professeur Mustapha BELAISSAOUI qui a dirigé et encadré cette thèse. C'est grâce à son expertise, ses conseils et son écoute que ce travail a pu aboutir. J'aimerais aussi souligner que son travail ne se limite pas à l'aspect scientifique mais aussi humain et relationnel. Il a su guider mon travail avec intelligence et a fait preuve de disponibilité et patience en toute circonstance.

Ma gratitude va également vers le professeur Mahmoud ELHAMLAOUI de l'ENSIAS de Rabat, et Dr. Yassine QAMSANE pour l'aide et soutien qu'ils m'ont donnés.

Merci également à tous les membres de l'équipe du laboratoire SIAD, et pour leurs conseils, encouragements, et pour la sympathie qu'ils m'ont témoigné.

Je tiens à remercier ma chère mère Fatima pour son amour inconditionnel, de soins et d'encouragement et de sacrifice tout au long de la période de préparation. Je serai éternellement reconnaissant, à ma grande sœur et deuxième maman Haja Khaddouj pour son support et soutien sans fin,

Je leurs dois beaucoup plus que je ne serais jamais capable d'exprimer en quelques phrases, que Dieu leurs accordent bonheur et santé.

Je remercie chaleureusement ma chère sœur la professeure Karima SALAH-EDDINE qui sans elle et son support moral et pédagogique, rien n'aurait été possible. Et à Dr. Amine BERRAZZOUK j'adresse mes éternels remercîments pour son soutien et encouragement fraternel.

Pour conclure, je garde une place toute particulière à mes chers et aimables amis Dr. Alae ELALAMI, Dr. Youness KHOURDIFI, Dr. Abdelkebir SAHID, Dr. Abdessamad JARRAR qui n'ont pas cessées leurs soutiens.

RÉSUME

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General Introduction

Today, with the abundance of information and communication technology (ICT) solutions in the business and personal life environment and the advent of an "Information Economy", has led to an exponential increase in the use of ICT in business and in all other areas of life, as employees are immersed in a continuous workflow with solutions that make their work easier and faster, but bring more daily tasks to do on their backs (Chesley, 2010, Chesley, 2014).

Whether it's tracking customer disputes, organizing a meeting or the drafting of a sales pitch, as well as many other activities using a huge information flow based on ICTs and in the form of messages, which involves the reaction of the employee to resolve and to support the customers' cases, these communications and messages between the different stakeholders, are carried out through the use of SMS, professional social networks, emails, instant messaging, etc. Solutions that make services' access easier for the customer, but which on other hand, put more and more tasks on the backs of employees, and those against their will, these messages can be checked on an enormous number of devices, which have gotten exceptionally scaled down in size and are in this manner prone to go with the employee on his movements: Smart phone, tablet, pc, smart watches, etc. (Kalika et al., 2007).

These new solutions allow the overcoming of the traditional notion of the spatial and temporal uniqueness of work, the permanent connectivity allows indeed a form of ubiquity of work: The employee can access his or her workplace and tasks at any time and from any location. This transformation of work is not without important challenges in terms of occupational health (Barber and Santuzzi, 2015), increasing unclear boundaries between professional and private life. This leads to increased consideration of the adverse effects on mental health related to the professional and private use of ICT, Individuals experience stress as a result of their use of ICT in organizations, and this type of stress which is caused by the inability to cope with the demands of organizational ICT usage is called Technostress (TS) (Tarafdar et al., 2010).

Technostress is an important organizational problem with immense consequences for individuals and organizations since it negatively influence employee's productivity, hence, job satisfaction and the overall organizational commitment of the organisation (Tarafdar et al., 2007, Ragu-Nathan et al., 2008).

Since the 80th, the field of technological stress has been largely explored. Most of the researches focused on alleviating and conceiving strategies regarding ICT related TS it different causes and measurements. The intention of our work is not to oppose to the finding of these researchers, but to find out the effective ways to use it to alleviate TS and making technology better fit the enterprises and society, and those by translating our ideas into achievements using computing techniques instead of turning our back totally to the ICT technology.

For an effective and efficient decision making and a targeted therapy, One of the current solutions and techniques is the use of automatic learning, namely Machine Learning (ML) and Deep Learning (DL) which are subsets of Artificial Intelligence (AI), the only problem here is that these techniques needs a huge amount of data generated from the field we want to study, for our case, Technostress is a sub-field of both Psychology and ICT domains, because of non-existence of adequate data and to meet the needs of the data analysts and data scientists in terms of structured data, and because of the sporadic researches, we first started our research by thinking to conceive a way that let enterprises be self-sufficient of outside interventions, in terms of TS management strategies, and training appropriate data sets, the solution is inspired from the Expert System (ES) technology, which is a system capable of carrying out logical reasoning in a field comparable to those that human experts in this field would do, It is above all a decision support system and belonging to the AI domain(expert, n.d.).

A. General Context

There is many instruments in the literature that were used by professionals to assess and manage TS problems, in this work and in order to not be distracted from our subject, we choose to use the CS which are a set of cognitive and behavioural efforts, constantly changing, made to manage specific internal requirements and/or external, that are evaluated by the person as exceeding or consuming its resources (Lazarus & Folkman, 1984b).

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The overall studies on TS don't focus on any specific organization or a particular technology or job professionals. Most of the literature deals with this category of studies just in an organizational context. Organisations are a closed environment using the ICT that suit their own local organisational needs, besides that, this entities care a lot about keeping private of their data concerning their ICTs architecture and the data concerning their Human Resources (HR), which makes difficult to monitor, study and use the knowledge of the HR and those of the Information systems (IS) department, not technically difficult, but in practice, and it's here where interfere the major role of our system, by permitting organisations to learn from past experiences and map out the causal effect linking TS to ICTs and to the CS locally, without the need to exteriorize their data or import data and coping instruments that doesn't suit their own ICT environment.

B. Motivation and Objectives

The Computerization of health care, whether carried by the medical profession or provided by patients, will not affect this quantitative treatment. Rather, it has scaled up with new sources of information, expanding to the max with the proliferation of patient-centric solutions and more data. The fusion of life sciences and information technologies makes it possible to collect more and more data, radiological images, physiological and microbiological parameters in laboratories, IT hospitals, or sometimes patients themselves using connected sensors like smart watches, etc. All of this is allowing the scientific community to store a lot of data for mining and bringing out knowledge hidden amongst it.

We can easily notice that the discipline of health is becoming more depending on data science for it improvement and the good accuracy of anomalies detection, but to achieve this higher accuracy levels, the AI And ML model training need a large amount of data, hence the implication of big data in the process, which isn't the case for our current TS situation, that lacks data.

As mentioned above, our solution can bring a new way to the field of Technostress Research, and those by permitting Managers to choose the proper strategy, mimicking from the past experiences, which are learned in the first place with assistance of a human agent "health care professional", and which showed good results on the employees, the idea that motivated us more her, is the fact that the data resulting from enterprises having a homogeneous ICTs architecture, can share their data if they will, for example within the same corporation through its different branches, and by this way the corporation will master more accurately its ICT's pros and cons, and build its own framework for better decision-making and Strategic ICTs Alignment.

C. Problem Statement

The whole study was designed upon the TS phenomenon, which is a type of occupational stress generally studied by the professionals using different questionnaires containing arrangements of stressors, selected a priori earlier by the researchers. These questionnaires contains general cases and not specific one's to the situation, and this was one of the primary reasons that pushed us to think about the issue and the suitable solutions capable to solve it or to decrease its effect, which opened the way to a series of ideas and innovations in relation to the topic, amongst the other reasons we can cite:

- Coping strategies (CS), for instance, are situationally reliant, with various reactions being inspired in various contexts (Lazarus & Folkman, 1984a) and Consequently, it is probably going to be more productive to examine this within the context of a specific experience, as opposed to soliciting subjects to list their ways from coping with conventional stressors, permitting the members to relate specific stressors to circumstances, instead of choosing stressors from a globally random list, with no priori existing information or pre-collected data concerning TS, even in the most famous datasets platforms, such as Kaggle, UCI, Google Public Data Sets, etc. Stress generated due to the usage of specific technology in an organizational context,for example suffering from the integration of a new operating system may have different symptoms and reactions from that of integrating a new Enterprise resource planning (ERP) system.Both of the managers and the health specialists, need to comprehend explicit stress factors in their specific context, if they want to apply relevant CS.
- TheOrganisations generally reacts only after TS symptoms are detected and not before their appearance, in order to limit the inconveniences and prevent them.

D. Research Contributions

This research project is divided into two main parts to achieve our objectives:

The first consists of extracting ideas from the literature concerning all the major points of the phenomenon of Technostress with the CS and their relations to the job satisfaction and the performance of organizations, then we ensure that these relations are modelled, in a way permitting it introduction and its initiation, for a large community of the computing field, through conceiving a conceptual process for organizations to overcome employees' TS. In order to cut with the old methods used in the field.

These contributions were published in:

- Salah-Eddine, M., & Belaissaoui, M. (2017). Technostress, coping and job satisfaction model of information systems. Proceedings - 2016 International Conference on Computational Science and Computational Intelligence (CSCI), LV, USA.
https://doi.org/10.1109/CSCI.2016.0033.**(Scopus)**.
- Salah-Eddine, M., El Hamlaoui, M., & Belaissaoui, M. (2018). Computerised method of coping with technostress in organizational situation. 2018 International Conference on Information Management and Processing London, UK, Volume: Pages 130-134. https://doi.org/10.1109/ICIMP1.2018.8325854.**(Scopus)**.

While the second part starts by confirming the effectiveness of the TS Detection operation, which concerns data classification, the reason why we used Data Mining, then we will conclude by giving a prototype of the solution to concretise and to show a portion of the willed system, that can also be used as a reproducer for structured and appropriate data for local organisational situations.

- Salah-Eddine, M., Belaissaoui, M., El Alami, A., & Salah-Eddine, K. (2019). Technostress management through data mining. Journal of Management Information and Decision Science. (Print ISSN: 1524-7252; Online ISSN: 1532-5806). **(Scopus).**
- Salah-Eddine, M., Belaissaoui, ElHamlaoui,& Salah-Eddine, K (2021). Computerizing Technostress Management: Toward An Artificial Intelligence Assisted Support and Diagnosis System. Academy of Strategic Management Journal (ASMJ) (Print ISSN: 1544-1458; Online ISSN: 1939-6104). **(Scopus).**

CHAPTER I:

State of The Art

I. Introduction

With the massive diffusion and the pervasiveness of Information Technology (IT) in all aspects of the organization and even of life, the company continues to invest heavily in information technology and human resources to improve its business processes. Doing business and creating jobs to gain a competitive advantage in the marketplace. With the help of ubiquitous digital technology, companies can achieve enormous benefits by effectively improving their business and industrial processes and increasing the productivity and efficiency of their employees.

Firms invest significantly in the areas of IT and human resources. With the development of ICTs, individuals and businesses are demanding access to applications from anywhere at any time(K. Wang et al., 2008). Due to the ubiquity of digitally-enabled technologies, firms are realizing great benefits in effectiveness and efficiencies in their business processes and in the productivity of their employees.

However, the use of IT also results in negative consequences that harm individuals, organizations, and entire societies. In many firms, these consequences lead to stress associated with ICTs usage experienced by employees. Employees continue to struggle following the fast pace of new ICTs introduction by firms.

Organizations, their Directorates, Managers and HR's managers, as well as political bodies, have become aware of the importance of taking an interest in suffering at work: the International Labour Office (ILO) thus offers a measure of the cost of Psychosocial Risks. in industrialized countries (amounting to 3 to 4% of their annual Gross Domestic product (GDP); the share of occupational stress in all working days has been around 60% in Europe since 1999; in France for example, since 2008, national agreements on stress at work have been signed between the social partners.

1. Fundamental models of stress

Stress has often been viewed as a state of divergence between environmental demands and the individual's response possibilities. (DE KEYSER & Hansez, 2000), present stress in the work sphere as "a response by the worker to the demands of the situation, for which he doubts having the necessary resources". This definition stresses, on one hand, the characteristics of the individual and, on the other hand, professional requirements. Historically, stress has been designed, either as a response (physiological design), or as a stimulus (physical design), or as a transaction-interaction (psychological design). Then to define stress in the light of TS situations, researchers and theorists agree on the usefulness of psychological approaches (De Keyser et al., 2004; Moore, 2000). Two theories come under this psychological conception: the interactionist approach (Karasek Jr., 1979; Karasek, 1990; Sell et al., 1984) and the transactional approach (Lazarus & Folkman, 1984a; Mackay et al., 1987; Siegrist, 1996).

Advocates of the transactional approach have both highlighted the influence of the individual's perception of the situation on work stress and coping mechanisms, which they call "coping strategies".

Attention is paid to the psychological and cognitive dimensions of the individual; stress here is linked to the transaction between the worker and his environment. Thus, the individual's perception of the situation plays a preponderant role in determining whether or not stress occurs.

As for the proponents of the interactionist approach, stress is seen as to be the result of the incompatibility between the characteristics and expectations of the individual and the elements of the environment

In this chapter, we cite in details some basic concepts in this area and notions that we come across throughout this document.

1.1.The Interactionist Approach

One of the researches at the origin of the interactionist approach is that of (Rosenman et al., 1975), dealing with the reactive differences of individuals faced with an identical event. By looking at the way a person functions, the authors have highlighted a link between personality and the risk of heart disease. For the proponents of the interactionist view, the importance of the gap between the situation and the individual would generate stress. This approach therefore focuses on the characteristics of the interaction between the person and his environment. According to (McGrath, 1976), this gap results from an imbalance between environmental demands and the response capacities of the organism under consideration. Thus, the anticipation of harmful consequences linked to the perceived inability to meet the demands, makes the situation stressful. Finally, this approach suggests that the quality of the fit between a person and his work environment offers a better explanation of behaviour than individual or contextual differences. Despite taking into account the work environment, this approach does not provide details on the resources to respond to demands (what McGrath calls "Response Capabilities"), which are central to the model.

1.2.The Transactional Approach

The transactional approach to stress considers as essential to the cognitive processes and emotional reactions that underlie the person's interaction with his or her environment. This vision is particularly significant in two examples which may be representative of this current of thought: the models of (Siegrist, 1996) and (Lazarus & Folkman, 1984a).

1.2.1. The Coping Theory

The specificity of this theory is that it focuses on the perception and evaluation of the situation by the individual, as well as on the implementation of CS. In fact,(Lazarus & Folkman, 1984a) define stress as "a specific relationship between the individual and his environment, assessed by the individual as exceeding or exceeding his resources and endangering his well-being", transactional model proposed by Lazarus and Folkman emphasizes the subjective evaluation of a situation by the individual and the CS implemented. The assessment process is crucial in that it determines the adjustment efforts that will follow. Evaluation is the way in which the individual perceives the situation according to his or her values, expectations and history. The model is therefore governed by a subjective context that is more than real.

According to (S. Folkman & Lazarus, 1980) the Coping is "all cognitive and behavioural efforts designed to control, tolerate or reduce internal or external demands that threaten or exceed an individual's resources" ,The coping strategy preferred by the individual may consist of eliminating the source of danger Problem-Focused Coping (PFC) or reducing the perception of danger Emotion-Focused Coping (EFC), which gives the individual the opportunity to react actively or passively to an event, PFC is recognized from EFC, which is pointed toward dealing with the feelings related with the circumstance, instead of changing the circumstance itself. Avoidance of the anxiety-provoking situation is a third alternative, which manifests itself through an escape strategy that allows the tension felt to dissipate, using distraction activities. The choice of the adaptation strategy adopted will depend on the individual's experience of similar situations.

1.2.2. Well Being at Work

When a large number of employees continue to be attentive to occupational health problems (new illnesses, high work intensity, work accidents, etc.), they seem to be uncoordinated in their interest in happiness at work.). However, this method has been widely supported by many institutions and all organizations related to occupational health. In addition to benefiting employees, it can also be constructive for the organization. In fact, maintaining or improving happiness at work can have a positive impact on the company's basic factors, such as fighting against absenteeism and motivation at work. Consequently, employee's well-being has proven to be one of the basic elements of the company's normal functioning and performance.

1.2.3. Organizational Well-Being

While assessing firm's work's well-being (WWB) seems important (Lachmann et al., 2010), it has not received much attention to date (Kiziah, 2004), especially since the WWB is generally considered as structure. Many authors consider happiness as a structure in itself (Gilbert et al., 2011; Massé et al., 1998), and its elements depend on many factors affecting the Domain de vie (Diener et al., 2003). Therefore, it seems constantly possible that contextual structures of the profession may have greater interpretive power than general structures if they can take into account different organizational outcomes.

1.2.3.1. The job Satisfaction

Job satisfaction is defined as "a pleasant or positive emotional state produced by a person's evaluation of his or her work or work experience"(Edwin A. Locke, 1969)and is an emotional response to work emotionally produced by internal comparison of the result with the expected result". However, recently, some critics have pointed out that the limitations of this definition are centred on the emotional aspect.

In terms of use and application, there are many different scales for measuring satisfaction, which according to Iglesias et al. can be divided into two groups(Iglesias et al., 2010).

In a global way: the overall job satisfaction scale (Blais et al., 1993), or the satisfaction with working life scale (Fouquereau & Rioux, 2002), and others by aspects: the Job Descriptive Index (JDI)(Smith et al., 1969), the Job Satisfaction Survey (JSS)(Spector, 1985) and Minnesota Satisfaction Questionnaire (MSQ), Job satisfaction can also be found to be described as a WWB background.

2. Information And Communications Technologies (ICTs)

According to Cambridge Dictionary definition, Information And Communications Technologies is the use of computers and other electronic equipment and systems to store collect, use, and send data electronically, which also means physical tools and software, Consequently, ICTs integrates all the hardware and software solutions to organize the flow and the processing of information in the company or elsewhere (Customer Relationship Management (CRM),ERP, intranet, FM radio to satellite for communication, etc) (Anderson, 2002; Gomez & Chevallet, 2011).

Consequently, ICT integrates all the hardware and software solutions to organize the flow and the processing of information and the communication of information in the company or elsewhere, remaining the objective, and the technology, the means.

what makes ICT different from some other traditional technologies, is the fact that ICT make the user the center of the information system, since the user must necessarily be present in an active and continuous way, for the proper functioning of operations including tics, creating a kind of interactivity between user and ICT,

2.1. Access to ICT Resources

Over ongoing decades, admittance to ICT tools and devices, for example, Laptops, PCs and smart phones, has improved extensively around the globe. In fact, cell phone memberships for example, dramatically increased worldwide somewhere in the range of 2007 and 2017, arriving at 102 memberships for every 100 individuals. With a triple increment over a similar period, sub-Saharan Africa generally added to this movement, arriving at 74 memberships for each 100 individuals (World Bank, 2018). In equal, the portion of people utilizing the Internet dramatically increased in the previous decade, to 46% of the worldwide populace in 2017. Once more, the development in sub-Saharan Africa (from 3.5% to 20%) and in low-and center pay nations as a rule (from simply over 11% to 39%) has been momentous (World Bank, 2018). Considering this ICT achievement, governments have gotten progressively worried about giving new ages admittance to great ICT assets and limiting the "computerized partition" in the population(*World Development Indicators (WDI) | Data Catalog*, n.d.).

2.1.1. ICT resources Availability

ICT resources document the presence of a specific ICT resource, which can be used either in organisation locally or at homes.

2.1.2. General ICT resources

General ICT resources can range from computers and access to the Internet (i.e .hardware resource to software) to cameras, and also include social networking, websites and image-processing programmes among other digital tools.

2.1.3. ICT resources Accessibility

Accessibility refers to the degree of availability and the flexibility with which users can reach available ICT resources.

2.1.4. ICT resources Quality

The quality of ICT resources technically refers to the components of ICT, and to the capacity of available ICT resources. ICT-resource quality is covered here under two aspects: the overall degree of connectivity and the maintenance and functionality of ICT resources.

2.1.4.1. ICT Resources Functionality and Maintenance

To let ICT resources be more available in organisation, users should be able to access ICT equipment in order to perform their tasks without delays, flaws, defects, or security issues. This depends on a number of factors, such as the resources allocated to ICT equipment, routine maintenance practices, the indicators of the overall state of modernity and capacity of the equipment.

2.1.4.2. ICT Overall level of connectivity

The extent to which available ICT resources can be connected to the Internet would provide complementary data. Indeed, the Internet is always used in combination with another

ICT resource, that why it is a transversal relation, the equipment with which it is associated can remark an expanded and modified possibilities.

2.2. The historical background behind TIC in organisations

The ICT arrived in the companies successively, at the beginning and after the Second World War with the computers. Then ICT marks the beginning of the 50's but exclusively in the military and armament field. On the other hand, the concept of information systems emerged in companies because of the rapid development and evolution of ICT, becoming a multidimensional solution using different resources (Reix, 2011). With the development of public-access computing following the information decentralization movement of the 1980s (Kocoglu & Moatty, 2010), companies were able to easily generalize the introduction of personal computers within their enclosures in the 1990s.

Nowadays one of the most used tools in companies and which has experienced a strong development is the ERP. They enable integrated and centralized data management, with a unique IS, optimized management processes, homogeneous information, etc. The implementation of this type of software package also promotes collaborative work, which aims to simplify and optimize the company's flows and processes, and therefore has a strategic dimension (Tristan Klein, 2012)(Tristant Klein & Ratier, 2012), and they are able to cover all functions of the company (Kocoglu & Moatty, 2010). The functions most concerned by the integration of ERP systems are usually finance, accounting, and controlling. In conjunction with the arrival of the personal computer in the company, noting also that tools related to Internet technologies have also undergone massive development, all these technological evolutions have brought many changes to the company, and they regularly introduce new problems (Tristan Klein, 2012).

3. Technostress

Company administrations, anxious to develop their competitiveness and increase their productivity and performance objectives, are investing heavily in ICT (Luftman& Ben-Zvi, 2011), But unfortunately, the integration of these technologies affects not only organizational processes, but also work and social and human aspects (Boukef, 2005), Sometimes other undesirable phenomena are generated, such as Information Overload (IO) or Technological Overload (TO), which results in the superposition of communication media (Kalika& others, 2003), the user being in a situation confronted with working with the resources at their disposal, a new type of stress associated with ICT born and it is called Technostress, organizations then see themselves unable to take advantage of all these Technologies (Tarafdar et al., 2007),

According to previous research on this subject, employees of organizations and in the face of this stressful situation linked to ICT try to develop methods and defensive reactions called Coping Strategies and which have already been mentioned before (Beaudry& Pinsonneault, 2005; Lazarus & Folkman, 1984b), based on many emotional and cognitive factors, these strategies vary from user to user, Individuals assess the stress conditions associated with ICT from two angles: the first is to assess the situation in terms of environmental threats or opportunities, and the second is to assess the user's level of personal resources to deal with it (Beaudry& Pinsonneault, 2005).

