A Framework to Improve Customer Service Using Brahms Model

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Abstract: **Human behaviour plays a vital role in the success and failure of an organization. Top management set organizational goals and objectives to run their business activities. Skill sets, proper training, team work, commitment, infrastructure and resources bring vital changes in any work practice system. The great challenge is to detect human behavioural errors while performing job activities in the customer service department of an organization. Human behavioural errors in the work practice system is a key factor to change the whole scenario. These errors could be monitored and well detected using a framework comprised of Brahms Model and Warning Alert Generation System. Rapid action and response from the management team can be established by using the same framework. Efficiency and quality assurance for the customer service improvement in an organization could be guaranteed and maximized.**

Keywords: **Brahms Model, Customer Service ImproveMent, Human Behaviour, Warning Alerts.**

1. INTRODUCTION

Human behaviour plays a significant role in all the spheres of life like economics, finance, education, scientific development, research, health department, sports, human resource development, information technology and communication etc. If people are well trained and fully committed in their job roles then quality assurance factor can be achieved and progress can be ensured in every organization. Every organization has some objectives and targets to achieve and huge investment is made in terms of infrastructure and resources in order to achieve those targets, but unfortunately some organizations not only lose their targets but unable to survive [1]. Consequently, these organizations fall into the category of failure state.

Customer Service Department faces different challenges in different organizations and sometimes problems are not addressed properly for a long time, consequently, organizational strength and reputation is compromised due to pending solutions. Every customer has high expectations to be served on priority basis due to the competitive dynamic market situation. In every field of life, competition is enhanced day by day and people always look towards perfection and improvement without noticing who is providing quality and how it is achieved?

Quality speaks its own language and people follow the latest trends. Therefore, it would be a great idea to address the problems of customer service specially when there is an involvement of human behaviour [1].

Currently, we have observed number of organizations which are not able to come up with achieved goals and targets just because, lack of efficiency and commitment of the people with an organization [15], [3], [21]. Administration tries their level best to resolve internal matters and allocate huge budget to resolve internal and external issues of an organization. It has been observed that many organizations couldn't survive despite providing them bailout packages and loans. Managers suggest investing more in the business in the form of purchasing latest machines and equipments, hiring skilled labour and train the existing staff but end result is again a question mark for the business owners. Important organizations in the country like airports, security agencies, telecommunication companies, scientific organizations, transportation system, health organizations including hospitals and ministries, education departments may lead to risk, if certain checks and corrective measures are not taken well in time in order to save the organizations.

Countries economy is based on the strength of different organizations, if these organizations perform well, country economy grows faster and if it performs under efficiency, country economy suffers and continues to suffer until and unless internal problem of certain organizations are not resolved. In case of third world countries and sometimes in developed countries, we have the same problem of quality assurance in different organizations. Shortly, we can say, if most of the organizations perform well in the country, it may guarantee the country's strength and economic growth.

Therefore, it would be a professional approach, if we are able to develop some framework which not only detect human behavioural errors but also respond while performing different job activities in the customer service department of an organization.

1.1 Problem Statement

Every individual in an organization has specific job role and responsibilities. People serve and contribute in an organization with formal discipline and create conducive environment in order to meet the organizational standards and objectives. Every organization comprised of different

category of people, machines, objects, artifacts, communication system, geography and location, timings, knowledge and activities. Human machine interaction system is defined and human centered activities are focused based on certain location at certain interval.

There is common observation in the customer service department related to different organizations like, hospitals, banks, transport system, tele-communication system, sale-purchase outlets, airline ticketing system and university admission system that human behavioural activities might cause serious error or damage in terms of complaints registered by customers. Plane crash accidents took place all over the world mostly due to the human errors in the system. Moreover, its not easy to check those human errors specially which is caused by the human behavioural activities for instance, most of the security failures are due to the human behavioural negligence not by the automated security tools used to indicate those errors. We consume lot of time to check and indicate errors in human behavioural activities and consequently, magnitude of human error increases day by day, cause damage and failure ofan organizations.

organizationswhich suffer due to human behavioural activities always possess missing links where human behaviour is involved. We can take the example of human behaviour while dealing with colleagues, handling computers and devices, movement of objects, communication and knowledge practices.

In this research project, qualitative, quantitative and design research methodology is applied. We can take corrective measures in the form of feedback loop once problem is faced in an organizational work practice system. Warning alerts would be generated in case of human error detection in the work practice system using Brahms Model while performing job roles in an organizations. Consequently, organizationcan be brought into the world of competition in terms of performance and improvement.