Two theoretical methods have been used to study TS, the first is an epidemiological vision, considering TS as a disease caused by overwork, and the identification of factors and measurement of stress are carried out objectively and separately from the individual (Fox et al., 1993), and the second is a cognitive vision, where researchers believe that TS is essentially generated by interpreting individual and environmental needs and assessing the gap between these needs and personal abilities (Fox et al., 1993), The measurement of the stressor is subjective because it is based on Individually Specific Cognitive Factors, and it is for this reason that in all our work we will only use the second cognitive approach.

3.1. Technological Overload

The introduction of ICT in the company affects to some extent the communication mechanism modifying the existing traditional communication equipment(meetings, face-to-face, telephone, paperwork etc.),into newer one, by mainly adding electronics (instant messaging, e-mail, Internet, Intranet, etc.), but instead of replacing the old ones, these new Technologies overlap, and add what is called Technological Overload Effect (Karr-Wisniewski & Lu, 2010).

3.2. Information Overload

For a long time, IO meant essentially receiving too much information (Eppler& Mengis, 2004), since the 1970s, many studies have been carried out to find a link between performance and the amount of information received. The researchers then focused on determining the optimal amount of information needed to carry out the work activity. Hence the hypothesis that individual performance in terms of decision making is appropriate for the amount of information received was verified (Chewning& Harrell, 1990), when the information processing requirements exceed the processing capacity one is said to be in a situation of IO (Tushman& Nadler, 1978). Today, the use of ICT is more and more diversified, sometimes lacking coherence between them. Employees often have to deal with the ever-increasing flow of information, compensate for low levels of aggregation, negotiate data from multiple sources, and structure information(Isaac et al., 2007), In the end, we can identify three dimensions of IO: cognitive overload, communicational overload and information overload.

3.3. The 4 Aspects of Technostress

- Physical aspects include irritable bowel syndrome, stomach discomfort, rapid heartbeat, chest pain, elevated blood pressure and difficulty Breathing, eye fatigue, backache, dry mouth and throat, muscle tension, stiff shoulders.
- The psychological aspect consists of IO in order to use resources in the appropriate context to analyse, find, evaluate, and apply information, Insufficient work and routine work can lead to inefficiency, or when the work performed involves only routine activities.
- Behavioural aspects include excessive comfort with computers, spending too much on computers, insomnia, uncooperative and unwillingness, use of computer terminology in non-computer conversations, navigating computer stores, smoking, drinking alcohol and social smoking to support terminal time.
- Emotional aspects like loss of temper, irritability, indifference of indifference having a high state of anxiety when separated from a computer monitor, feeling fearful , frustration, lack of appreciation, guilt, depression, paranoia that leads to avoiding negative attitudes and computers use.

3.4. Technostress Creators

Technostress Creators (TC) are organizational stressors that generate stress in humans and are associated with inappropriate use of ICT (Ayyagari et al., 2011; Srivastava et al., 2015; Tarafdar et al., 2007), (Ayyagari et al., 2011) had identified five TC factors:

- Techno-Overload: Describes situations in which the use of computers forces people to work faster and more.

- Techno-Complexity: Describes a situation where the complex computer systems used at work force people to spend time and energy to learn and understand how to use new applications and update their skills, People find the various applications, features and jargon intimidating, so they feel stressed.
- Techno-Invasion: Describes the situation when people feel their self's always exposed, meaning that they are always reachable anywhere and anytime and feel the need to maintain continuous contact, because of that working hours have been extended and office work is following them even at home and it is almost impossible to cut away this situation.
- Techno-uncertainty: Involves the short life cycle of a computer system. Continuous changes and upgrades will not provide people with the opportunity to gain experience with a particular system. People are upset because their knowledge quickly becomes obsolete and they are asked to relearn very frequently.
- Techno-insecurity: It is related to situations where people lose their knowledge of new gadgets and computing devices and threaten others to lose their jobs.

4. Big Data in E-health

The computerization of health, whether carried by the medical profession or provided by patients, will not cause quantitative treatment problems. Instead, it has changed the scale with new sources of information and expanded as many people as possible by disseminating patient-centric solutions and more data. The integration of life science and information technology makes it possible to collect more and more data in laboratories, computer hospitals, insurance companies or the patients themselves, thanks to the connected sensors: microbiota, Deoxyribonucleic Acid(DNA), blood analysis, Especially DNA sequencing, now individuals can use it directly, so that they can store large amounts of data for themselves, this change of scale implies new practices that are no longer reserved for medicine, which has imperfectly mastered the tools of big data. Strictly speaking, big data is defined as "data sets that are so large that it becomes difficult to analyse them with traditional database management tools", Big data is particularly applicable for epidemiology, DNA analysis and oncology, etc., the study of factors that influence the health of a population can also be used to identify in advance the probability of an adverse health event or hospitalization based on mass data collection, allowing predictive models to be validated.

The collective intelligence generated by the mass of data is no longer just an opportunity to get to know populations better, it will soon be the opportunity to use mass processing to understand better and even predict individual specificities using new statistical tools. It leads to a new approach to medicine, which is increasingly predictive and personalized. While applications and uses are primarily professional, digital technology has the extraordinary ability to quickly make these same technologies accessible to the public, because they can be distributed at low cost to individuals.

4.1. Big Data

Great progress has been made in the medical field. Medical innovation has solved many problems, except that they have not shifted from correction to prevention. These are two different methods, the first is therapeutic and the second is preventive. Big data is an emerging technology field, which is gradually emerging with more and more structured and unstructured data. It aims to provide an alternative to traditional database and analysis solutions. This technology can perform very fine analysis on massive amounts of data.

In the beginning, the given term "BIG DATA" was related to the 3V (Volume, Velocity, and Variety), the 3V are the dimensions of the big data:

Volume: Big data has a unique design: big, it is the most famous function, because many organizations have created very large data internally, or assembled other large amounts of data (data has been injected from these data) and data externally. Volume refers to the amplitude of the data.

Velocity: his is usually time-sensitive and refers to the speed at which data is generated and the speed at which data must be analysed and applied. The increasing use of digital devices such as smart phones and sensors has resulted in unprecedented speed of data creation, and the need for real-time analysis and results-based planning in data mining is increasing.

Variety: The term diversity refers to the heterogeneity of data structure, because technological progress means that various types of structured, semi-structured and unstructured data can be used, which come from internal data (such as sensor data) and External data (such as social media). With big data, you can not only expand structured data, but also include all kinds of unstructured data: click stream, text, video, audio, log files, etc. However, they sometimes have to overcome the structural organization required by the machines for analysis.

Today, to enrich the 3 V's model has been added else 4 V's:

- **Veracity:** Presents the integrity of the data.
- **Value:** Provides an indication of useful results.
- **Variability:** References to format, structure and semantic changes in data.
- **Visualization:** Presents the description of the presentation of large data.

5. Artificial Intelligence

In the 21st century, AI has become an important research field in almost all fields: accounting, engineering, economics, science, medicine, business, education, finance, stock market, marketing and law, etc.(Halal, 2003; Masnikosa, 1998; Metaxiotis et al., 2003), AI is a set of techniques that allow machines to perform tasks and solve problems normally reserved for humans and certain animals, sometimes the tasks under AI are very simple compared to Human intelligence, for example, planning the movement of a robot to catch an object or driving a car, locating and identifying the objects in the images, they sometimes require complex planning, for example to play chess, chat-bot, while the most complicated tasks require a lot of knowledge and common sense, for example to conduct a dialogue or to translate a text. Intelligence is generally related to learning abilities, and it is through learning, that the intelligent systems is capable of performing a task and improve its performance with experience, and also through it can acquire new skills and learn to perform new tasks.

It should also be noted that the AI field has not always considered learning as essential to intelligence, building an intelligent system in the past, was to manually write a chess program by searching in a tree, make a medical diagnosis based on symptoms; on the basis of the rules written in advance by experts, logical deductions are then taken, by comparing the prototype images with the printed characters, and then identifying them.

AI encompasses a wide-ranging topic, bellow we will give brief explanation of some of it important areas discussed in our chapters.

5.1. Foundation of AI

The foundation and development of AI is built based on the integration of several subjects like:

- Computer Engineering: The way to build a system that functions like an AI artefact. Improve their ability and efficiency and improve their efficiency and ability.

- Control theory and cybernetics: how AI artefacts can act or function on their own. It includes feedback and adaptation to adapt to the environment.
- Economics: Used to understand and optimize payout Duration and size.
- Linguistics: The study of understanding natural language through using AI artefacts. Natural language processing (NLP) is widely used.
- Mathematics: involving calculation, probability theory, decision-making, logical representation, And. Mathematics is used to determine computability, reason about knowledge and form a model of knowledge representation.
- Neuroscience: How the human physical brain performs logical reasoning. The working method of any specific action taken by the brain.
- Philosophy: The idea of acquiring knowledge, understanding and taking action is based on the knowledge embodied in the human brain from the physical brain. It gives the concept of "how the machine draws conclusions". From official rules".
- Psychology: It gives ideas about the way humans act, think, and intersect.

5.2. Applications of AI

Devices with AI functions can solve complex problems more accurately. Some of the current uses of AI in the world are represented in the figure bellow.

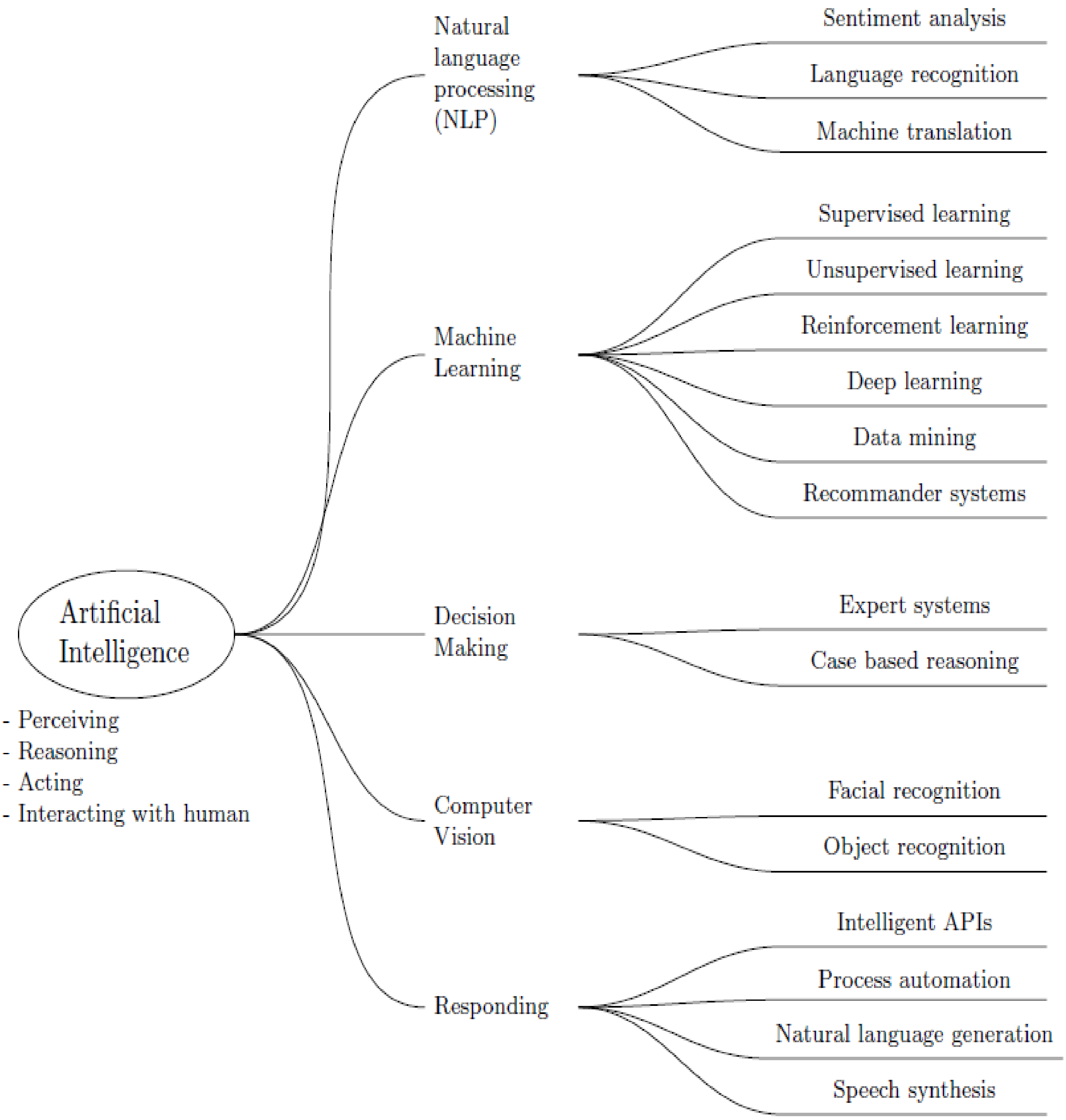


Figure 1 Applications ans fields of AI

On a very broad account the areas of AI are classified into sixteen categories (Becker et al., 2000; Chen & Van Beek, 2001; Hong, 2001; Singer et al., 2000), On a very broad account the areas of AI are classified into sixteen categories, we will cite only few of them related to our present work.

5.2.1. Reasoning

The first major area considered here is the area of reasoning. Research reasoning has Evolve from the following dimensions: Model, Automation, case-based, non-monotonic, model, qualitative, Automation, space, common sense and time.

For illustrative examples, Case-Based Reasoning (CBR) is briefly discussed. In CBR, a set of cases stored in the case library is the main source of knowledge, cases doesn't represent general rules but specific experience in the problem domain; the case-based case describes the main activities when solving the case problem reasoning cycle, This cycle proposes four steps: reuse, mitigation, retention and modification.

The new problem at first, to be solved should be formally cited as a case (new case), after that, from the case base, a case similar to the current problem is retrieved, this retrieved case contain the solution that is re-used to answer the new problem, with new obtained solution, And provide it to users who can verify and possibly modify the solution, then keep the revised case (meaning the experience gained in the case-based problem solving process) for future problem solving (Singh et al., 2002).

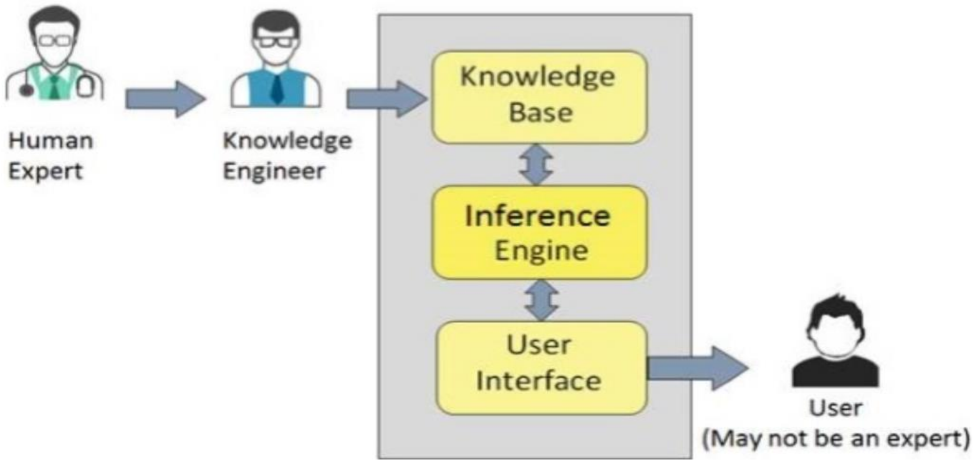
5.2.2. Expert system

ES is one of the important research areas of AI. It was first introduced by researchers from the Department of Computer Science at Stanford University, ES is a computer application developed to solve complex problems of extraordinary human intelligence and professional knowledge in a specific field, their Characteristics are high performance, reliability, high responsiveness, understand ability; and these systems are capable of Advising, Demonstrating, Deriving a solution, Diagnosing, Justifying the conclusion, Instructing and assisting human in decision making, Interpreting input, Predicting results, Suggesting alternative options to a problem.

5.2.2.1. Components of Expert Systems

ES are made up of 3 components:

- Knowledge Base: It contains high-quality domain-specific knowledge. Knowledge is needed to show intelligence. The success of any ES mainly depends on collecting highly accurate and precise knowledge. (Data is a collection of facts. This information is organized as data and facts about the task domain. The combination of information, data and past experience is called knowledge).



5.2.2.1.1. Components of Knowledge Base

The ES's knowledge base contains both factual knowledge and heuristic knowledge.

- Factual Knowledge: It is widely accepted information by scholars and knowledge engineers in the task domain.
- Heuristic knowledge: It involves accurate judgment, practice, assessment ability and guessing ability.

The success of any expert system mainly depends on the completeness, quality, and accuracy of the information stored in the knowledge base.

5.2.2.1.2. Inference Engine

The effective procedures and rules of the inference engine itself are essential for deriving correct and perfect solutions, in the case of knowledge-based ES, the reasoning engine will acquire and manipulate knowledge from the knowledge base to arrive at a specific solution.

5.2.2.1.3. User Interface

The user interface provides interaction between ES users and ES itself. Generally, it is NLP to be used by users who are proficient in the task domain. ES users do not have to be experts in AI; it explains how ES arrives at specific recommendations. The explanation may appear in the following forms:

- ✓ Natural language is displayed on the screen.
- ✓ Oral narration in natural language.
- ✓ The list of rule numbers displayed on the screen.

5.2.2.2. Expert Systems Limitations

No technology can provide a simple and complete solution. Large-scale systems are very expensive and require a lot of development time and computer resources. The limitations of ES include:

- ✓ Difficult knowledge acquisition
- ✓ Technical limitations
- ✓ High development cost
- ✓ ES is difficult to maintain

5.2.2.3. Benefits of Expert Systems

- Availability: Since the software is mass produced, it is easy to obtain them.
- Less Error Rate: Compared with human error, the error rate is low.
- Less Production Cost: The production cost of ES is reasonable. This makes them inexpensive and affordable.
- Reducing Risk: They can replace humans by working in their place in dangerous environments.
- Speed: They provide extremely fast speed. They reduce personal workload.
- Steady response: They work steadily without getting physical human problems like getting tensed, motional, or fatigued.

5.3. Machine learning and Deep learning Techniques

Applying ML means the process of collecting knowledge from data. This is a field of research at the intersection of statistics, AI and computer science, also known as predictive analysis or statistical learning. In recent years, automatic learning methods have become an integral part of daily life. Whether it's automatic recommendations about movies to watch, products to order or to buy, personalised online radio or picture recognition of your friends, a lot of websites and modern devices have automatic learning algorithms at the core of their features. Looking at a complex website like Facebook, Amazon or Netflix, each part of the site contains several ML templates.

With AI, computers are able to think. And made much smarter. The sub-domain of the AI study is ML. Some researcher think that intelligence cannot develop without learning.

There are several types of ML techniques presented in Figure2 Supervised, Unsupervised, Semi-Supervised Learning, Reinforcement, Evolutionary Learning Deep Learning are different categories of Machine Learning techniques. These techniques are used

To classify all the data set,

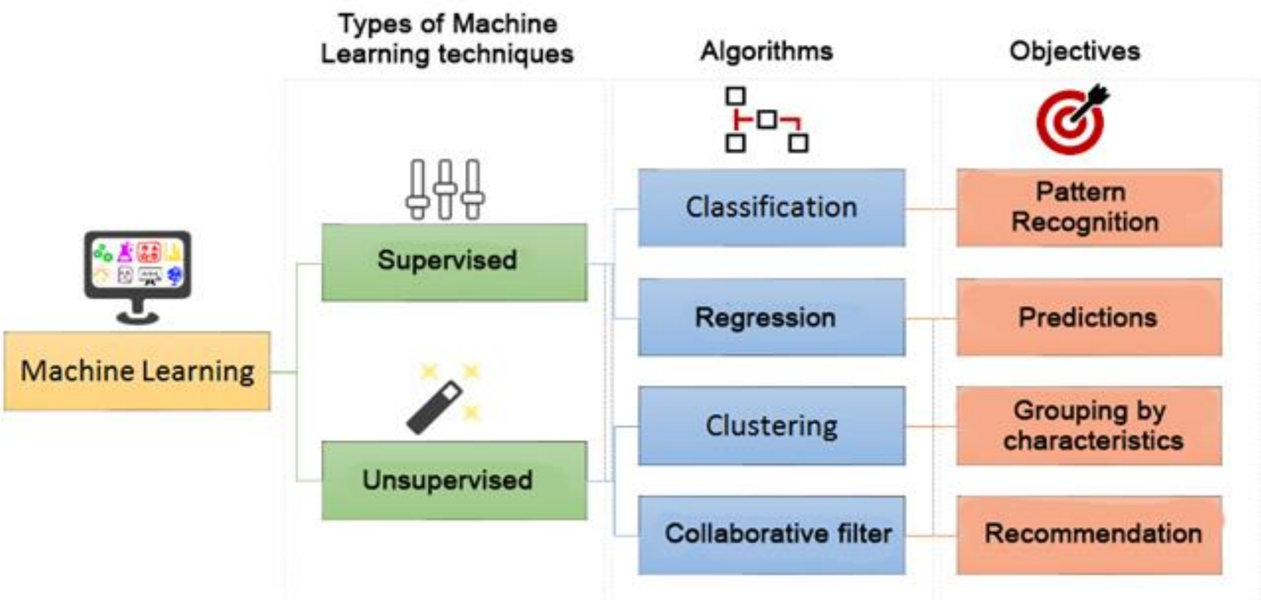


Figure 2 Types of Machine Learning Techniques

- Supervised Learning: Provided a collection of learning experiences by using appropriate targets and through this set of learning, algorithms responding correctly to all inputs available. Another name for supervised learning is learning from examples. Both classification and regression are models of supervised learning.
- Unsupervised Learning: Answers or objectives are not provided correctly. The unsupervised learning technique aims to determine the similarities between the input data, and by using these similarities as a reference; however, it classifies data in the unsupervised learning technique. It is also called density estimation.
- Semi-Supervised Learning: This learning uses unlabelled data for training purposes, the data is usually a minimum labelled with a huge amount unlabelled.

It is a class of supervised learning techniques. Semi-supervised learning is a hybrid combination of unsupervised learning using unlabelled data and supervised learning using labelled data.

- Reinforcement Learning: This learning is supported within behavioural psychology. If the answer is incorrect, the algorithm is informed but does not know how to correct it. It must search and test different possibilities to find the correct answer. Also called learning with a critic. It does not recommend improvements. Reinforcement learning is not the same as supervised learning because it does not provide specific sets of inputs and outputs, or sub-optimal actions. In addition, it puts the accent on performance online.
- Evolutionary Learning: Is an algorithm using natural mechanisms and solve problems with processes that simulate the interactions of living organisms. The Evolutionary Learning is a large class of heuristic randomized optimization algorithms. By simulating the natural evolution process, they consider both variational reproduction and superior selection as key factors. Several different implementations are available, such as Genetic Algorithm (GA), Genetic Programming (GP) and Evolutionary Strategy (ES).
- Deep Learning: Can be described as a ML technique that learns computers to do what comes to human beings naturally: in other words, to teach by example. A key technology in the back of driverless cars is deep learning, which allows them to detect a stop sign or distinguish a pedestrian from a street lamp. It is also the key to voice control in consumer devices including telephones, tablets, televisions and hands-free speakers. DL has attracted a lot of attention recently and for good reasons. It is about providing results that were not possible before.

In DL, with a computer model, the computer model teaches how to do classification tasks directly from images, texts or sounds. The models of deep learning can achieve high accuracy, sometimes exceeding the level of human performance. These models are designed using a large set of tagged data and neural network architectures that have multiple layers.

For many years, the pattern recognition process and data classification have been valuable. Humans have a high level of skills in monitoring the state of the environment. Huge data is transformed into pieces through the combined efforts of ML, databases and other statistics. Nowadays, in health sciences, diagnostic disease assessment is a difficult challenge.

Understanding the exact diagnosis of patients through clinical examination and evaluation is very important.

For effective diagnosis and efficient management, computer based decision support systems can play a vital and essential role. The field of health care produces large data on medical evaluation, a patient report, healing, monitoring, treatment, medication, etc. The challenge of organizing correctly is difficult. As a result of weak data management, the quality of data organization has been affected. The improvement of the amount of data involves appropriate means to extract and process the data effectively and efficiently. In addition, one of the many ML applications is used to build such a classifier that can split the data according to their attributes. The data set is split into two or more classes. These classifiers are used for medical data analysis and disease detection.

At first, ML algorithms were designed and used to analyse medical data sets. Now, for effective data analysis, ML requires different tools. In recent years in particular, the digital revolution has provided relatively inexpensive and available means for data collection and storage. Data collection and analysis machines are being implemented in new and modern hospitals to allow them to collect and share data in large information systems.

ML technologies are very useful for the analysis of medical data, with a lot of work being done on diagnostic problems. Diagnostic data are presented in the form of medical records or reports in modern hospitals or in their specific data section. In order to implement an algorithm, the correct patient diagnostic record is entered into a computer as an input. Outcomes can be obtained automatically from previously resolved cases. Doctors are using this derived classifier to diagnose a new patient at high speed and with increased accuracy. Such classifiers can be used to train specialists or students to diagnose the cause of the problem.

II. Conclusion

In this chapter we presented the basic concepts of our field of research, we focused on the mother theme of our work which is TS and which is a subset of the huge fields of psychology and ICT and which is seen repeated in all the chapters. We also detailed the concepts of stress and ICT and the AI, that next chapters will be using some of their nomenclature and techniques.

The next chapter will discuss the basic solution or idea behind the genesis of the TS, Coping and Job Satisfaction Model, that will be the key for the start and development of next chapters.

CHAPTER II:

Technostress, Coping and Job Satisfaction Model of Information Systems.

1. INTRODUCTION

Excessive use of ICT in our society at the office, at home situations, and against its adaptation possibilities, people saw arise the TS. For that reason, we can say that ICT is a double-edged sword.

Craig Brod, a pioneer in the field, wrote in 1984 that TS is "a modern disease of adaptation related to the inability to cope with the new information technologies in a healthy manner" (Brod, 1984). This may be particularly worrying that in addition to the threats to the well-being and health, previous research has revealed a negative relationship between individual productivity and TS (Tarafdar et al., 2007).

Instead of focusing on their daily routine job to gain time and performance, ICT's users find themselves bombarded with information from many different sources, such as networks (Internet) and wireless computing devices (smart phones, laptops, tablets…). This mass of information added to the basic works and spots of organizations makes users feel that they are like slaves of ICTs instead of being their masters.

In this chapter, and for the first time, we present a new conceptual model that solves the negative effects of TS and boosts the performance for organizations with a unique manner.

The remainder of this paper is organized as follows. In Section II, we give an overview of the problem of TS, its CS leading to Job Satisfaction. Then, the coping model of user adaptation is presented. In Section III, we present our proposed conceptual model for overcoming TS and getting job satisfaction. Finally, Section IV concludes the paper.

2. OVERVIEW

2.1 Technostress in the workplaces

TS in the workplaces is an adaptation problem faced in our new modern age, and it is linked to the incorrect Use of ICT by Persons (Brod, 1984; Tarafdar et al., 2007), when the problem is felt in organizations it is always noticeable that employees can't find themselves able to manage exigencies related to the use of ICT (Tarafdar et al., 2007).

TS combined with Stressors are called TS Creators (Ragu- et al., 2008), TC represent the factors that create Technostress in the organization, until now there are five conditions or dimensions of Technostress (Tarafdar et al., 2007), "Techno-overload" is a situation where ICT forces people to work more and faster. "Techno-complexity" is a situation where people feel stressed due to the lack of understanding of how to use ICTs because of their inadequate level. “Techno-invasion” in this situation people feel the incapability to stay far from the use of ICT and when there is no border between private life and work since people can be reached anytime and everywhere, “Techno-uncertainty” short life cycles of ICT forces people to give efforts and to always update their knowledge compared to ICT which are in perpetual change, “Techno-insecurity” a situation where people feel threatened by the existence or the recruitment of anyone more competent than them in the field of ICT.

2.2 The causes of Technostress

According to (Clute, 1998), the major causes of TS include insufficient training, lack of training, inexperience with computers, organizational factors, insufficient staffing, overwork, the fast pace of change, information overload, performance anxiety, multiple interfaces among others, language, jargon intimidation. In addition to all these major causes we can add some others like the quick pace of technological change, lack of proper training, out-dated computer skills, lack of technical support, out-dated technologies (both software and hardware), increased workload, increase management expectation, lack of standardization with technology, technological breakdown, the reliability of software and hardware, security problems, poor user interface, Things are complicated in the global work environment, the reliability of software and hardware, slow network response time.

2.3 STRAINS Due to Technostress Creators

Strains are divided into two types, whether psychological or behavioural, the psychological ones are emotional reactions to the stressor conditions including among other things, negative self-evaluation, dissatisfaction with the job, and depression. Whereas Behavioural strains include poor task performance, reduced productivity, increased absenteeism and turnover (Jex, S. M. & Beehr, 1991; “Organ. Stress A Rev. Crit. Theory, Res. Appl.,” 2012).

Both of these two types of strains illustrate general job-related outcomes from Technostress Creators. From the psychological strains point of view, TC decrease the job satisfaction and organizational commitment(T. S. Ragu-Nathan et al., 2008)and increase the role stress (Tarafdar et al., 2007) of the individual while Behavioural strains tell that: TC reduce the productivity of the individual (Tarafdar et al., 2007).

2.4. Coping Strategies of Technostress

Coping is a new concept, appeared for the first time in a book by Richard LAZARUS, "Psychological Stress and Coping Process"(Lazarus, 1966), where there is a set of reactions and strategies developed by individuals to cope with stressful situations.

CS that individuals implement in response to stress were the heart of several researches by Folkman and Lazarus in their theory of coping defined as "all efforts as well as cognitive behavioural incurred by individuals to manage internal and external requests exceeding their resources"(Lazarus & Folkman, 1984a), and we have to know that every organization which cannot cope with computer-related TS properly, may be confused by higher rate of separation and absence (Harper, 1998).

CS have been classified into two major categories: emotion-focused strategies and problem-focused strategies according to LAZARUS and colleagues, coping has two main functions: it can help to change the problem that is causing the stress, and it may allow regulate emotional responses associated with this problem (Lazarus & Folkman, 1984b; Lazarus & Launier, 1978), Among the methods that we will use to assess coping with pain in this study, the most widely used instrument at present is the CS Questionnaire (CSQ) developed by Rosenstiel and Keefe (Rosenstiel& Keefe, 1983), This questionnaire is composed of 48 items distributed in eight subscales each including six items: reinterpreting pain sensations, ignoring pain sensations, diverting attention, coping self-statements, praying and hoping, ignoring pain sensations, catastrophizing, increasing pain behaviour and increasing activity level. And this study remains open to any other instruments of CS that can help remedy the TS.

2.5. Model to Job Satisfaction

Job satisfaction is an emotional feeling of employees about job, which may be negative or positive Independently of areas of knowledge, job satisfaction has received an essential consideration from researchers due to its contributions toward employees job performance and attainment of organizational goals (Somvir& Kaushik, 2012), Numerous research findings postulate satisfied employee as an active job performer (Boyatzis, 1982), Job satisfaction reflects (inversely) the strain(E A Locke, 1976). Therefore, it is an Important organizational, valued outcome of work-related stress, and that why it will take a relevant place in this present paper(Sullivan & Bhagat, 1992).

Based on the literature review, we present a summarized conceptual model of the study Figure 3.

This conceptual model shows for us in a brief way; the steps how job satisfaction is earned in a TS environment, first of all, and depending on the degree of use of ICT in a nondescript domain of work, the awareness of an ICT event on the employee gives rise to the phenomena of TS, and for overcoming its problematic consequences via management action, managers are obliged to use some appropriate strategies that are designed especially for these cases and which are the CS. After a certain lapse of time from the implementation and supposing that the action was beneficial, we get the wanted Job satisfaction.

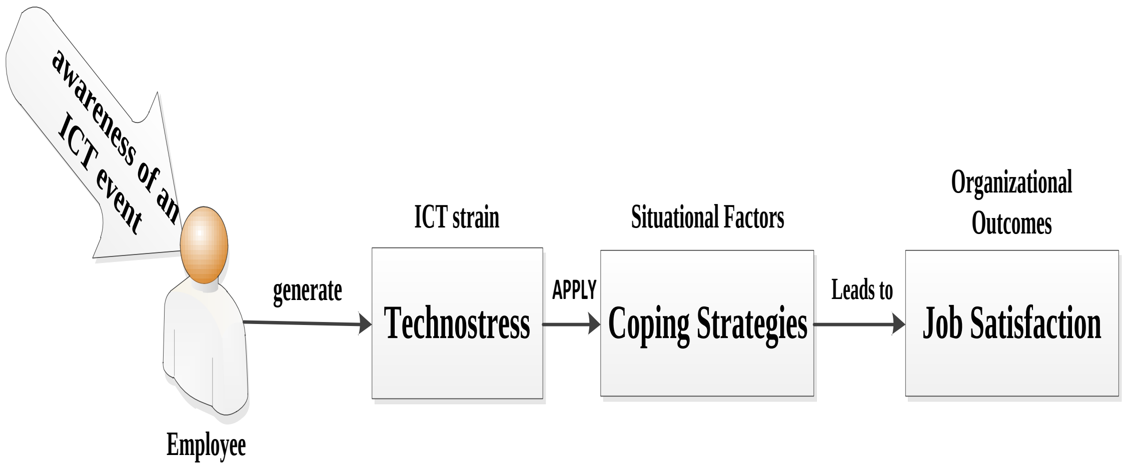


Figure 3 The Summarized Conceptual Model

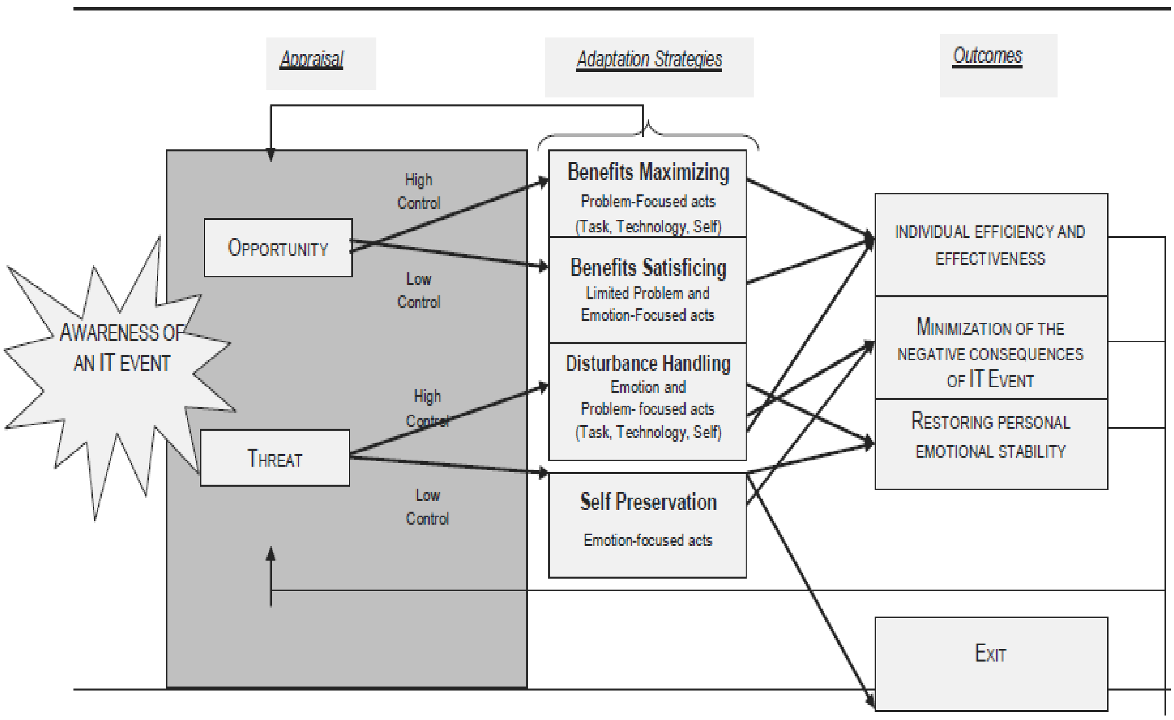


Figure 4 Coping Model of User Adaptation (CMU by Beaudry et Pinsonneault (2005).

3. Coping model of user adaptation

In the previews model Figure 4, Beaudry and Pinsonneault (Beaudry & Pinsonneault, 2005) have made an application of adaptation strategies in the field of IS according to the approach of coping that distinguish four significant strategies, based on the combination of consequences evolution of situation (Opportunity / Threat), and the evolution of control level (High/Low) of it, the Adaptation strategies resulting from it are: Benefits Maximizing, Benefits Satisfying, Disturbance Handling and Self Preservation, and all of them plays a significant role in reversing TS strains.

3.1 The proposed conceptual model for overcoming Technostress and getting job satisfaction

The conceptual model proposed in figure 5, is Inspired from The study above and from many anterior researches and elaborated in a new approach that helps to overcome TS in a visible logical way, which permit fewer errors and fast specific treatments.

First of all, every user "employees" must proceed by passing the "detection stage" which is based on the same questionnaire developed by Ragu-Nathan et al (B. Ragu-Nathan et al., 2002) for measuring the extent of TS perceived by people, and classified according to the specific dimensions of TS.

Notice that it's possible to use any other questionnaire that can help to detect TS, then before proceeding by applying the computer-related CS the detection stage have to check on the Knowledge Management Server (KMS) which save on it, for all the employees, their anterior functioning "CS", so in this case the KMS is used to keep a tracking for eventual comparison or future use and to accelerate the learning ability so that managers can take decision rapidly without following all the steps of the model, and directly lead to job satisfaction in final.

The second step begins when the KMS is empty or does not contain any functioning recording, then the detection stage will look for each employee (his or her) to detect the type of TS and save it in a problems database that will help managers to save for every employee (his or her) TC type detected after every detection stage, all that to follow the evolution of employee case.

Now that the TC is defined, we will apply the adequate CS on it, and then we will be faced to two possibilities, whether the CS worked: then we get job satisfaction by reversing all the resulting bad thing from TS, and we save the used CS in the KMS, or does not work, then we repeat the loop from the beginning,

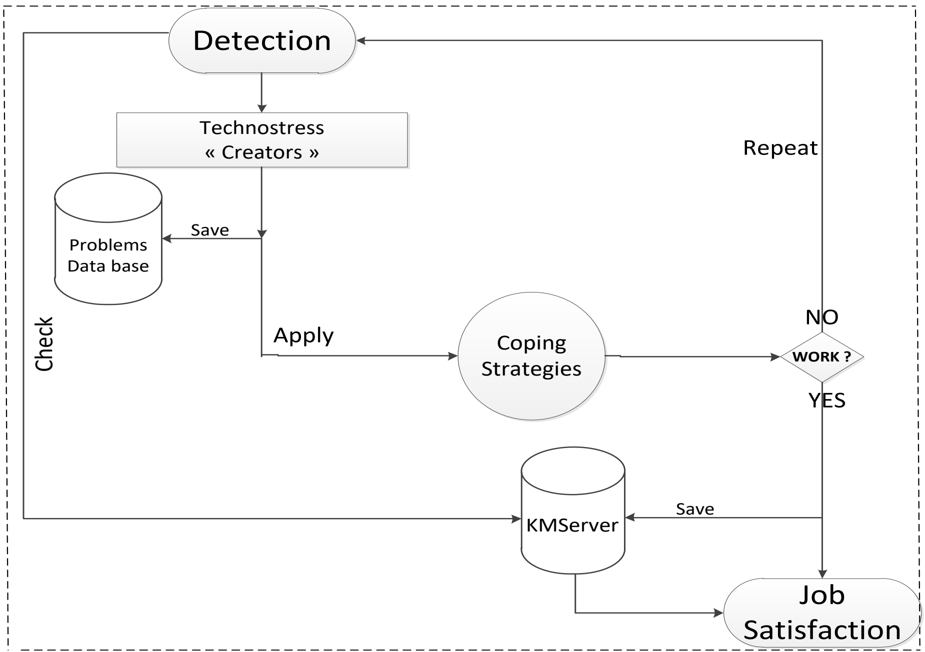


Figure 5 The Conceptual Model For Overcoming Technostress And Getting Job Satisfaction

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4. Conclusion

Organizations invest heavily in ICT. However, they do not always see these investments turn into increased performance. Add to this, Organizations underestimate the dark side imposed by ICT on employee's psychological health, which acts as a time bomb, that has a disastrous effect on the welfare of the employees who are the beating heart of any Organizations, this is why we proceeded like an old Arab quote that said, "treat the disease with what caused it", and we employed some ICTs resources to remedy the negative impact caused previously.

CHAPTER III:

Computerised Method of Coping with Technostress in Organizational Situation

1. Introduction

According to Craig BROD, a pioneer in the field, TS is described as a modern disease of adaptation related to an inability to cope with the new information technologies in a healthy manner (Brod, 1984). In addition to the mental health threats of people, previous researches have revealed a cause-effect relationship between individual productivity and TS(Tarafdar et al., 2007).

This paper presents a conceptual process for organizations to overcome employees' TS in order to get job satisfaction. It is an extension and continuation of our previous work on TS (Salah-Eddine& Belaissaoui, 2017). In this chapter, we will try to explain more in details the components of TS and CS and how they interact with each other. This same interaction has revealed to us, after reading and comparing many studies, the absence of a referential that can provide a specific coping strategy to all elements of TC This problem has prompted us to devise a method which can give a particular alternative to each organization.

The remainder of this paper is organized as follows. In Section II we present an overview of TS factors and CS. Section III offers the proposed approach whereas section IV is the conclusion of our paper in which we talk about some of our major findings.

2. Overview Of Technostress Factors And Coping Strategies

In recent IS research, stressors are termed Technostress creators, and they are responsible for creating the phenomena of TS which is the stress resulting of inappropriate use of ICT by employees in organizations (T. S. Ragu-Nathan et al., 2008; Tarafdar et al., 2007). TC refer to ICT circumstances or factors that have the potential to create ICT and job-related strain outcomes among employees in organization (Tarafdar et al., 2007). Up to now, there are five factors or dimensions of TC (Cooper, 2002; Harper, 1998; Tarafdar et al., 2007): Techno-overload (the ICT pushes employees to work faster), Techno-complexity (the complexity of new ICT makes employees feel incompetent), Techno-invasion (the pervasive ICT invades personal life), Techno-uncertainty (the constant changes, upgrades and bug fixes in ICT hardware and software impose stress on the end-users) and Techno-insecurity (the job security of employees threatened by fast-changing ICT).

According to the work of researchers in this field (Tarafdar et al., 2007), the items that compose TC factors are:

- Techno-overload (OV): OV1: I am forced by this technology to work much faster, OV2: I am forced by this technology to do more work than I can handle, OV3: I am forced by this technology to work with very tight time schedules, OV4: I am forced to change my work habits to adapt to new technologies, OV5: I have a higher workload because of increased technology complexity;
- Techno-invasion (IN): IN1: I spend less time with my family due to this technology, IN2: I have to be in touch with my work even during my vacation due to this technology, IN3: I have to sacrifice my vacation and weekend time to keep current on new technologies, IN4: I feel my personal life is being invaded by this technology;
- Techno-complexity (CO): CO1: I do not know enough about this technology to handle my job satisfactorily, CO2: I need a long time to understand and use new technologies, CO3: I do not find enough time to study and upgrade my technology skills, CO4: I find new recruits to this organization know more about computer technology than I do, CO5: I often find it too complex for me to understand and use new technologies;
- Techno-insecurity (INS): INS1: I feel a constant threat to my job security due to new technologies, INS2: I have to constantly update my skills to avoid being replaced, INS3: I am threatened by co-workers with newer technology skills, INS4: I do not share my knowledge with my co-workers for fear of being replaced, INS5: I feel there is less sharing of knowledge among co-workers for fearing of being replaced;
- Techno-uncertainty (UN): UN1: There are always new developments in the technologies we use in our organization, UN2: There are constant changes in computer software in our organization, UN3: There are constant changes in computer hardware in our organization, UN4: There are frequent upgrades in computer networks in our organization. Notice that we will use some of these items to explain our method next in this paper.

Concerning CS, generally speaking, the expression "to face" refers to the term "coping", that is to say, all that a person uses to manage a stressful situation. The term coping is historically linked to the psychoanalytic concept of the Mechanism of Defense. According to

Lazarus and al. (Monat& Lazarus, 1991), coping has two main functions: modifying the problem PFC and changing the emotional response EFC. EFC refers to thoughts or actions whose goal is to relieve the emotional impact of stress, for example "Find new faith" (Susan Folkman, 2010), "made light of the situation; refuse to get too serious about it" (Susan Folkman, 2010), "praying" (Susan Folkman, 2010), "told myself things that helped me to feel better" (Susan Folkman, 2010). For the Problem-focused coping, it refers to the effort to improve the troubled person-environment relationship for example "use regular technology training" (Isiakpona& Adebayo, 2011), "Use more adequate and user-friendly hardware and software" (Aghwotu&Owajeme, 2010), "use technology-based training" (Poole & Denny, 2001). However, generally, to assess coping, there have been many contributions from different researchers. We quote for example the Coping Strategy Questionnaire (CSQ) instruments developed by Rosenstein and Keefe (Rosenstiel & Keefe, 1983), the methods of Champion (Champion, 1988), the manual for the Way of Coping Questionnaire (WCQ)(Susan Folkman et al., 1988) and Weil and Rosen human-centred model (Weil & Rosen, 1997).