1.2 Scope

Human behaviour related activities in an organizationcan be monitored and checked by using Brahms Model and Simulation technique. Three different departments related to customer services are taken into account as case study to apply Brahms Model for example, ISD-IIUM, Naqaba-Hajj Department-Makkah and Health Management System-Makkah.

The need of an hour is to find human errors related to customer services in an organizationand fix it well in time before we compromise an organizational goals and objectives. Normally, it's very hard and time consuming to detect human errors in an organization which are caused by human behavioural activities. If we are able to detect human errors by designing some model and simulation technique, we can hit the nail on the head and desired objectives can be achieved in order to eradicate the errors in an organizationwith the help of generating warning alerts.

Technological errors in an organizationlike database errors, artifacts errors, and communication errors have alternative solutions but the human error detection in an organizationand its solution is challenging and time consuming. Therefore, Brahms Model along with warning alert generation system is applied to detect human behavioural activities in an organizationrelated to customer service improvement.

1.3 Significance

There is a great challenge to detect the human activity error in an organization; Brahms Modeling and Simulation tool provides us an opportunity to proceed in this direction [22], [27]. Human activities are divided into different categories and monitored while dealing with agents, objects, artifacts, activity, timing, geography, communication and knowledge[23], [20], [2], [27].

Brahms Simulation application provides us the general behaviour of work practice system with respect to time using the concept of various activities, communication and movement of each agent and object in the work practice system [2], [20], [21], [22], [23], [24], [25]. Brahms simulation engine executes the complete model consequently; relational database is created by the simulation engine which involves all the events. Brahms display tool known as Agent Viewer is used to display all the different agents, objects, activities, and areas etc [2]. We can check the timeline of different activities in the work practice system by using Agent Viewer tool using Brahms Model. Therefore, it would be easy for us to detect the human errors and generate the warning alerts in case of any error caused by the human behavioural activities in the work practice system and rapid action can be taken for the customer service improvement in any organization.

The main concern for the research project is to detect the human error in the functioning of an organizationrather than to find the technological errors in the system. Brahms Modeling and Simulation tool and warning alert generation system would be combined together to detect human error in the customer service departments of ISD-IIUM, Naqaba-Hajj Department-Makkah and Health Management System-Makkah. Consequently, warning alerts would be generated in the customer service department and rapid action could be taken for the improvement of an organization.

2. RESEARCH METHODOLOGY

Initially bibliographic research approach is used with literature study, later on Qualitative and Design Research Methods are followed. Ethnography study is going to be conducted to propose mental model for customer service improvement by choosing three different customer service departments related with ISD-Center of Postgraduate Studies, International Islamic University, Malaysia, Naqaba-Hajj Department-Makkah and Health Department-Makkah. Questionnaire-based survey is also arranged carrying twenty two questions related to organizational-based human behavioural problems causing in efficiency in an organization. This questionnaire-based survey would be distributed among hundred people comprised of domain experts and general working class people performing duties in different organizations around the world. Domain

experts would be selected mainly from ISD-Center of Postgraduate Studies, International Islamic University, Malaysia, Naqaba-Hajj Department-Makkah and Health Department-Makkah while general public feedback would be recorded from different organizations from different places in the world in order to generalize our model design in terms of people behaviour in an organization.

2.1 Quantitative Approach

In our quantitative approach, we need such a methodology which can solve our problem of human behavioural errors while performing job in an organization related with customer service improvement which is given below:

i. Finding different tools in existing literature to check the human behavioural activities.
ii. Focusing the exact monitoring tool for human behavioural activity system.
iii. Propose benchmarking for available tools regarding human behavioural activity system.
iv. Analysing formalism for available tools for monitoring human behavioural activities in an organization.