3. The Proposed approach

3.1 General Process

In our precedent chapter, we have presented a conceptual model that was designed for the purpose of minimizing and relieving the harmful effects of TS generated by the employees' use of ICT in organisations as shown in Figure 5. In this current work, we will describe in more details each part of the model by transforming it into an activity process which will help us to emphasize the treatments as it is particularly adapted to the modelling of the flow path of data. The process will allow us to represent the behaviour of our method, by producing it in the form of a flow chart that will make it easily intelligible. In other words, the activity diagram will also allow us to specify sequential processing and will offer us a very close vision to that of the imperative programming languages such as C++ or JAVA and thus it will be useful during the realization phase.

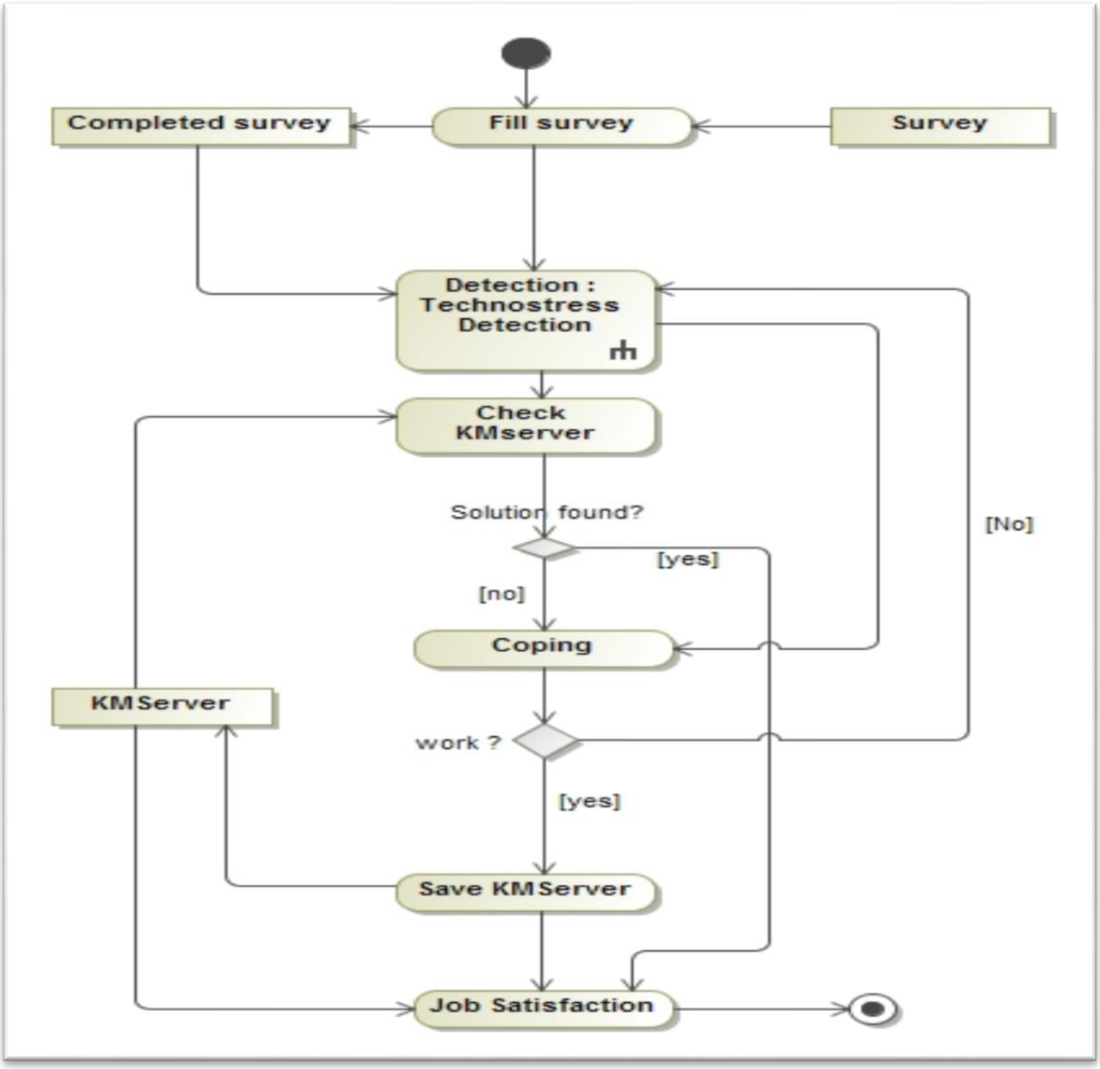

Figure 6 Technostress Management Process

Figure 6. Presents our proposed process. The first operation aims at filling the empty survey based on the questionnaire of Ragu-Nathan et al (B. Ragu-Nathan et al., 2002). It is worth noting that we left the field open for mental health specialists to make their choice among using the contents of the survey as we have proposed, or another of their own choice. As explained above, the items comprising the TC are divided into 5 factors that should be read by all employees. As soon as the employees finish their survey, the TS detection operation begins.

Due to the extent of this operation and it complication, we will present it as a sub process in the next section. Once the TS detection step has been concluded by the detection of one or more items of TC, we can then move to the next operation of coping.

In this phase, and since every organization is characterized by its own ICT, the CS items that can cope with TS for a specific organization, will not automatically give the same effect for other organizations, so to overcome this problem, we propose to launch this step with the assistance of the human factor, which is in this case represented by the Mental Health Specialists (MHS), who would be in charge of diagnosing and overseeing employees' TC, in addition to assigning for every detected item of TC, the appropriate CS, based on their experience in the field and knowledge of the ICT being used in the concerned organization.

We believe that it would be better to leave the choice of the most appropriate way of CS to the MHS because when we compare different instruments and ways of coping that exist, we notice the non-existence of a frame of reference which we can use, and that contains, the items of both TC and CS, in such a way that CS came as an answer to each of the items of TC.

The introduction of the human factor is the reason why we consider our process to be semi-automatic. This situation gave us a new idea that will be discussed in section IV. Once the appropriate CP are allocated to the items of TC, the process will take one of two ways, either the CP work and reverse the TS bad effects, or don’t work and then the process returns back to the detection operation. If CS work, employees will find back their normal emotions and normal behaviors toward the use of ICTs, which will lead to job satisfaction and which is the desired results behind the implementation and use of ICT (Cheney & Scarpello, 1985).

Whenever the CP works, we move to the operation of saving in the KMS, in this operation the system will save on it all employees’ anterior working CS and their related TC's items. From now on and assuming that the KMS has stored at least one record for each item of TC that constitutes the Ragu-Nathan questionnaire, whenever an item of TCs is detected in the Technotress detection operation, the process goes first check in KMS, if it finds a similar item of TC (which has been already resolved and saved), then we will have to work with its CS that are proper to the saved item of TC. Previous successfully treated cases will provide a learning ability to our Knowledge Management System, and will help organizations to eliminate their urgent and permanent need for mental health specialists to assign CS. The KMS will also enable the employees of the organizations to have access to the company's knowledge concerning TS, source of information, and solutions.

Moreover, sharing this knowledge with employees could potentially lead to more effective problem solving and it could also lead to ideas for new or user-friendly products and services. Now we can say that the KMS has reached the maturity (for example: the full of successful coping cases, for the maximum of the items of TC that have been remedied), and with that, it will be able of shortening the time between the beginning and the ending of the process, so that it exempts all new Technostressed employees from passing through the test period, that the CS should take in order to know whether they will be effective or not. In such a way, that all the CS that have been saved in KMS will be accessible for employees through their organizations' personal network, so all that the employees need now to get their CS, is to select the type of TC that they suffers from, and then the system will take care of automatically assigning the appropriate strategies. As a consequence, employees will find back their normal emotions and normal behaviors toward the use of ICT, which will make KMS an easy direct way to obtain the job satisfaction.

3.2 Detection Sub-process

The detection sub-process starts by detecting the eventual presence of the TCs factors explained above, which are: OV, IN, CO, INS and UN. Once all factor items have been analyzed, the evaluation operation can start. Its principal role is to gather all collected results. Then if no factor is detected, the employee is diagnosed as TS free. Otherwise, if there is at least one factor detected a save of data operation is performed in the Database (DB) to store the TC' item(s) of the corresponding factor(s). The DB contains the following fields: Employees name, gender, age, education, detected TC items, checking date. These saved data will be used to monitor the evolution of the employees' case. For security reasons, the confidentiality of employees is protected and that by allowing access to DB only to managers and health specialists of the organization.

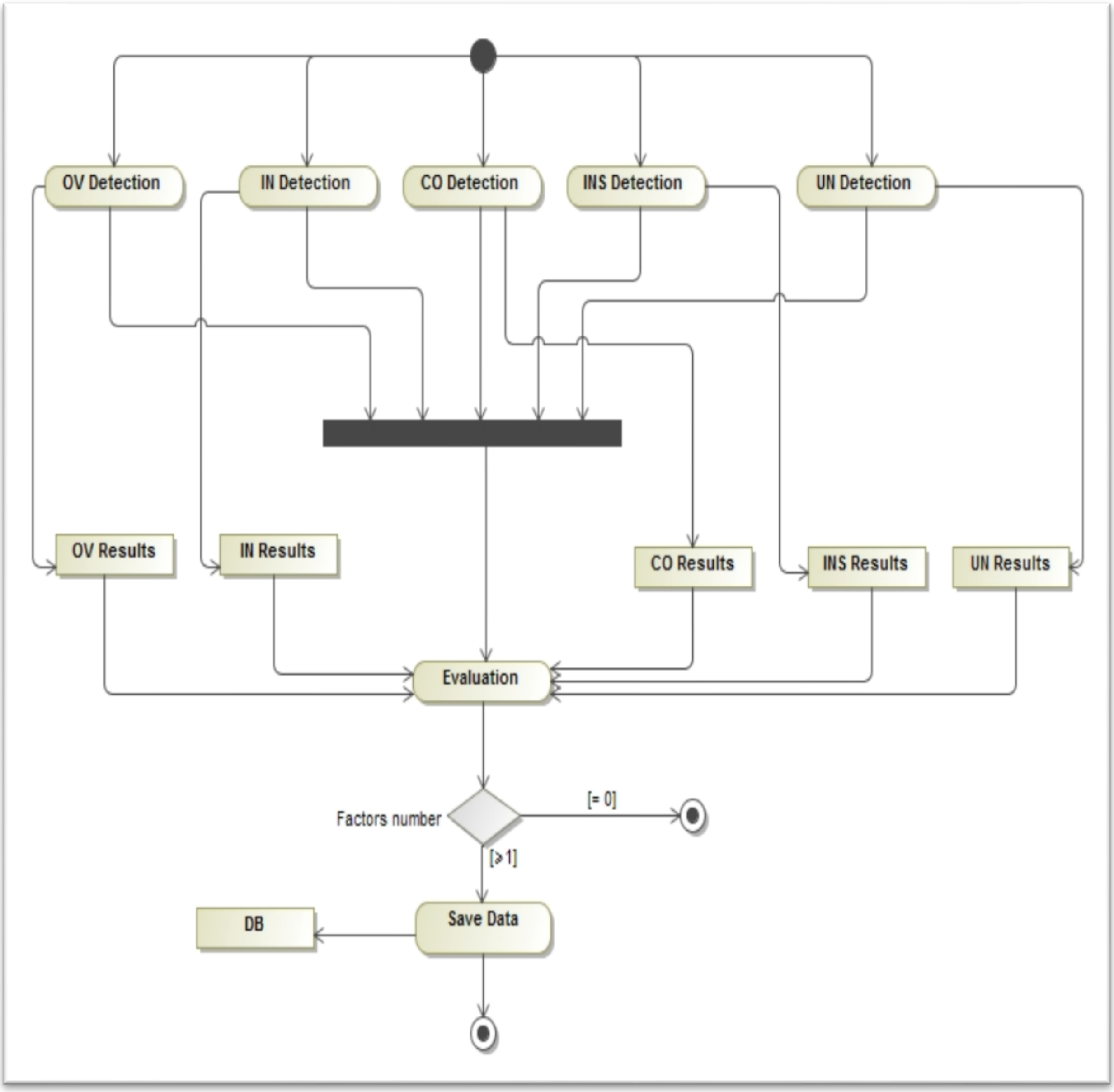

Figure 7 Detection Sub-process

4. Conclusion

Our work only scratches the surface in this growing field of TS. The aim behind this research to assist the health managers by giving them a computerized solution that will help them automate the whole TS management process by gaining time, more precision in the selection of CS. This same automation process, when it reaches its maturity (for example the full of successful coping cases, for the maximum of TC items that have been remedied), will provide each organization with a coping referential specific to its internal requirements, and this without the need for repetitive mental health checking, which will ultimately provide the organization with a sustainable and flexible automated solution, capable, in the long term, of changing the negative effects of TS in performance.

CHAPTER IV:

Technostress Management Through Data Mining.

1. Introduction

In this chapter we are interested in one of the drawbacks of ICT which is known as TS and which is a type of stress resulting of inappropriate use of ICT by employees in organizations (T. S. Ragu-Nathan et al., 2008; Tarafdar et al., 2007) in our previous chapters we have discussed in detail the phenomenon of TS and its relation with the CS and based on the existing literature on this subject, we have conceived a conceptual process for organizations to allow ICT employees overcome TS, by reducing and/or eliminating its negative effects as a way to increase job satisfaction (Somvir & Kaushik, 2012) and all this by using ICT themselves for the first time, in order to cut with the old methods used in the field of TS.

Before conceiving our conceptual process, we have noticed that the causality relationship between TC, which represents ICT circumstances that have the potential to create job-related strain outcomes among employees in organizations (Cooper, 2002; Tarafdar et al., 2007) and between TS which is the consequence of TC associated with the repeated use of the CS(Lazarus, 1966; Lazarus & Folkman, 1984a) that health specialists use to face TS, have given us a quick overview of what we can develop from the relation between these three components, as shown in Figure 3. (Salah-Eddine & Belaissaoui, 2017) we have simply begun by gathering the parts of TS, CS and job satisfaction in a hierarchical way to facilitate the understanding of the whole phenomenon of TS from the moment it is detected to the moment it is cured.

The summarised conceptual model presented in Figure 3. has been, despite its simplicity, the foundation stone in the process of our research development. This helped us elaborate the Conceptual Model for overcoming TS and Getting Job Satisfaction (Salah-Eddine & Belaissaoui, 2017) as shown in Figure 5. Anyone who observes this new model will notice that it was built on the backbone of the above summarised conceptual model and inspired from the relation between TS and Coping and elaborated in a new approach that would help overcome TS in an obvious logical way but still making use of some ICT resources. We have added these ICT resources on purpose to remedy the negative effects caused previously by ICT themselves as an Arabic proverb says "*Treat the disease with what caused it*".

After creating the conceptual model, as shown in Figure 5. We transformed it into an activity process as shown in Figure 6. Which allowed us to emphasise the treatments and to represent the behaviours of our method, by producing it in the form of a flow chart that made it easily intelligible (Salah-Eddine et al., 2018).

This research is mainly carried on to confirm the effectiveness of our previous work concerning The TS Management Process Figure 6. And for that reason, we will proceed by steps; this step which concerns our current study will only focus on the TS Detection operation. And which is detailed in Figure 7. Which also represents the Detection Sub-Process (Salah-Eddine et al., 2018) and as long as this operation focuses on data, then we will be interested in the classification of data.

2. Methodology

To analyse the data to predict best results, we know that AI provides many software solutions that have multiple classification filtering data processing algorithms, for learning and visualisation.

The classification provides a prediction model from training data and test data. These data are screened by a classification algorithm, which through the combination of mathematical tools and computational methods produced a new model capable of classifying any data with the same data classes.

The analysis of data in the field of medicine is more and more frequent in order to specify diagnoses, refine research methods and provide appropriate supplies of equipment according to the importance of the pathologies that appear. The intertwining of our environment and health is becoming more and more linked, hence the birth of TS.

Our study is particularly interested in the classification of data. The classification provides a prediction model from training data and test data. These data are screened by a classification algorithm that through the combination of mathematical tools and computational methods produced a new model capable of classifying any data with the same data classes.

The first phase of our study is the data pre-processing phase which is often the most laborious and requires the most time, and this is mainly due to the lack of structure and a large amount of noise present in the raw data of use.

Pre-processing consists of cleaning and structuring the data contained in files to prepare them for future analysis. The objectives of the pre-processing stage are to transfer these data into an environment that is easier to exploit. (In our case, this is the case of a database in .arff format).

We will use 3 databases (Techno-stress.arff, Techno-consulting.arff and Techno-consulting-test.arff).

% 1. Title: Techno-stress Database

%

% 2. definition:

%Techno-overload

%I1_1—I am forced by this technology to work much faster. ?

%I1_2—I am forced by this technology to do more work than I can handle. ?

%I1_3—I am forced by this technology to work with very tight time schedules. ?

%I1_4—I am forced to change my work habits to adapt to new technologies. ?

%I1_5—I have a higher workload because of increased technology complexity. ?

%Techno-invasion

%I1_8—I spend less time with my family due to this technology. ?

%I1_9—I have to be in touch with my work even during my vacation due to this technology. ?

%I1_10—I have to sacrifice my vacation and weekend time to keep current on new technologies. ?

%I1_11—I feel my personal life is being invaded by this technology. ?

%Techno-complexity

%I1_12—I do not know enough about this technology to handle my job satisfactorily. ?

%I1_13—I need a long time to understand and use new technologies. ?

%I1_14—I do not find enough time to study and upgrade my technology skills. ?

%I1_15—I find new recruits to this organization know more about computer technology than I do. ?

%I1_16—I often find it too complex for me to understand and use new technologies. ?

%Techno-insecruty

%I1_17—I feel constant threat to my job security due to new technologies. ?

%I1_18—I have to constantly update my skills to avoid being replaced. ?

%I1_19—I am threatened by coworkers with newer technology skills. ?

%I1_20—I do not share my knowledge with my coworkers for fear of being replaced. ?

%I1_21—I feel there is less sharing of knowledge among coworkers for fear of being replaced. ?

```
%Techno-uncertainty
%I1_22—There are always new developments in the technologies we use in our organization. ?
%I1_23—There are constant changes in computer software in our organization. ?
%I1_24—There are constant changes in computer hardware in our organization. ?
%I1_25—There are frequent upgrades in computer networks in our organization. ?

%
%
@RELATION Techno-stress
@ATTRIBUTE I1_1  numeric
@ATTRIBUTE I1_2  numeric
@ATTRIBUTE I1_3  numeric
@ATTRIBUTE I1_4  numeric
@ATTRIBUTE I1_5  numeric
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```

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………………………………………………
```

```
% 1. Title: Techno-consulting Database

@relation Techno-consulting

@attribute Consultation {0,1,2,3,4,5,6,7}
@attribute FirstConsultation numeric
@attribute LastConsultation numeric
@attribute sick {1,0}

@data

4,200210,200601,0
5,200301,200601,1
………………………
```

We realised a TS database based on the results we got from a survey that we carried out based on Ragu-Nathan TC questionnaire(T. S. Ragu-Nathan et al., 2008) and in which took part several colleagues and relatives who despite their different works they all use ICT. The majority of the participants are civil servants in Hassan I University of Settat, including:

Faculty of Science and Technology-Settat.

National School of Commerce and Management-Settat.

Higher School of Technology-Berrechid.

We have divided the Techno-consulting section into two distinct parts to realise the tests which are primordial for the validation of the matrix of confusion that will guarantee the effectiveness of the selected model and at the same time guarantee that new records can enrich the database without impacting the latest results.

3. Data Mining at the Heart of the Decision-Making Process

Literally, Data Mining means "*digging data*", yet talking about extracting knowledge from the data would be more accurate. The term initially refers to a central stage of the process known as Knowledge Discovery in Databases (KDD), but in use, it has acquired a broader meaning. Today DM refers to all the computer techniques, tools and applications, allowing to automatically discovering new knowledge within large databases (Lajnef et al., 2005).

In what follows, we will quote the methods that we will perform and understand the role of each model and stains it will accomplish. We will use our databases techno-stress.arff and techno-consulting.arff.

These methods are classification and clustering techniques; they are considered as strategies and main divisions of DM processes. These strategies are essential in managing algorithms for data analysis. Precisely, these two processes split data into sets.

3.1. Classification

Classification is a DM function that refers to items in a collection to target categories or classes. The objective of classification is to predict precisely the target class for any case in the data. To approve the classification model, we have to compare the predicted values to recognise target values in a set of test data. The historical data for a classification project is regularly divided into two data sets: one for building the model; the other for testing the model(*Classification*, n.d.).

The classification is also known as the classification tree that creates a step-by-step guide that determines the output of the new data instance. The nodes of the tree represent the decisions that must be made by the function. Any instance of data can use this model and this is supposedly its best advantage.

Known values build the model, each time we have new unknown output values and we present it to the model to produce the expected output. This concept is called over fitting, which is used to predict future unknowns, hence the need for our Techno-consulting-test.arff database.

The data that we will use for the classification are summed up on medical consultations for users. The attributes we used in our database are:

Consultation: The number of consultations that the user has performed.

-First Consultation: The date of the first consultation.

-Last Consultation: The date of the last consultation.

-Sick: The result of the diagnostic.

And the database used is Techno-consulting.arff.

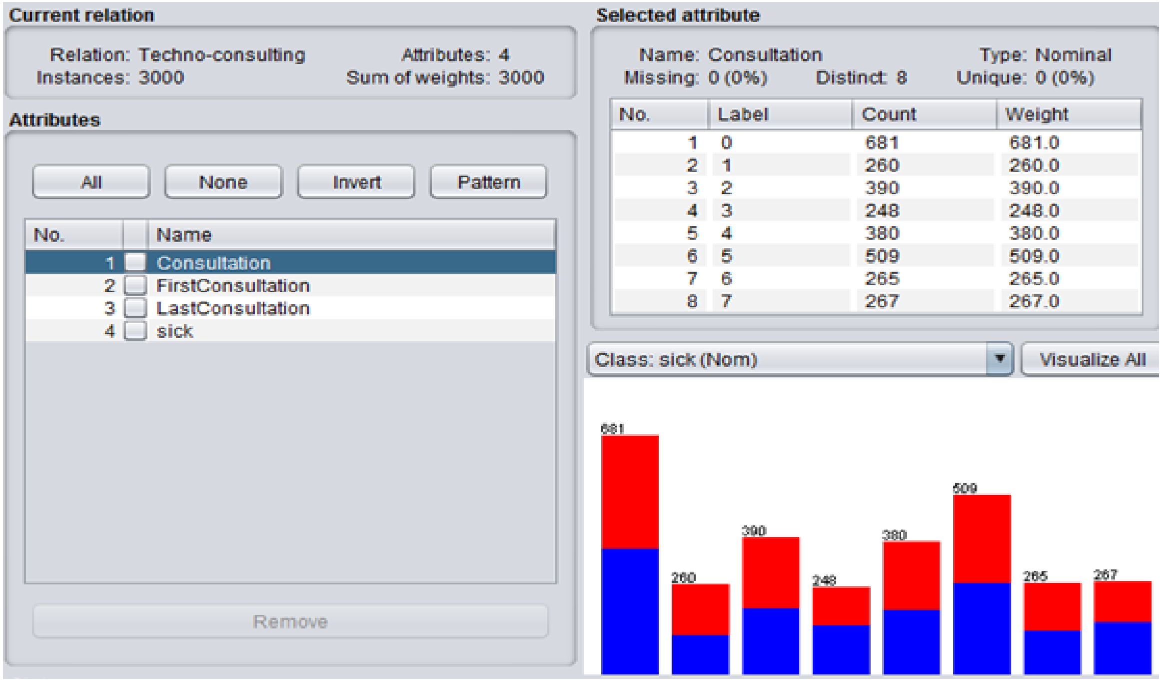


Figure 8 Techno-Consulting Classification Data

As shown in Figure 8. We used a database with 3000 records that we will use to establish a classification model and then choose the appropriate model for our case.

3.2. J48 Decision Tree

Decision tree J48 is the implementation of algorithm ID3 (Iterative Dichotomiser 3) developed by the WEKA project team (Kumbhar et al., 2017; Rebecca Jeya Vadhanam et al., 2016). It is a supervised classification algorithm based on class examples.

Dichotomisation is a separation of two opposite things(*J48 decision tree - Mining at UOC*, n.d.). It means that the algorithm separate attributes iteratively into two groups; the first group is the dominant attribute; the second group is the rest of the attributes for the cause to construct a tree. Then, it calculates the entropy and information gains of each attribute. After founding the dominant attribute, we will put it as a decision node in the tree. After that, entropy and gain scores will be calculated another time among the other attributes. So the dominant attribute is found another time. So on until the decision-making.

The Iterative Dichotomiser 3 algorithm is as follow (Y. Wang et al., 2017):

$$Ent(D) = -\sum_{d=1}^{k} pklog2Pk$$

$$Gain(D,a) = Ent(D) - \sum_{v=1}^{V} \frac{DV}{D}, Ent(DV)$$

D: the number of training samples.

Algorithm: Iterative Dichotomiser 3 algorithm
Input: Attribute set $A = \{a1, a2, \cdots, ad\}$ &&Training set $D = \{(x1, y1), (x2, y2), \cdots, (xn, yn)\}$
Output: decision tree
1 Generate node
2 **If** example from $D \in$ to the same class. **Then**
3 The node is labeled as class C leaf node; **Return**
4 **End if**
5 **If** $A = \varphi$ or the values in A= the values in D, **Then**
6 The node is labeled as leaf node; **Return**
7 **End if**
8 Entropy is chosen as a heuristic strategy to select the optimal splitting attribute ai
9 **Foreach** aiv in ai **do**
10 Generate a branch for node
11 **If** Dv.isEmpty() **Then**
12 The branch node is labeled as a leaf node
13 **Else** Take Tree Generate (Dv, $A \backslash \{ai\}$) as the node divided
14 **End if**
15 **End for**

The information obtained after the application of the algorithm:

=== Run information ===

Scheme: weka.classifiers.trees.J48-C 0.25-M 2
Relation: Techno-consulting
Instances: 3000
Attributes: 4
Consultation
FirstConsultation
LastConsultation
sick
Test mode: evaluate on training data

```
=== Classifier model (full training set) ===

J48 pruned tree
------------------


FirstConsultation<=200011
|   Consultation=0: 1 (271.0/114.0)
|   Consultation=1
|   |   LastConsultation<=200512: 0 (69.0/21.0)
|   |   LastConsultation>200512: 1 (69.0/27.0)
|   Consultation=2: 1 (194.0/84.0)
|   Consultation=3: 1 (109.0/38.0)
|   Consultation=4
|   |   LastConsultation<=200511: 0 (54.0/22.0)
|   |   LastConsultation>200511: 1 (105.0/40.0)
|   Consultation=5
|   |   LastConsultation<=200505
|   |   |   LastConsultation<=200504: 0 (8.0)
|   |   |   LastConsultation>200504
|   |   |   |   FirstConsultation<=199712: 1 (2.0)
|   |   |   |   FirstConsultation>199712: 0 (3.0)
|   |   LastConsultation>200505: 1 (185.0/78.0)
|   Consultation=6
|   |   LastConsultation<=200507
|   |   |   FirstConsultation<=199812: 0 (8.0)
|   |   |   FirstConsultation>199812
|   |   |   |   FirstConsultation<=200001: 1 (4.0/1.0)
|   |   |   |   FirstConsultation>200001: 0 (3.0)
|   |   LastConsultation>200507: 1 (107.0/43.0)
|   Consultation=7: 1 (115.0/40.0)
FirstConsultation>200011
|   Consultation=0
|   |   FirstConsultation<=200412: 1 (297.0/135.0)
|   |   FirstConsultation>200412: 0 (113.0/41.0)
|   Consultation=1: 0 (122.0/51.0)
|   Consultation=2: 0 (196.0/79.0)
```

```
|  Consultation=3: 1 (139.0/69.0)
|  Consultation=4: 0 (221.0/98.0)
|  Consultation=5
|  |  LastConsultation<=200512: 0 (177.0/77.0)
|  |  LastConsultation>200512
|  |  |  FirstConsultation<=200306: 0 (46.0/17.0)
|  |  |  FirstConsultation>200306: 1 (88.0/30.0)
|  Consultation=6: 0 (143.0/59.0)
|  Consultation=7
|  |  LastConsultation<=200508: 1 (34.0/11.0)
|  |  LastConsultation>200508: 0 (118.0/51.0)
```

Classifier output

```
Number of Leaves  :     28

Size of the tree :      43


Time taken to build model: 0.03 seconds

=== Evaluation on training set ===

Time taken to test model on training data: 0.02 seconds

=== Summary ===

Correctly Classified Instances        1774               59.1333 %
Incorrectly Classified Instances      1226               40.8667 %
Kappa statistic                          0.1807
Mean absolute error                      0.4773
Root mean squared error                  0.4885
Relative absolute error                 95.4768 %
Root relative squared error             97.7122 %
Total Number of Instances             3000

=== Detailed Accuracy By Class ===

                 TP Rate  FP Rate  Precision  Recall   F-Measure  MCC      ROC Area  PRC Area  Class
                 0,662    0,481    0,587      0,662    0,622      0,182    0,616     0,599     1
                 0,519    0,338    0,597      0,519    0,555      0,182    0,616     0,596     0
Weighted Avg.    0,591    0,411    0,592      0,591    0,589      0,182    0,616     0,597

=== Confusion Matrix ===

    a    b   <-- classified as
 1009  516 |    a = 1
  710  765 |    b = 0
```

Figure 9 Output From The Classification Model

In Figure 9. The confusion matrix shows us that we have 516 as false positives and 710 as false negatives. A false negative is a test result that indicates that a person does not have an illness. As a result, a false-positive test result indicates that a person has a disease. According to the accuracy rate of 59.1%, the model is pretty good.

To finalise our classification, we will run the test via our Techno-consulting-test.arff database as shown in Figure 10. To confirm that the accuracy of the model is almost the same for all learning.

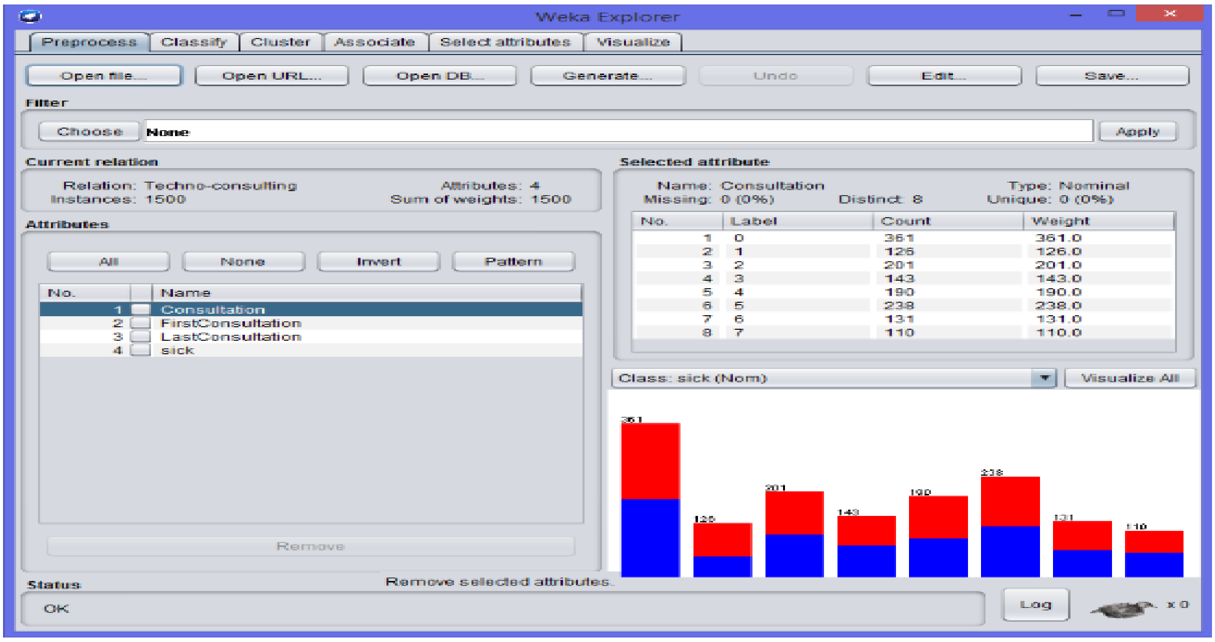


Figure 10 Techno-Consulting-Test Classification Data

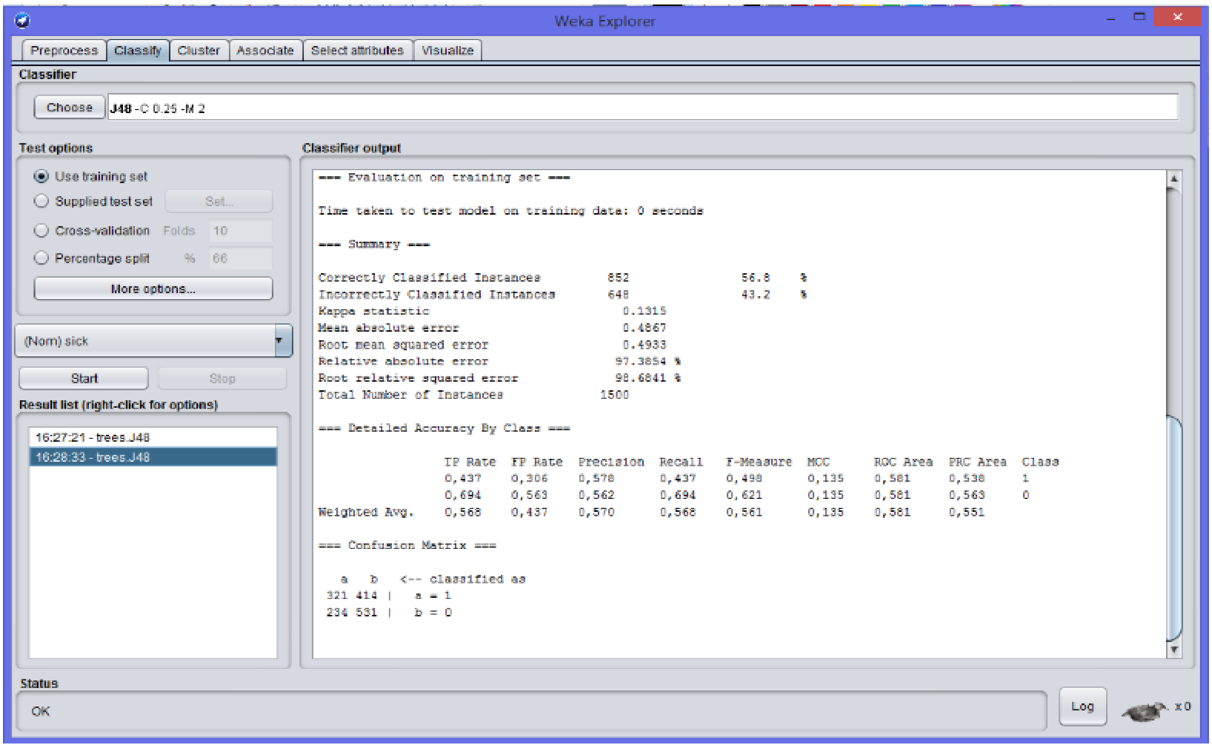


Figure 11 Classification Tree Test

Based on the comparison of the "*Correctly Classified Instances*" as shown in Figure 10 and Figure 11. An element of the 56.8% test with the 59.1% training set, we notice that the accuracy is almost identical, which guarantees that the prediction of future unknowns will not change the results. However, the accuracy of the model remains unsatisfactory ranking the data correctly between 50% and 60%, which is a minimal rate in our case study. Therefore, we will test new models until we reach satisfactory results.

3.3. Random Forest

A random forest is a classifier consisting of a collection of tree-structured classifiers {h(x, θk), k=1} where the {θk} are independent identically distributed random vectors and each tree casts a unit vote for the most popular class at input x (Breiman, 1999; Louppe, 2014).

Random forest is a supervised algorithm that creates a random forest that is a set of decision trees merged for better accuracy and prediction, which can be used for classification and regression(*Random forests - classification description*, n.d.).

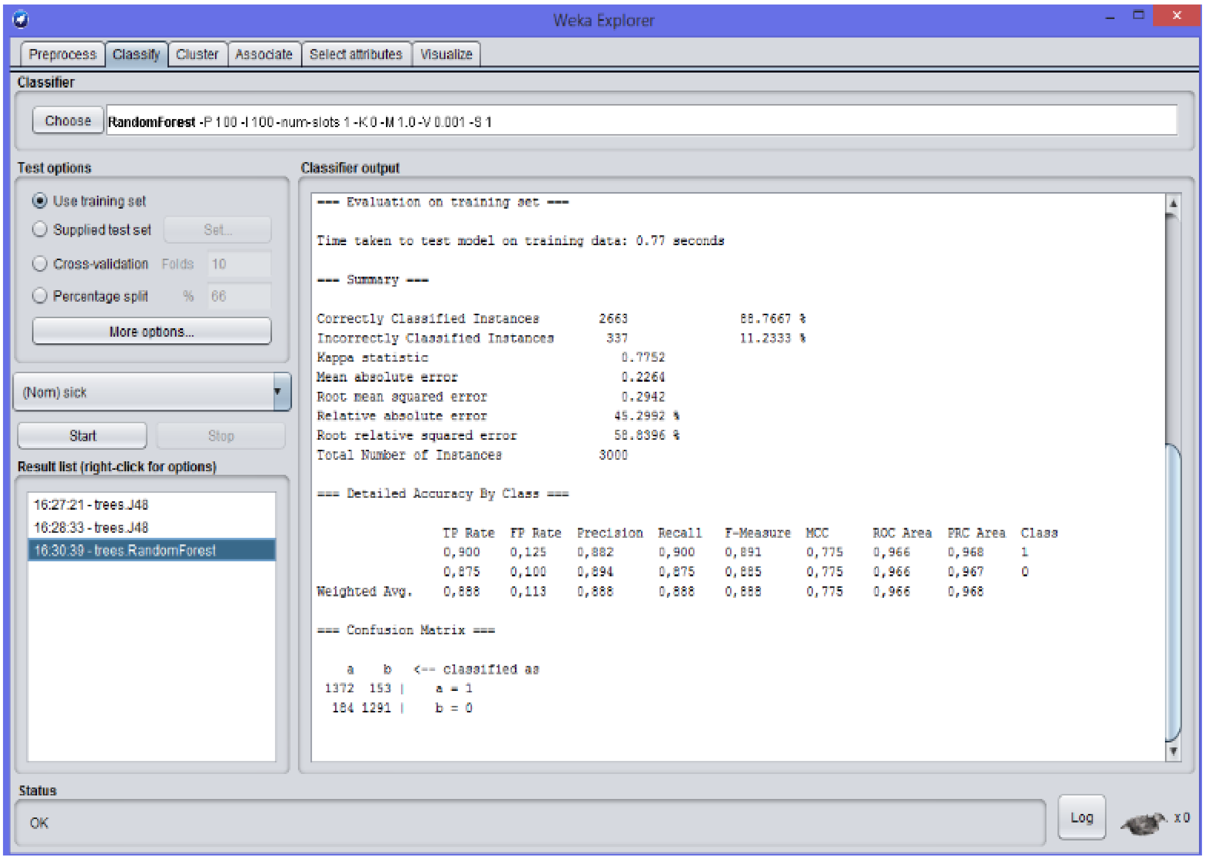


Figure 12 Output From The Classification RF Model

The confusion matrix as shown in Figure 12. Shows us that we have 153 as false-positive and 184 as false-negative. False negatives are people who do not suffer from any illness; false-positives indicate people with an illness. According to the accuracy rate of 88.7% it is a good model.

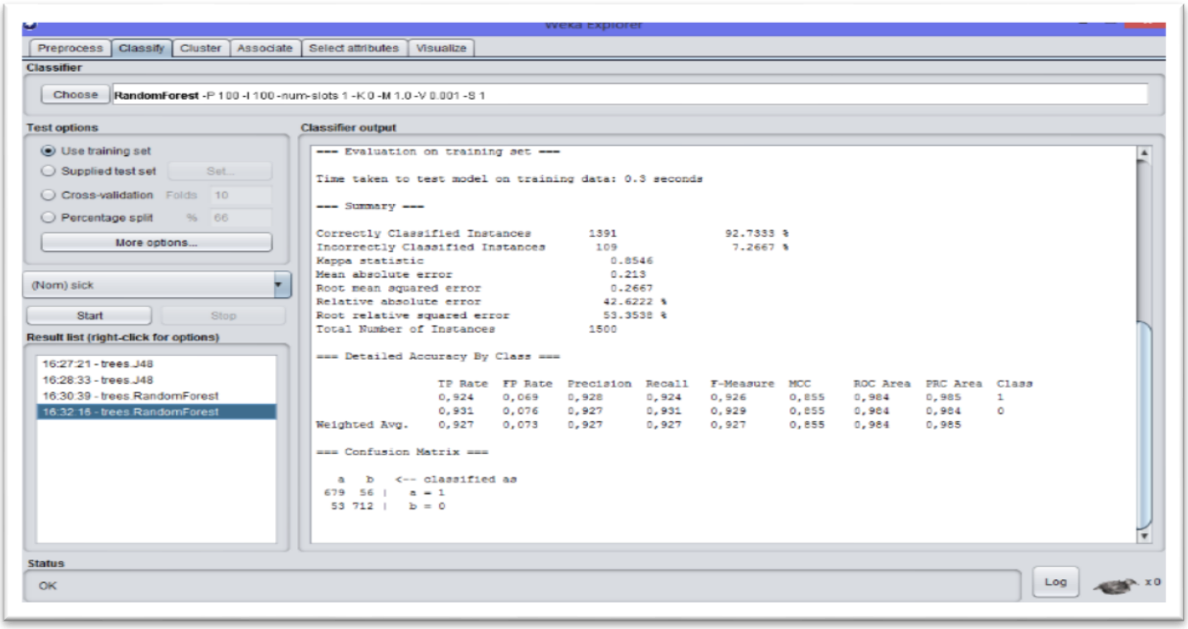


Figure 13 Classification Test For RF

As shown in Figure 13. The comparison of the "Correctly Classified Instances" element of the 92.7% test with the 88.7% training set, shows us that the accuracies are almost identical, which guarantees that the prediction of future unknowns will not change the results.

3.4. Clustering

Clustering is a statistical analysis method used to organize raw data. Within each group, the data are grouped according to standard features. Clustering is mainly used to segment, classify a database, or extract knowledge to solicit subsets of data that are difficult to identify.

Formalization:

Either a database $S = \{xi, i = 1 \dots N\}$ such as xi is a tuple.

Clustering problem: determining a function $f: S \to \{1, \dots, k\}$.

* A class Ci, j=1k contains the tuples taking the value j on the function f.

* Requires a measure of similarity sim.

* Determine$f: X \rightarrow \{1, \ldots, k\}$ as for each class Cj, $\forall xu, xv \in Cj \wedge xw \notin Cj$:

$(xu, xv) > (xu, xw)$and$(xu, xv) > (xv, xw)$

We will use the dataset Techno-stress.arff to be able to group the problems defined in the database in the form of a questionnaire. We seek to extract this data by finding patterns in the data and using clusters to determine whether certain behaviours are emerging among users. There are 100 data records in this sample, and each column describes user responses to the stress caused by the technology.

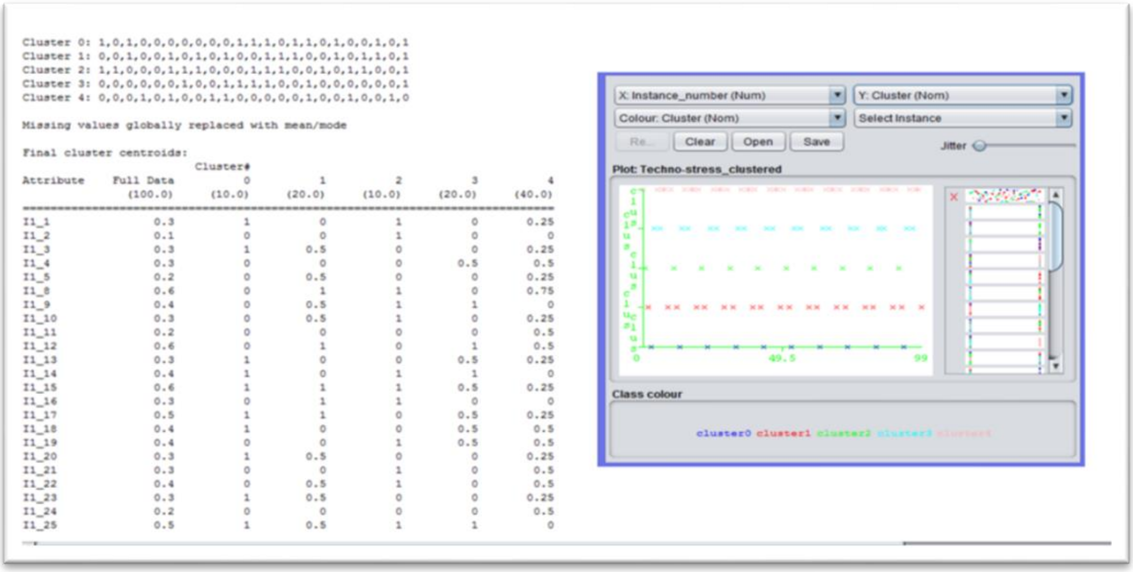
With this dataset, we are looking to create clusters; we will use k-Means. K-Means is an unsupervised algorithm for non-hierarchical clustering. It allows the grouping in k separate clusters the observations of the data set. Thus similar data will end up in the same cluster.

To consolidate a data set into k distinct cluster, the K-Means algorithm needs a way to compare the degree of similarity between different observations(*CS221*, n.d.). We will have a choice between two methods: The Euclidean distance (Krislock & Wolkowicz, 2012) and The Manhattan distance (Dulong, 1995). For high dimensional vectors, one might find that Manhattan works better than the Euclidean distance. That is why we are going to work with the Euclidean distance in our case.

Euclidean distance: $\sum_{i=1}^{n} |xi - yi|$

We will use 5 clusters to be able to extract 5 categories to assign them to 5 types of processing.

4. Results



Cluster 0: 1,0,1,0,0,0,0,0,0,0,1,1,1,0,1,1,0,1,0,0,1,0,1
Cluster 1: 0,0,1,0,0,1,0,1,0,1,0,0,1,1,1,0,0,1,0,1,1,0,1
Cluster 2: 1,1,0,0,0,1,1,1,0,0,0,1,1,1,0,0,1,0,1,1,0,0,1
Cluster 3: 0,0,0,0,0,0,1,0,0,1,1,1,1,0,0,1,0,0,0,0,0,0,1
Cluster 4: 0,0,0,1,0,1,0,0,1,1,0,0,0,0,0,1,0,0,1,0,0,1,0

Missing values globally replaced with mean/mode

Final cluster centroids:

Attribute	Full Data (100.0)	Cluster# 0 (10.0)	1 (20.0)	2 (10.0)	3 (20.0)	4 (40.0)
I1_1	0.3	1	0	1	0	0.25
I1_2	0.1	0	0	1	0	0
I1_3	0.3	1	0.5	0	0	0.25
I1_4	0.3	0	0	0	0.5	0.5
I1_5	0.2	0	0.5	0	0	0.25
I1_8	0.6	0	1	1	0	0.75
I1_9	0.4	0	0.5	1	1	0
I1_10	0.3	0	0.5	1	0	0.25
I1_11	0.2	0	0	0	0	0.5
I1_12	0.6	0	1	0	1	0.5
I1_13	0.3	1	0	0	0.5	0.25
I1_14	0.4	1	0	1	1	0
I1_15	0.6	1	1	1	0.5	0.25
I1_16	0.3	0	1	1	0	0
I1_17	0.5	1	1	0	0.5	0.25
I1_18	0.4	1	0	0	0.5	0.5
I1_19	0.4	0	0	1	0.5	0.5
I1_20	0.3	1	0.5	0	0	0.25
I1_21	0.3	0	0	1	0	0.5
I1_22	0.4	0	0.5	1	0	0.5
I1_23	0.3	1	0.5	0	0	0.25
I1_24	0.2	0	0	0	0	0.5
I1_25	0.5	1	0.5	1	1	0

Figure 14 Cluster Output With A Visual Inspection

The resulting output in Figure 14. Shows us that clusters match with a "*1*" means that users share the same value and a "*0*" means that users in this cluster have a value of zero for this attribute (*DISTANCES IN CLASSIFICATION*, n.d.).

Each cluster shows us a type of behaviour among users, from which we can draw some conclusions:

Cluster 0: This group represents only 10 people. We cannot, therefore, make a weak conclusion against them knowing that they are not statistically relevant.

Cluster 1: These are the patients who have trouble keeping up with new technologies (which we can classify as Belonging to the old school).

Cluster 2: This group represents only 10 people. We cannot, therefore, make a weak conclusion against them knowing that they are not statistically relevant.

Cluster 3: These are the patients that we will classify as part of laziness intelligent, who finds excuses for not working so much. These people are often remarkably ingenious; when they are given a task, they always find the simplest and the least tiring way to perform it. This leads to thinking more and to working one's mind to find the optimal way to perform the tasks. Their logic for success is not to work harder but simply smarter.

Cluster 4: This group represents patients who do not need treatment, but simply training sessions to adapt to new technologies and keep pace with the group.

5. Discussion

We want to indicate that this long-term solution will be almost costless since it will concerns only the maintenance and updates of the application, using this solution will eliminate or at least reduce the need of spending money on repeated physician diagnosis on every patient, and the professional secrecy of the organization and staff is respected by keeping all collected data shared locally, Without forgetting that this data can be used by the same organization managers, in order to acquire more knowledge about the relationship of their employees towards organizational ICT.

In a survey made by Microsoft, results shows that interference between humans and computers generally lead to TS, about 20,000 workers from all around Europe were questioned, and the findings says that 20% was the average of European employees that feel highly engaged at work in their current workplaces, But in a robust digital culture, this increases dramatically with four times as many employees saying they felt engaged, the same Research indicated that TS is a matter of serious discussion now and employees' health cannot be put at stake because of it (*Digital Culture: Your competitive advantage*, n.d.).

6. Conclusion

The aim behind this first phase of our research is to use data mining as a tool to confirm the accuracy of our computerized solution, from the beginning of our conceptual model until the TS detection step. We did an employee-based case study and a TC classification by type. Moreover, we applied a set of processing's to the results via learning algorithms which we have classified in accordance with the five categories: Techno-overload, Techno-invasion, Techno-insecurity, Techno-uncertainty and Techno-complexity.

This study is very important for MHS because, in addition to their traditional evolutionary and diagnostic methods, this solution will be of great help to them in the TS detection process and in the precision of specific CT for each patient and for any eventual comparison, but the main target for our current research is organizations and specifically the organizations whose employees are daily confronted to the use of ICTs which often results in the appearance of TS among them.

In the next chapter, we will focus on the second phase of our conceptual model which will analyse the CS as a way to gain time, precision in prescriptions and to provide organizations with a dynamic coping referential that would fit the ICT of each organization without the need for repetitive mental health checking’s, thus helping every category of these TC to automatically get the most appropriate treatment using AI.

CHAPTER V:

Computerizing Technostress Management: Toward An Artificial Intelligence Assisted Support and Diagnosis System.

1. **Introduction And Literature Review**

Driven by the sudden proliferation of Covid-19 pandemic, the forced turn toward remote ICT solutions, was a survival matter for many companies willing to accompany the lockdown situation. While on the other hand it was an unexpected change for many of their employees, this led to the emergence of new forms of health issues that we can associate to the general phenomenon of TS. One of these noticed problems is called (zoom fatigue) and it refers to the mental exhaustion associated with online video conferencing (Zoom fatigue: how to make video calls less tiring, n.d.). We think this situation is a clear warning to CEOs to pay more attention to the side effects induced by the use of ICT in normal and lockdown times.

In the past decade a plethora of measures have been developed to assess and treat the phenomenon of TS which is described by professionals as a kind of stress experienced by individuals due to the use of ICT. TS has been defined as "a state of excitement observed in some employees who are highly dependent on computers in their work" (Arnetz& Wiholm, 1997). One of the largely used definitions describes TS as a "Modern disease of adaptation caused by the inability to cope with new computer technologies in a healthy manner "(Brod, 1984). According to Brod's definition, in order to correctly fit the New Computer Technologies and ICTs, some of the largely used methods for dealing with TS are called the Coping Strategies or TS Inhibitors as called by others (e.g., (Ragu- et al., 2008)).

Originally these strategies or mechanisms are partitioned into two categories: behavioural and psychological (Mick & Fournier, 1998), but for technological situations these strategies have been categorized into two significant groups: problem-focused strategies (behavioural) and emotion-focused strategies (psychological) (Beaudry & Pinsonneault, 2005; Susan Folkman, 1984; K. Wang et al., 2008). Emotional-focused CSs are seen as indirect approaches used to reduce the stress by managing the emotions (Lazarus & Folkman, 1984a), while problem-focused CSs are viewed as direct approaches (Hudiburg, 1996), meaning efforts used to solve the problems that were behind the creation of the stress (Pastorino & Doyle-Portillo, 2012).

The methods of coping are methods that require a relatively long period of time for the patient to practice them. Likewise, the evaluation and the testing of their efficacy by the health professionals and managers is time consuming, especially if the stressor is faced for the first time. The difficulty of this encounter which initially pushed us to work on the conception of this solution (Coping Methods) (Salah-Eddine et al., 2018, 2019; Salah-Eddine & Belaissaoui, 2017).

Furthermore, the fact that each company has its proper internal management policies, decides for the choice of adopting the type of ICT that best suit their needs. Knowing that the ICT (the stressor conditions in our case) vary in terms of complexity, specialty, distributions, versions, etc., we therefore deduce that the type of TS experienced by employees will vary depending on the type of ICT being used in different companies or enterprises. Hence the used CS are also variable, situationally specific and context-dependent, which is in line with the findings of previous researches (Beaudry, 2009; Richmond & Skitmore, 2006). Accordingly, our solution has come to give companies' managers the possibility to manage their TS problems, exploiting and re-using the records of past successful data, of the previous diagnosis and treatments of "TS-Coping" performed on the employees of the same company. These data can be applicable to all the branches of the company with same ICT infrastructures, which describe all information and communication infrastructures and systems (including firmware, hardware, software, networks and websites) used in the organization (Martucci et al., 2020).

This Chapter will continue along the same lines as our previous chapters, into making the phenomena of TS more computerized, so it can be accessible for the community of data analytics and AI in general, by offering them a reliable structured data. The rest of this paper is organized as follows. Section II provides a brief reminder of our previous works and their relationship with the actual work, with a glimpse into the problem we face in order to test the solution, and the hypothesis we adopted in order to overcome this problem. In section III we present our solution's use case diagrams, which due to their simplistic nature, can be a good communication tools providing a high level view of the system to stakeholders and software developers. Then in section IV we follow up by giving the screen-prints of the major interfaces of our solution. Finally, in Section V we conclude by a discussion of the benefits and gains one can get from this solution, and conclusion and perspectives.

2. The Proposed Methodology

We have presented our TS Management Process Figure 6. In the form of an activity process that better emphasizes the treatments and make these easy to comprehend for the user. In the context of this work, finding a company willing to share with a third party such critical information concerning its technological infrastructure and the psychological aspects of its employees is a challenge.

One can add to that the constraint of time needed in order to apply and check the effectiveness of the selected CS, which can go from days to months depending on the type of triggering stressors and the significance of the patient's mental and physical state. In order to bypass these constraints and test our proposed solution, we assume that the whole time the CS Process consumes was already fulfilled, which according to our same previous works means that the KMS has reached its maturity. This system is used by companies to help organize document by gathering, evaluating, and sharing valuable information (What is a Knowledge management system? | Freshdesk, n.d.). In our case, the KMS records for each item of TS, the best CS having already yielded fruitful results.

To test our prototype solution all along with the circumstances explained above, we have adopted a largely used questionnaire comprised of 23 items, developed by (B. Ragu-Nathan et al., 2002; Tarafdar et al., 2007) to measure the extent of TS perceived by people, and address each of these items accordingly with the literature on the subject.

We chose arbitrarily two different types of CS' instruments from among many existing ones, first one is the Weil & Rosen instrument (Weil & Rosen, 1997) which is more problem-focused (Figure 15), and the second one is the Ways of Coping Questionnaire (Susan Folkman et al., 1988), which is more emotional-focused (Figure 16).

Assuming that these CSs have shown efficiency in the coping process, and according to our personal choice, we auto-assigned each of the 23 TC items with a variable number of CS from the two instruments. Weil & Rosen Instrument (reference) is represented by the capital letter "A", and WCQ by the capital letter "B", then the final data structure obtained is aimed to be represented in the structural form of a table as shown in Figure 17.

"A

A1) Enterprise provides employees more interior or exterior training opportunities for new technology and increases budget of new technology training.
A2) Improve and enhance enterprise's ability of system maintain and try to prevent accidents resulting in technostress.
A3) Establish enterprise sharing information database in the form of typical cases and resolving plan, so that the learning curve of individual and enterprise can be shortened obviously when similar problem happens.
A4) Amend the relationship between technology consumers and IT employees in order to resolve many instances resulting in technostress.
A5) Enterprises need adopt all-round and scientific IT evaluating method to avoid wrong investment resulting from carelessly adopting prevalent technology.
A6) Enterprise provides clear new technology documentation for consumers.
A7) Enterprise establishes efficient technology services center, so technology problems meet by employees can be resolved in time.
A8) Enterprise provides better compensation and welfare plan for employees in order to enhance working activity of employees that is helpful to reduce mental stress.
A9) Enterprise adopts appropriate police to keep the balance between working efficiency and worker welfare, so employees can obtain equivalent reward to their efficiency.
A10) Promote the team spirit, making them share the working burden resulting in technostress and resolving technological problem together.

Figure 15 WEIL AND ROSEN

"B

______ 1. Just concentrated on what I had to do next – the next step.
______ 2. I tried to analyze the problem in order to understand it better.
______ 3. Turned to work or substitute activity to take my mind off things.
______ 4. I felt that time would make a difference – the only thing to do was to wait.
______ 5. Bargained or compromised to get something positive from the situation.
______ 6. I did something which I didn't think would work, but at least I was doing something.
______ 7. Tried to get the person responsible to change his or her mind.
______ 8. Talked to someone to find out more about the situation.
______ 9. Criticized or lectured myself.
______ 10. Tried not to burn my bridges, but leave things open somewhat.
______ 11. Hoped a miracle would happen.
______ 12. Went along with fate; sometimes I just have bad luck.
______ 13. Went on as if nothing had happened.
______ 14. I tried to keep my feelings to myself.
______ 15. Looked for the silver lining, so to speak; tried to look on the bright side of things.
______ 16. Slept more than usual.
______ 17. I expressed anger to the person(s) who caused the problem.
______ 18. Accepted sympathy and understanding from someone.
______ 19. I told myself things that helped me to feel better.
______ 20. I was inspired to do something creative.
______ 21. Tried to forget the whole thing.
______ 22. I got professional help.
______ 23. Changed or grew as a person in a good way.
______ 24. I waited to see what would happen before doing anything.
______ 25. I apologized or did something to make up.
______ 26. I made a plan of action and followed it.
______ 27. I accepted the next best thing to what I wanted.
______ 28. I let my feelings out somehow.
______ 29. Realized I brought the problem on myself.
______ 30. I came out of the experience better than when I went in.
______ 31. Talked to someone who could do something concrete about the problem.
______ 32. Got away from it for a while; tried to rest or take a vacation.
______ 33. Tried to make myself feel better by eating, drinking, smoking, using drugs or medication, etc.
______ 34. Took a big chance or did something very risky.
______ 35. I tried not to act too hastily or follow my first hunch.
______ 36. Found new faith.
______ 37. Maintained my pride and kept a stiff upper lip.
______ 38. Rediscovered what is important in life.
______ 39. Changed something so things would turn out all right.
______ 40. Avoided being with people in general.
______ 41. Didn't let it get to me; refused to think too much about it.
______ 42. I asked a relative or friend I respected for advice.
______ 43. Kept others from knowing how bad things were.
______ 44. Made light of the situation; refused to get too serious about it.
______ 45. Talked to someone about how I was feeling.
______ 46. Stood my ground and fought for what I wanted.
______ 47. Took it out on other people.
______ 48. Drew on my past experiences; I was in a similar situation before.
______ 49. I knew what had to be done, so I doubled my efforts to make things work.
______ 50. Refused to believe that it had happened.
______ 51. I made a promise to myself that things would be different next time.
______ 52. Came up with a couple of different solutions to the problem.
______ 53. Accepted it, since nothing could be done.
______ 54. I tried to keep my feelings from interfering with other things too much.
______ 55. Wished that I could change what had happened or how I felt.
______ 56. I changed something about myself.
______ 57. I daydreamed or imagined a better time or place than the one I was in.
______ 58. Wished that the situation would go away or somehow be over with.
______ 59. Had fantasies or wishes about how things might turn out.
______ 60. I prayed.
______ 61. I prepared myself for the worst.
______ 62. I went over in my mind what I would say or do.
______ 63. I thought about how a person I admire would handle this situation and used that as a model.
______ 64. I tried to see things from the other person's point of view.
______ 65. I reminded myself how much worse things could be.
______ 66. I jogged or exercised.

Figure 16 Lazarus and Folkman

KMSERVER	
Technostress Creators	KMS Coping Strategies
1—I am forced by this technology to work much faster	A9+B26
2—I am forced by this technology to do more work than I can handle.	A9+B22+B31
3—I am forced by this technology to work with very tight time schedules.	A3+B7
4—I am forced to change my work habits to adapt to new technologies.	A5+A12+B2+B5+B66
5—I have a higher workload because of increased technology complexity.	A6+A10+B8+B22
8—I spend less time with my family due to this technology.*	B8+B7+B31
9—I have to be in touch with my work even during my vacation due to this technology.	B26+B31
10—I have to sacrifice my vacation and weekend time to keep current on new technologies.	B26+B5
11—I feel my personal life is being invaded by this technology.	B26
12—I do not know enough about this technology to handle my job satisfactorily.	A1+A12+B63
13—I need a long time to understand and use new technologies.	A1+A6+B4
14—I do not find enough time to study and upgrade my technology skills.	A1+B22
15—I find new recruits to this organization know more about computer technology than I do.	A10+B41
16—I often find it too complex for me to understand and use new technologies.	A1+A4+A10+B22
17—I feel constant threat to my job security due to new technologies.	A1+A8+B15+B26
18—I have to constantly update my skills to avoid being replaced.	A4+A9+B23
19—I am threatened by coworkers with newer technology skills.	A10+B23+B35
20—I do not share my knowledge with my coworkers for fear of being replaced.*	A6+A10+B9+B29+B35
21—I feel there is less sharing of knowledge among coworkers for fear of being replaced.	A10+A4+B22
22—There are always new developments in the technologies we use in our organization.	A5+A11+A12+B15+B41
23—There are constant changes in computer software in our organization.	A1+B44
24—There are constant changes in computer hardware in our organization.	A11+A12+B15+B41+B44
25—There are frequent upgrades in computer networks in our organization.	A1+A5+A12+B15+B41

Figure 17 Knowledge Management Servers

3. Conception

In the life cycle of our project, design is a critical phase in producing a high quality application. It is at this stage that we must first clarify the global view by describing the general architecture that we will follow in the realization part of our project. Then, in a second place we will detail our conceptual choice through several types of diagrams.

4. Use Case Diagram's Role

The roles of use case diagrams are to collect analyse and organize requirements, as well as to identify the major functionalities of our system. It is therefore the first Unified Modelling Language (UML) step in our system design. A use case diagram captures the behaviour of a system, subsystem, class, or component as seen by an external user. It divides the functionality of the system into coherent units, the use cases, which make sense to the actors. Thus these use cases make it possible to express the needs of the users of the system, they are thus a user-oriented vision of this need, as opposed to an IT vision.

5. The Actors Of Our Project

- The User: is the employee in our case, who can log in and answer questions, and see what recommendations the health care professionals will send to him. Human Resources Manager: Is the person responsible for supervising and ensuring the smooth running of the overall process involving the users and the health specialists.
- The health care professional: This actor has the right to consult user responses and send recommendations.

6. Our Web page's Use Case Diagrams

6.1. User Case Diagram

The figure bellow illustrates the different functionalities offered to the user of our application.

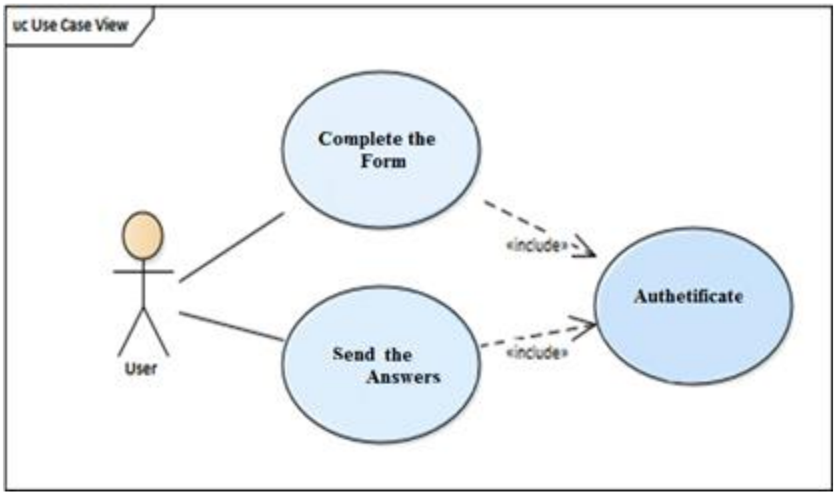


Figure 18 User use Case

6.2. Provider Case Diagram

The two figures below illustrate the different functionalities offered to the Health Care Professional and to the Human Resource Manager users of our application:

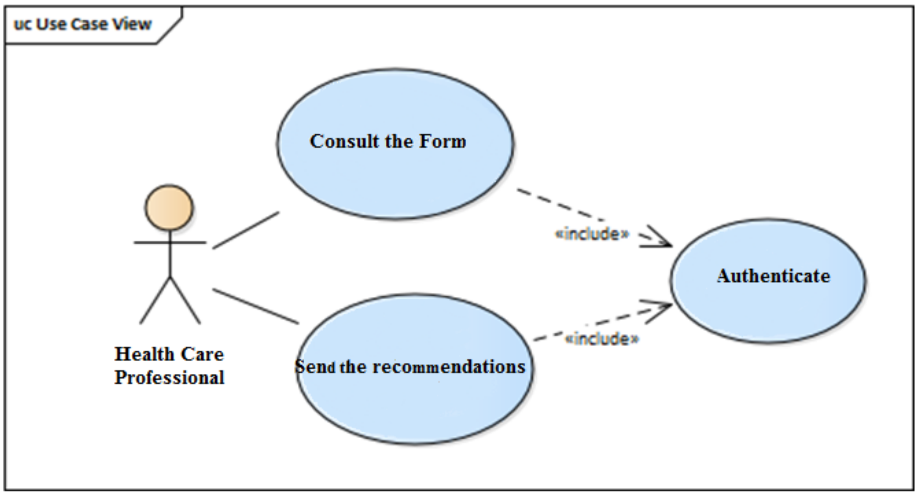


Figure 19 Use Case of a Health Care Professional

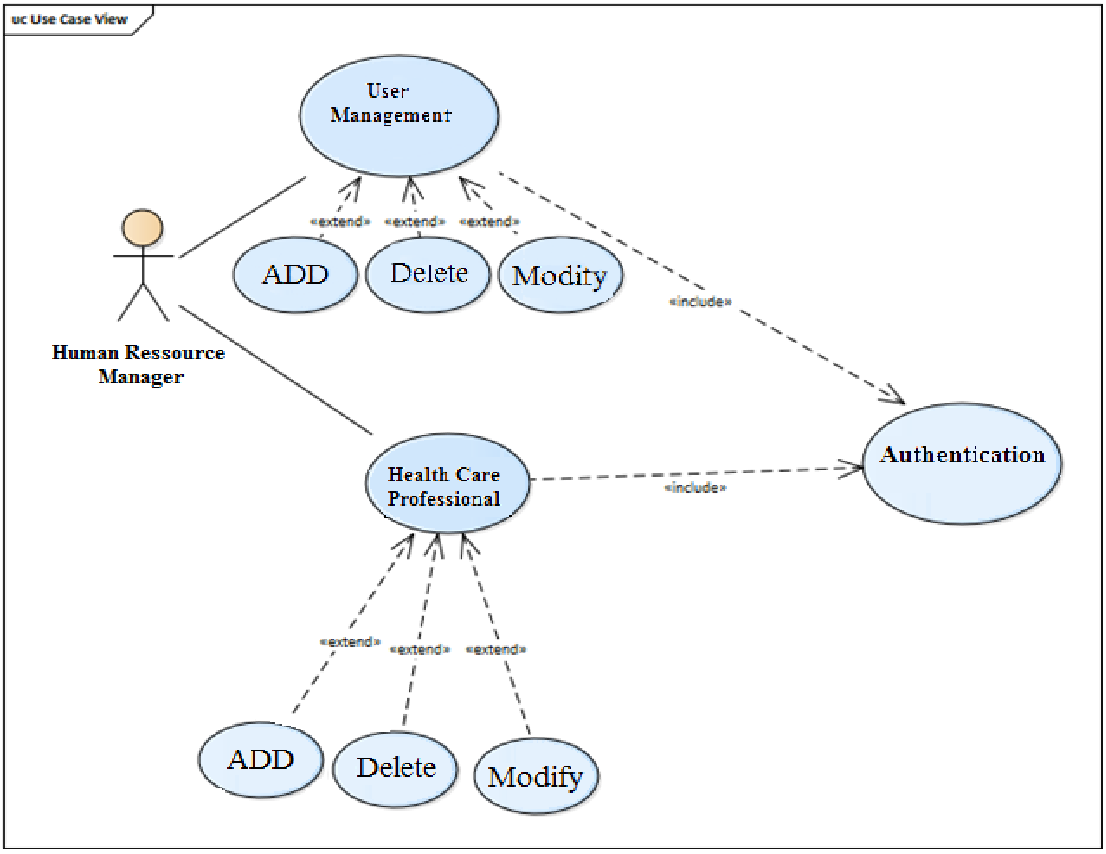


Figure 20 Case of Use of a Human Resource Manager

7. Sequence Diagrams

A sequence diagram is an interaction diagram that details how operations are performed: what and when messages are being sent. Sequence diagrams are organized according to the time that elapses as we move through the page. The objects involved in the operation are listed from left to right according to when they take part in the sequence.

7.1. Sequence Diagram For Adding a User

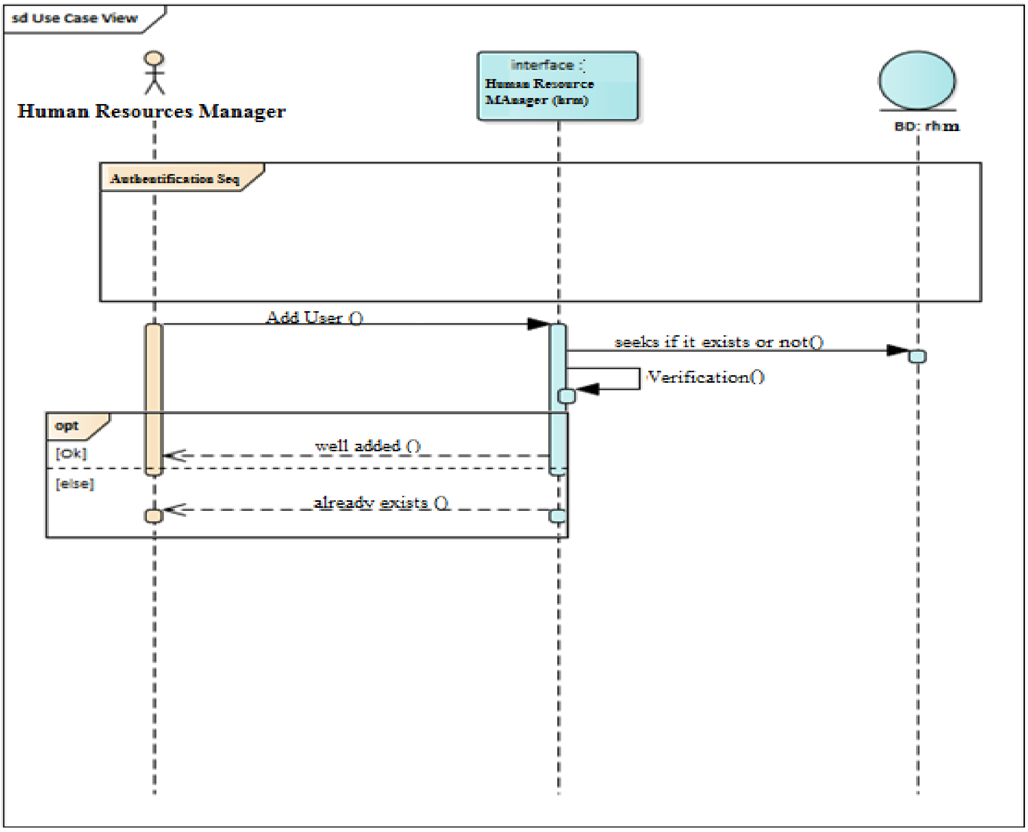


Figure 21 Add User

7.2. Sequence Diagram for The Notification of a Health Care Professional

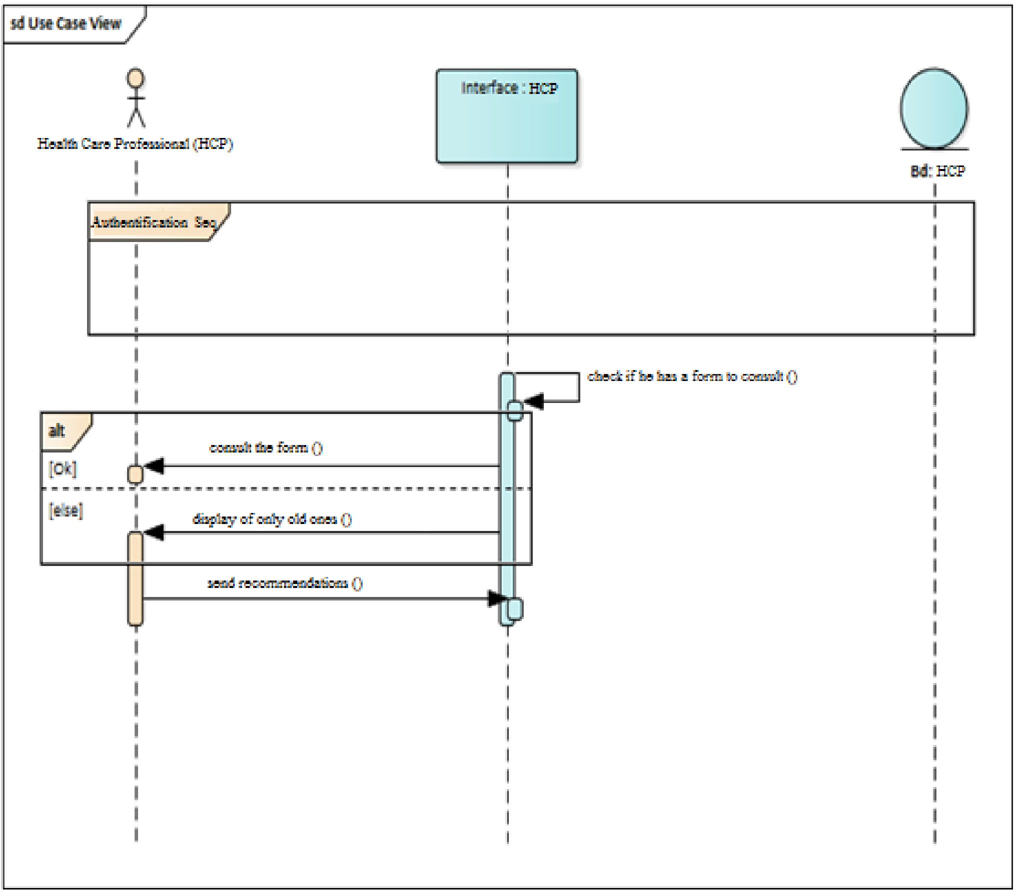


Figure 22 Notification of a Health Care Professional

8. Class diagram

Our UML class diagram describes the object and information structures used on our web page, both internally and in communication with its users. It describes the information without referring to a particular implementation. Its classes and relationships can be implemented in many ways, such as database tables, XML nodes or software object compositions.

8.1. Our Class Diagram

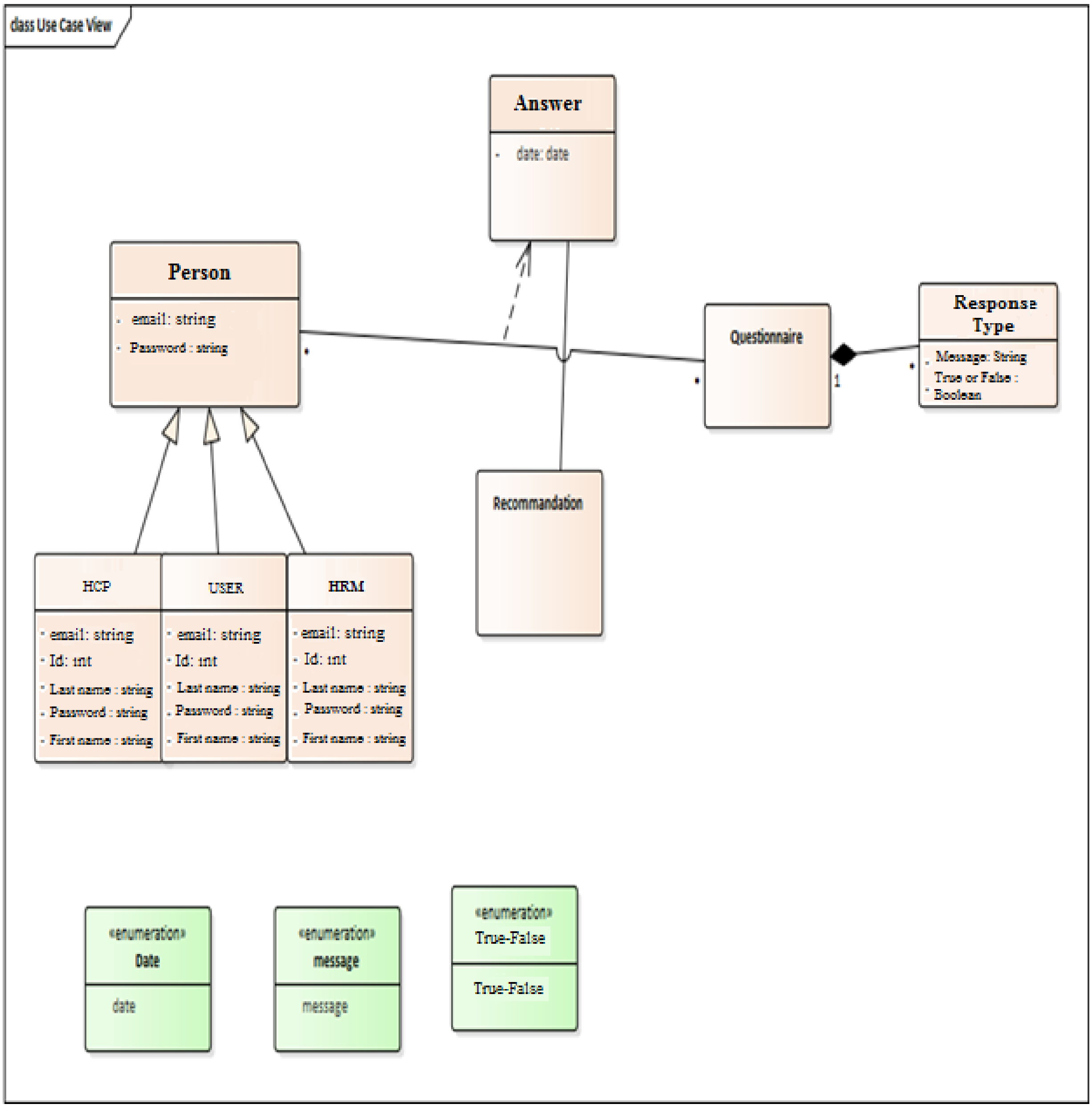


Figure 23 Class Diagram

9. The Realization of the Application

This part enumerates the presentation of the Application Scenarios. In the in appendix section, we will present the screen-prints of the main interfaces realized in our Application.

The Figure 26. In Appendix A.1, shows the system administrator which can handle the add and delete of users (Employees) who use ICTs, by adding their full names, email address, and authentication password.

After creating a user profile for the employees, this time as shown in Figure 27. in Appendix A.1, the admin will proceed by filling more information details on users, such Gender: ("Man" or "Woman"), Age: ("-29" or "30-39" or "40-49" or "50+"), IT Experience ("under 10 years" or "10 - 19" or "20 - 29" or "30+"), Education ("Less then high school" or "Graduated high school" or "Trade / Technical school" or "some college, no degree" or "Associate Degree" or "Bachelor's degree" or "Master's degree/ PhD degree"), these information are presented in the form of drop-down lists, and can be modified afterward, in the Edit page, as shown in Figure 28. In appendix A.1.

Figure 29. In appendix A.1, presents the page where the system administrator can add for the first time the Health specialists, by adding their full names, email address, and authentication password.

Figure 30. In appendix A.1, shows the page that lists all the existing Health specialists and permit the admin of deleting their profiles, or editing their information as shown in Figure 31. in appendix A.1.

The Figure 32. In appendix A.1, shows how The Health specialist or the Admin can fill questions manually one by one and create his own questionnaire, or choose from among already existing ones as shown in Figure 33. in Appendix A.1, Where named file contains many overviewed questions Q1, Q2, Q3, etc..

Figure 34. In appendix A.1, Is showing us the Page that allows The Manager selecting the suitable Health Specialist to perform the current questionnaire process, while Figure 35. in appendix A.1, Is for selecting the Employees who will be chosen to take the Detection questionnaire process.

After filling the questionnaire the files are gathered in a page in the form of files AND The HR and the MHS will receive a notification (Figure 36.), in the Figure 37. As example we have one file completed, named “Honore” and the user that has performed the test is the owner of the email mkwaya@gmail.com.

Figure 38. in appendix A.1, Depict the details of the Honore file showed in Figure 37. In Appendix A.1, with all the Questions answered in the form of check boxes, plus a recommendation area in case of remarks.

10. Discussion

The benefits of our approach will provide to companies when fully implemented are:

- Monitoring the employee's health status, whether locally from inside the company enclosures, or from outside by enabling Our Project Actors the possibility to access our solution through the company's hosting web server, which can be very useful in case of lockdown situations.

- Providing companies with their own dynamic TS's guideline, which adapts the CS according to the needs and the evolution of the company's ICT infrastructure.

- Eliminate the permanent need for the physical presence, of the Health care specialist in case of usual or non-urgent cases, by using the results collected in the KMS.

- Gaining time by skipping the time consuming CS step, applied on employees of the same company (using the previously successfully experimented CS).

- Monitoring the development of user's health status by checking and comparing their records.

- Preventing future recurrences of TS symptoms, and this is through analysing the records of past problems and their appropriate remedies, which are hierarchically preserved in knowledge and problem database and this according to the time of their appearance and by respect to the different control variables of gender, age, experience, and the education of each employee.

-In general, finding relevant training data can be a surprisingly difficult process. Datasets are usually created for either one unique model or for general use, therefore and due to the specificity of the field of TS, our solution is aimed to be like a molding form, for the preparation of structured data, and if further we can imagine the gathering of a big amount of data from the different branches of the same company in one server (the more the data is bigger, the more the patterns will be correct), or from many companies with similar field of work, thereafter enabling a more easy way to patterns recognition (Pattern recognition is the process of recognizing patterns using a ML algorithm. it can be defined as the classification of data based on previously acquired knowledge or statistical information derived from standards and/or their representations. An important aspect of pattern recognition is its applicability.) that are identified through the learning of data by using ML technology, which is a subset of AI based on the idea that systems can learn from data, identify patterns, and make decisions and predictions with minimal human intervention (Mohamed & Ali, 2019).

11. Conclusion

This chapter gives a glimpse on the general purpose of our research, which was not specifically focused on only creating a key in hand application, but rather to give a more visible explanation on how we see our conceptual models treating the TS' subject; and on how this solution is able to support its users, and keeping managers aware of their employees mental health status, whether at home or at the office, permitting in final, companies to build their own TS' guidelines, and enriching their knowledge regarding the interaction between their ICT infrastructures and their employees behavioural and overall health.

CONCLUSION AND FUTURE WORKS

The main objective of this current research in general, is to participate in the global efforts to improve the overall quality of health care, and specially in organisational situation, by offering a new solution to manage TS which is a big and multidisciplinary subject needing vast knowledge on different discipline such as computing, psychology, management, RH, etc., The primary objective of this research was to first address the TS phenomenon in a computational way to permit it assessing and inhibition according to the used ICT and according to the specificity and policies of organisations, and for this reason we have applied the definition of AI to our subject, which involves simulating human intelligence and copying their way of thinking and problem solving and integrating it into machines.

Along this quest we realised that the use of the coping strategies can be used for many people as much needed but for this reason, the TS creators items and their respective coping items should be standardized; which leaded us to propose our conceptual model for Overcoming TS And Getting Job Satisfaction, that was the heart of the TS management system, which we had presented in the last chapter as to be the first prototype, representing the steps and the major part of the system that were built following the different information and findings described in the top chapters.

since this solution is aimed to produce as results a high quality structured data, it can be used further more in machine learning and deep learning, but for this we will need a large amount of data in case we want faster and more accurate predictions, this can be done through the generalisation of this solution through the different branches of the company.

For our future work, and to further improve the proposed approach, we intend to see the possibility of integrating our system with the Hospital Information System (HIS), in order to access a larger and richer healthcare database. With this integration we can then replace the subject of TS by all possible mental or neurological illnesses that the hospital receive and archive, and thus create a link between for example the radiological images of Magnetic resonance imaging (MRI) or Computed Tomography (CT), etc. And the data of the mental or neurological patients produced from our system; with this method we can match MRI scans with the data from our system, to get labelled images, permitting the manipulation of the resulting annotated images with ML algorithms, to better understand the brain areas responsible of mood and cognition in humans.

THESIS PUBLICATIONS

International journals

- Salah-Eddine, M., Belaissaoui, M., El Alami, A., & Salah-Eddine, K. (2019). Technostress management through data mining. Journal of Management Information and Decision Science. (Print ISSN: 1524-7252; Online ISSN: 1532-5806). **(Scopus)**

- Salah-Eddine, M., Belaissaoui, ElHamlaoui,& Salah-Eddine, K (2020). Computerizing Technostress Management: Toward An Artificial Intelligence Assisted Support and Diagnosis System Academy of Strategic Management Journal (ASMJ) (Print ISSN: 1544-1458; Online ISSN: 1939-6104 Volume: 19 Issue: 5. **(Scopus)**

International conferences

- Salah-Eddine, M., & Belaissaoui, M. (2017). Technostress, coping and job satisfaction model of information systems. Proceedings - 2016 International Conference on Computational Science and Computational Intelligence (CSCI), LV, USA.

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APPENDIX A

COMPUTERIZING TECHNOSTRESS MANAGEMENT: TOWARD AN ARTIFICIAL INTELLIGENCE ASSISTED SUPPORT AND DIAGNOSIS SYSTEM:

Appendix A.1: The Realization of the Application

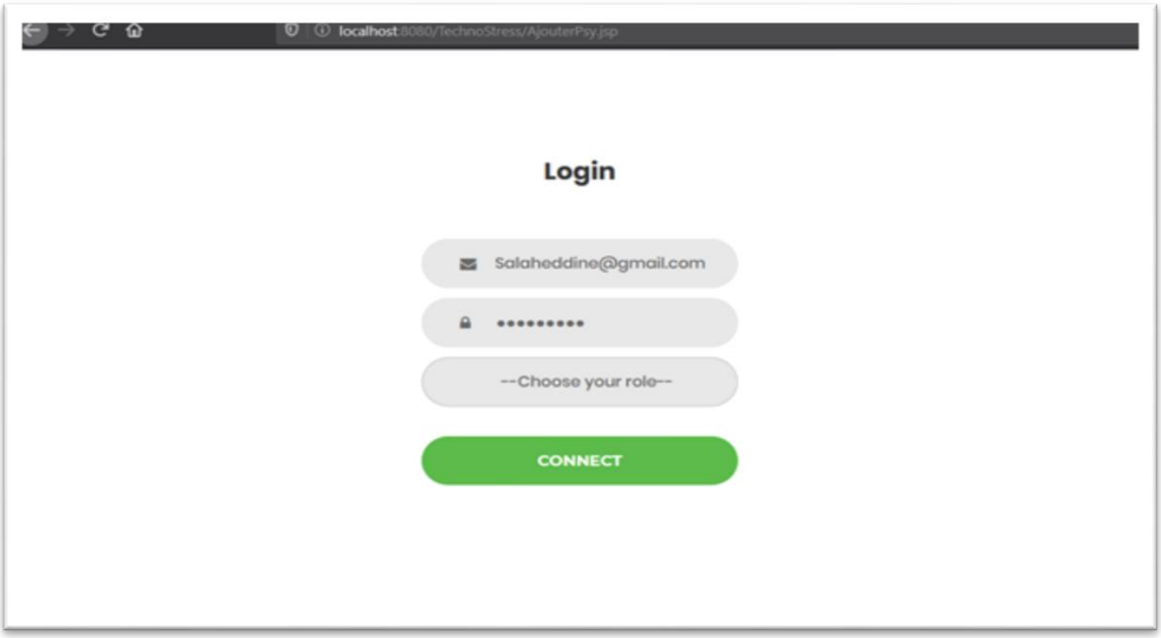

Figure 24 The LoginPage

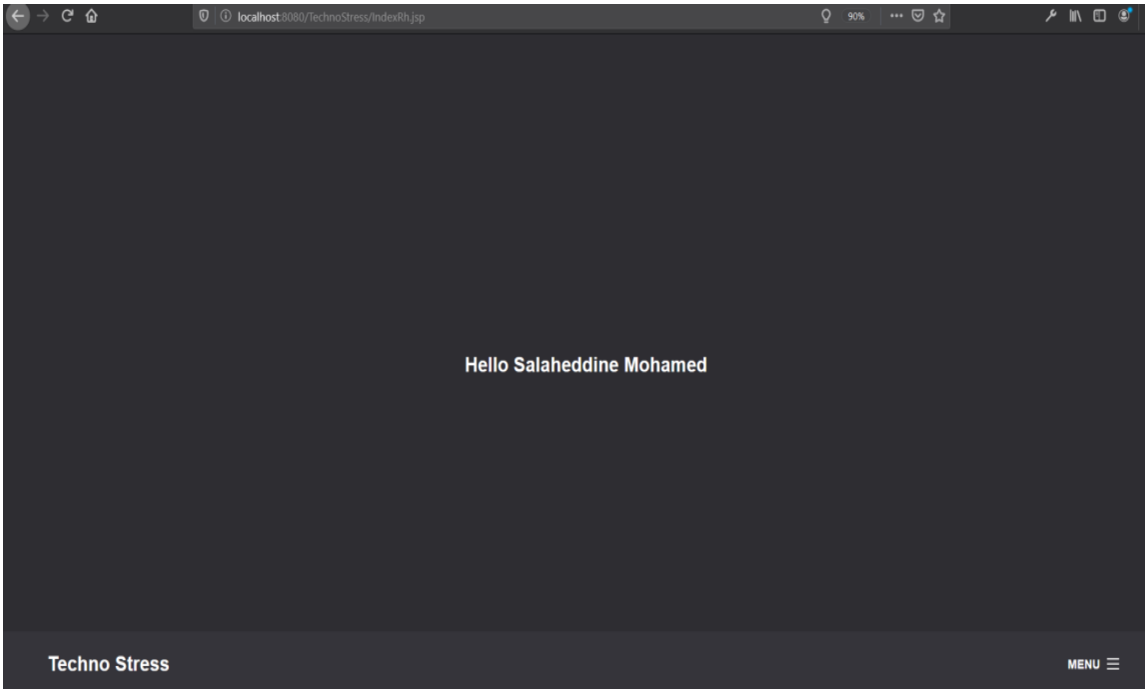

Figure 25 The Admin Index page

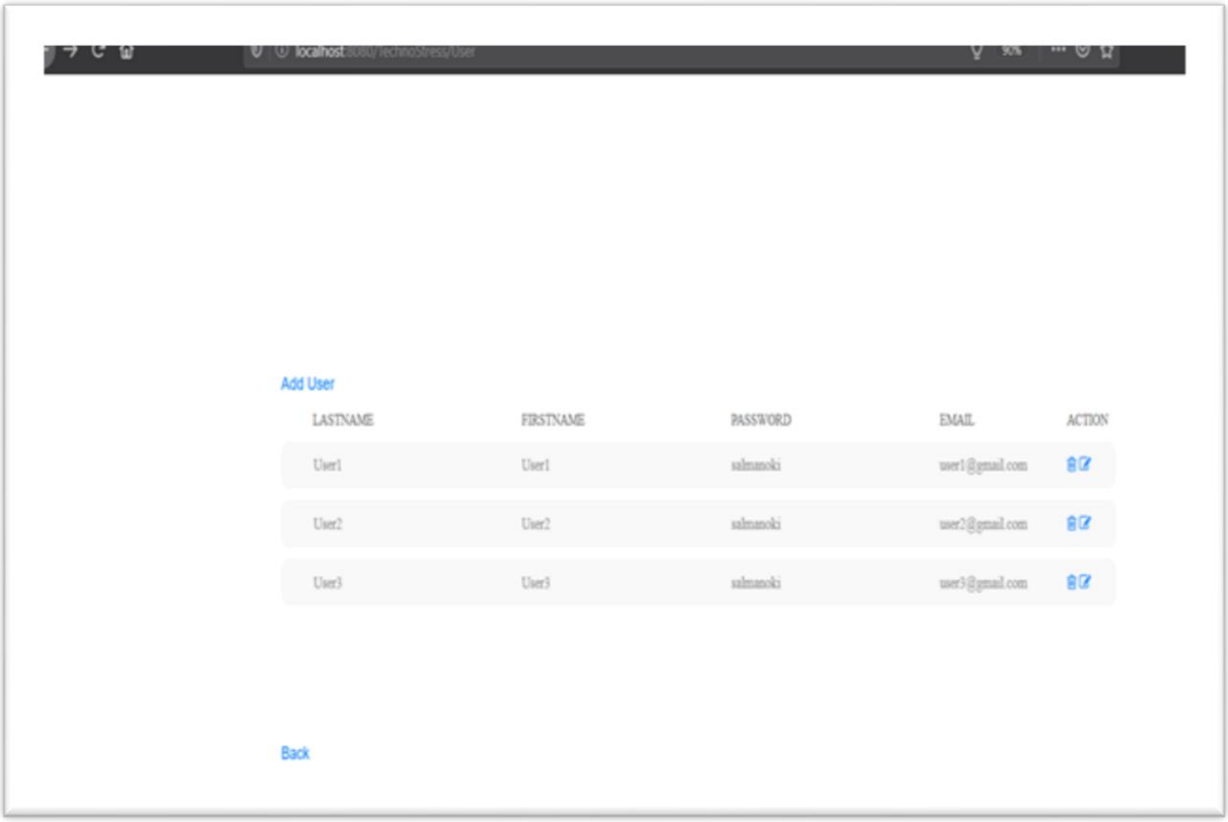

Figure 26 The User Management Page

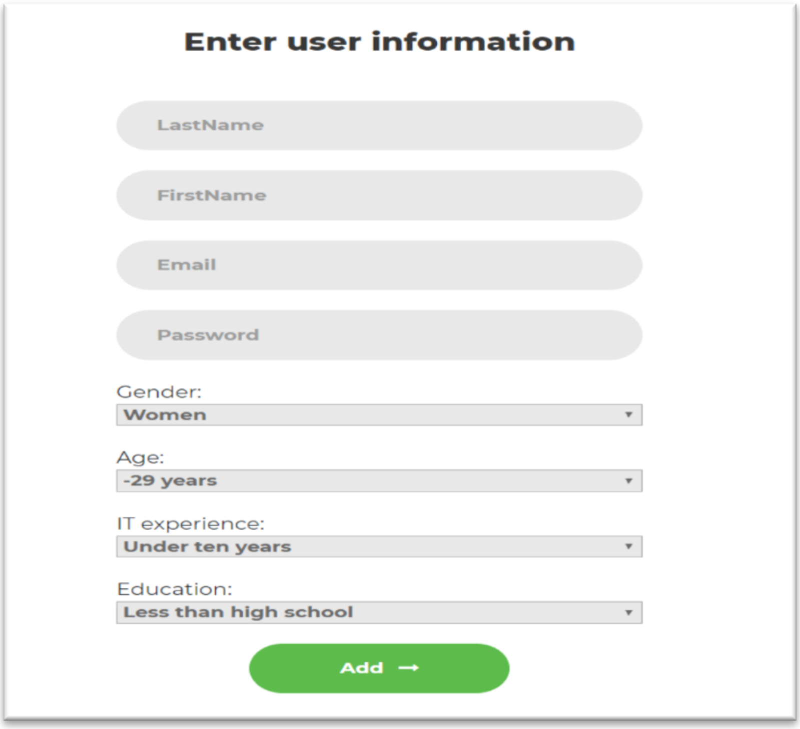

Figure 27The Add User Page

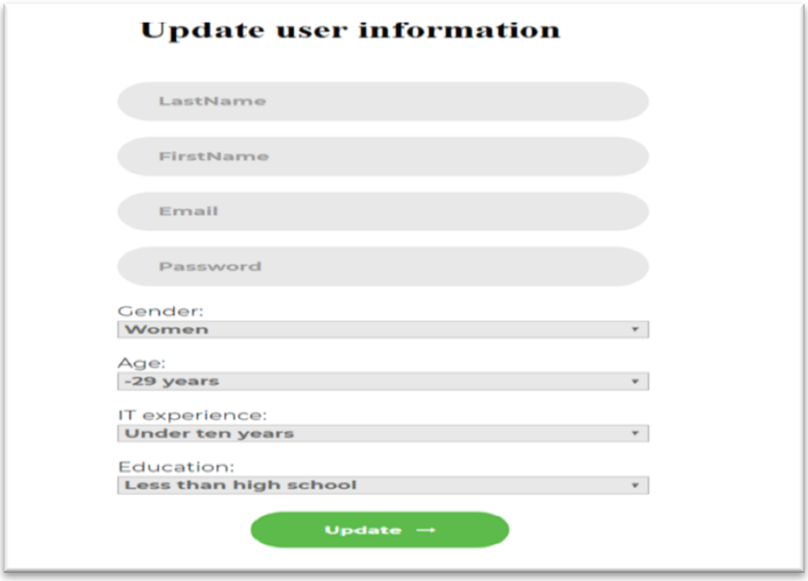

Figure 28 The Edit UserPage

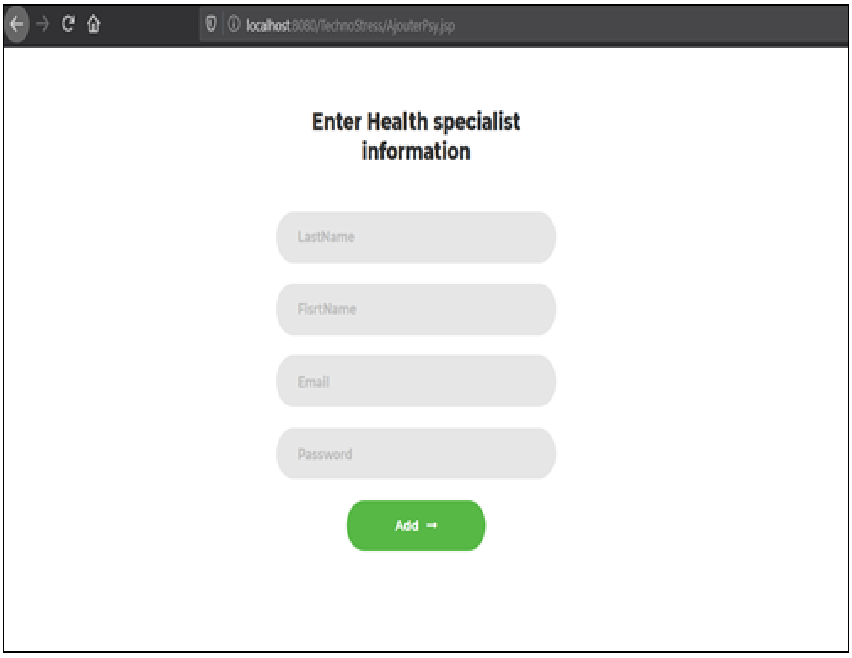

Figure 29 The Health Specialist Management Page

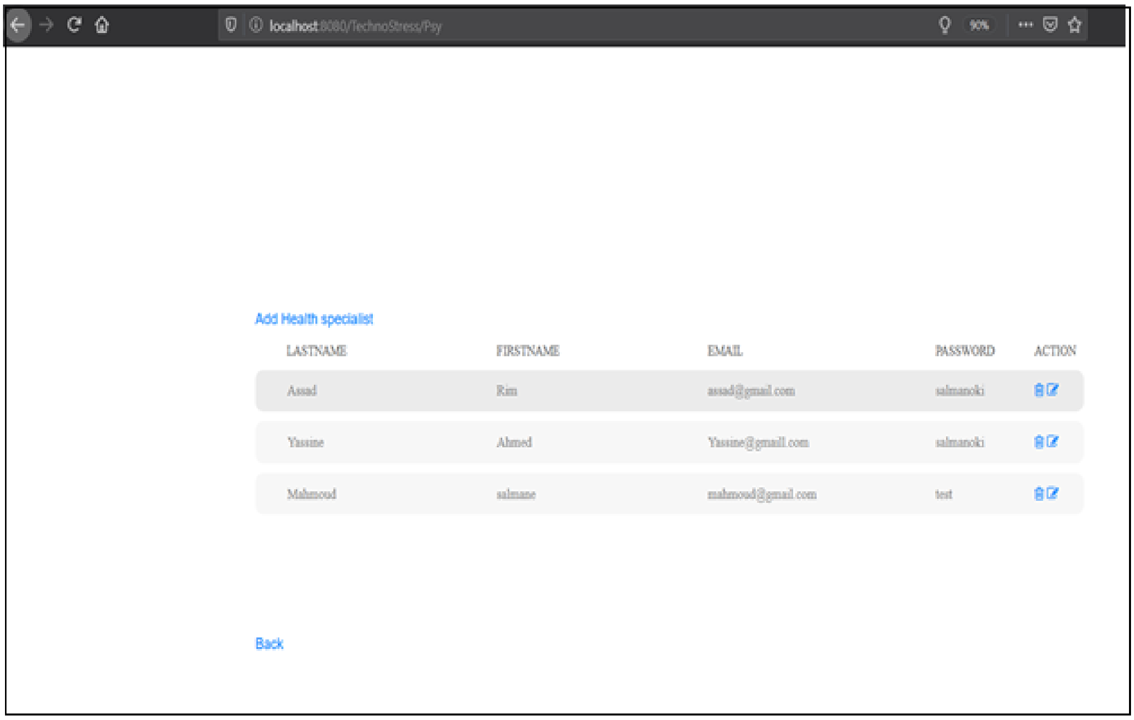

Figure 30 The Add Health Specialist Page

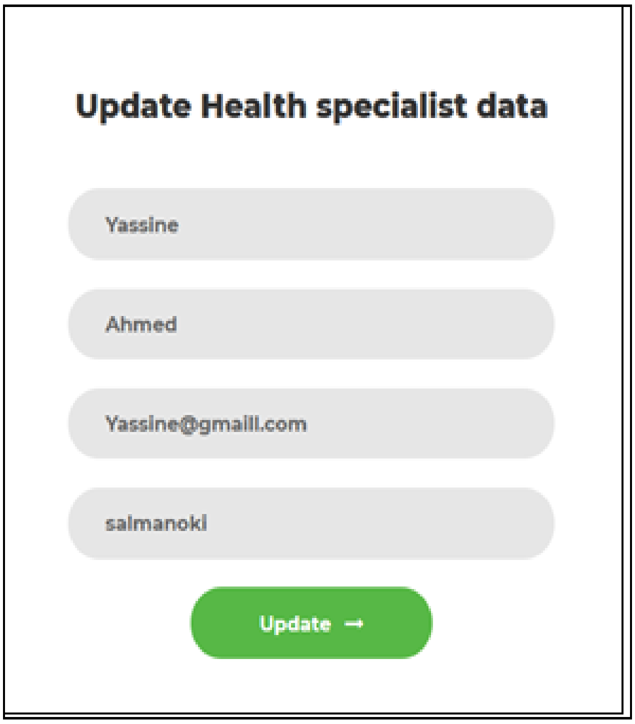

Figure 31 The Modify Health Specialist Page

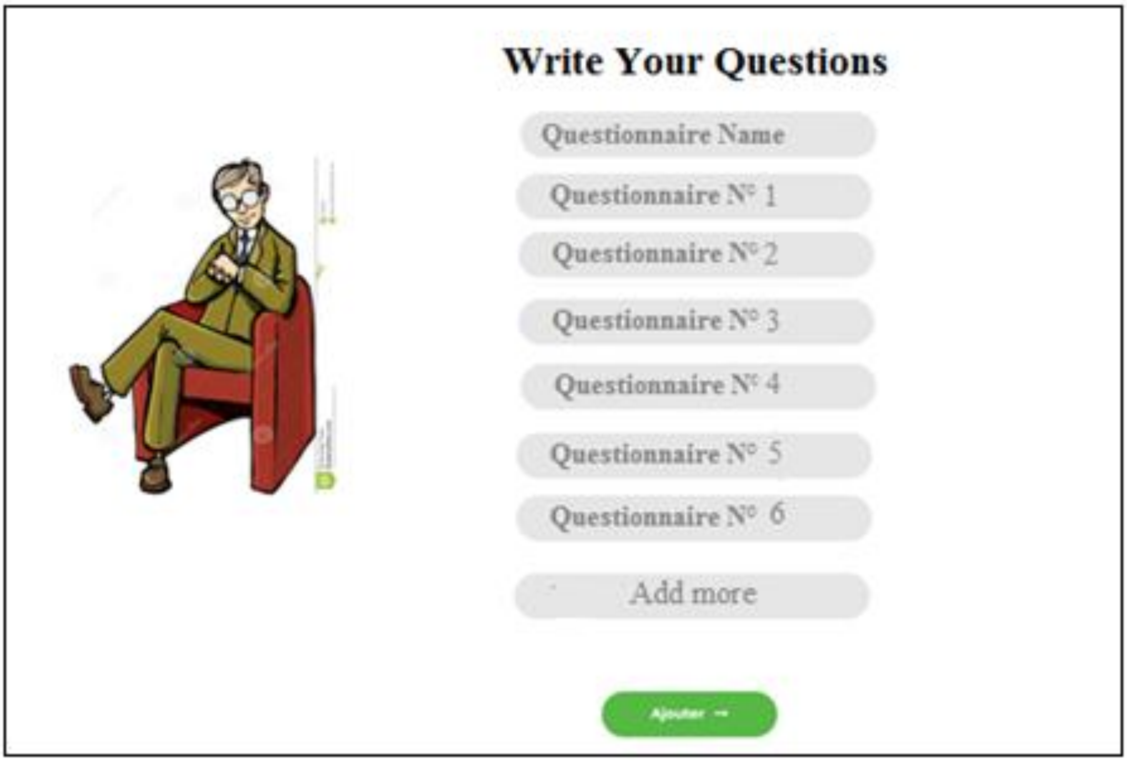

Figure 32 Manually Add Questions

Questionnaire Filename	Q1	Q2	Q3	Q4	Q5	Q6	ACTION
teachersdunet	Puto	denote	ppos46ojdkld	18	ppos46ojdkld	ppos46ojdkld	Select
Umdre	Calio	calio23	28mkoms46ojdkld	26	28mkoms46ojdkld	28mkoms46ojdkld	Select
Care	Ramos	rami	s45532jdkld	9	s45532jdkld	s45532jdkld	Select
Hoore	Sanchez	sanitos	DI5jaqeekld	32	DI5jaqeekld	DI5jaqeekld	Select
Oreal	Canavaro	o.carna	shd7689	11	shd7689	shd7689	Select
Honore	Hourwanou	mercuryseries	xfs546ojdkld	135	xfs546ojdkld	xfs546ojdkld	Select
Heilki	Pedro	pedroh	jsj36373	14	jsj36373	jsj36373	Select
Honore	Hourwanou	mercuryseries	xfs546ojdkld	135	xfs546ojdkld	xfs546ojdkld	Select

Figure 33 Select Questionnaire From Existing Ones

Lastname	Firstname	Email	Action
cc	jh	soufiane@nitro.com	select
moha	cc	mohmade@gamil.com	select
hajar	merrouni	hajar@gmail.com	select
kheifh	jhdfejfh	qyoub@gmail.com	select

Figure 34 The Manager Page for The Selection of Health Specialist

Lastname	Firstname	Email	Action
mkwaya	ss	mkwaya@gmail.com	Select
huhu	amin	huhu@gamil.com	Select

Figure 35 Select User

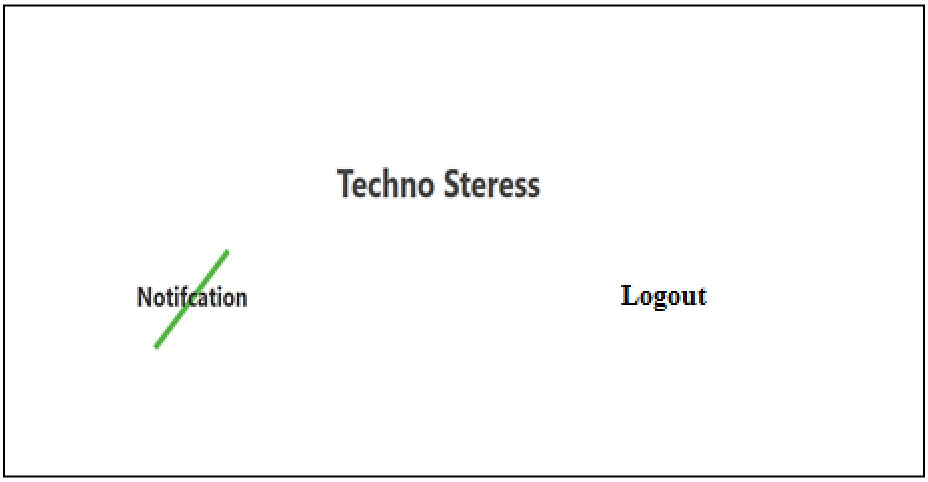

Figure 36 The Health Specialist Index Page

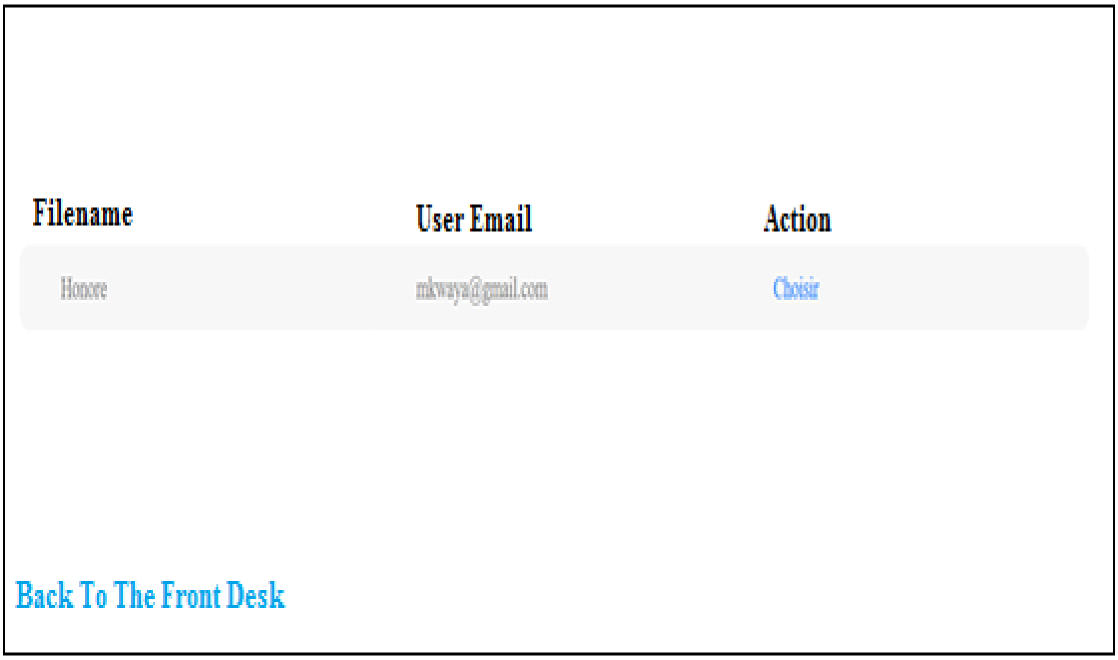

Figure 37 The Answers List Page

Figure 38 The Page: Add A Recommendation For The User