2.2 Design Research

Design Research is also considered as improvement research which is used to solve different problems in different domains. According to the current scenario for the human behavioural problems in an organization, we want to generate warning alerts in case of an error caused by human behavioural activities related with customer service in an organization. Therefore, we have used design research steps as given in figure 1.
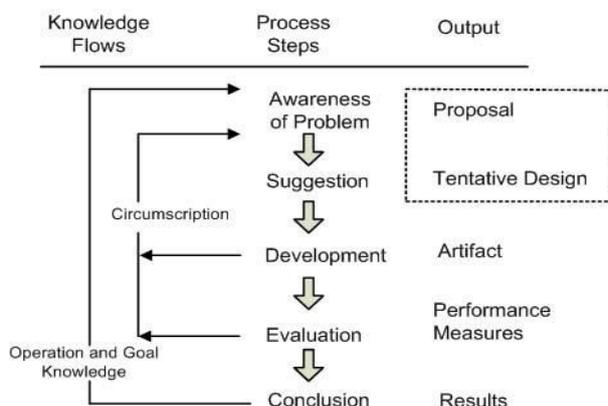

Fig.1. Design Research Methodology (isworld.org)

2.2.1 Knowledge Flows

Innovation needs background knowledge and information. Therefore, in order to create innovation, an innovator must have some background knowledge by using design research methodology. In our case, knowledge flows towards monitoring the human behavioural activities while performing different roles in an organization, warning alerts would be generated in case of any error caused by human behaviour in a customer service department.

2.2.2 Process Steps

Process steps play a significant role while creating

innovation using design research. It consists of the following steps:

Awareness of Problem:

With the help of available literature study, we have understood that human factor plays a key role for the success or failure for any organization [15]. Once we are able to control this human behaviour factor, we can control an organizational performance as well. One of the possible approaches to tackle this problem is Brahms Model which can be used to monitor the human behavioural activities in any work practice environment, while we can utilize the Lorry Faith Cranor idea for the improvement of warning message design system [8], [23]. We can create our mental model design for the customer service improvement using Brahms Model [23], [7].

Suggestions:

According to Brahms modeling and simulation concept, human behavioural activities can be recorded in different work practice systems [23]. Brahms applied this concept in the space mission and found successful results despite certain drawbacks which is beyond the control like human mood and emotions [23], [20], [2], [27]. Brahms Model can be applied in an organizational behaviour while recording human behavioural activities which cause success or failure for an organization. Warning alerts could be generated using Brahms Model along with Warning Alert Generation System which would detect human errors in the work practice system. Mental model for the work practice system could be designed using ethnography study which would help us to understand the functioning of an organization [16], [17].

Development Phase:

The development phase consists of different work packages represented as WP1, WP2 WP3, WP4, WP5 and WP6. Each work package is based on different activities which is the part of whole thesis project.

Evaluation:

This is the stage which is referred after development stage. Evaluation can be achieved by comparing the work practice system before and after using Brahms Model in combination with warning alert generation system on the basis of performance results in the human behavioural activities.

Conclusion:

Organizational performance is improved by using Brahms Model in combination with warning alert generation system. It is confirmed that human behavioural role can be improved if we follow proper job patterns and monitor human behavioural activities in any work practice system.

Output:

All the process steps have different outputs in connection with knowledge flow. Every process step has an output which can be shown in Table 1.

Table 1. Process steps with outputs.

Process Steps	Outputs
Awareness of problem and suggestion	Research Proposal

Development	Artifact: Brahms Model and warning alert generation system
Evaluation	Performance measure: Comparison of organizational behaviour before and after using Brahms Model in combination with warning alert generation system
Conclusion	Verification for the organisational total performance

Motivation of Methodology:

Design research ensures the logical flow of steps. For example, there is a relationship between Knowledge Flows and Process Steps and one can fix the mistakes at any stage of the whole procedure. If there is any mistake committed in the stage, "development stage" (process step-3), the developer can go back to the stage, "awareness of the problem" (process step-1) and then he can proceed accordingly. Therefore, it is possible to change the output at the same time.

The Philosophical Ground of Research Design:

Design Research is used as standard methodology in many resources like "Design research in the technology of information systems: Truth or Dare" [19]. In this research, author expresses his philosophical views about the design research in technology or Information System (TIS). Design research is widely used in MIS [13], [18]. It is also distributed by "The Association for Information Systems AIS" [28]. The detailed work packages are shown in figure 2.

Development:

The developments phase is based on several work packages like WP1, WP2, WP3, WP4, WP5 and WP6. Each work package consists of different task which is an integral part of the entire thesis project.

*WP1:*Different work practice systems in an organizations are observed and it is found that organizations are becoming inefficient or compromising their objectives mostly due to improper human behavioural roles while performing different job activities assigned to them [15].

Problem is identified related to human behaviour roles in the customer service department in an organization. It is confirmed that if people perform their job activities in an organization properly related to customer service and follow the proper job patterns, we can save many organizations for possible failure threats and we can improve organizational efficiency by taking timely necessary measures and actions.
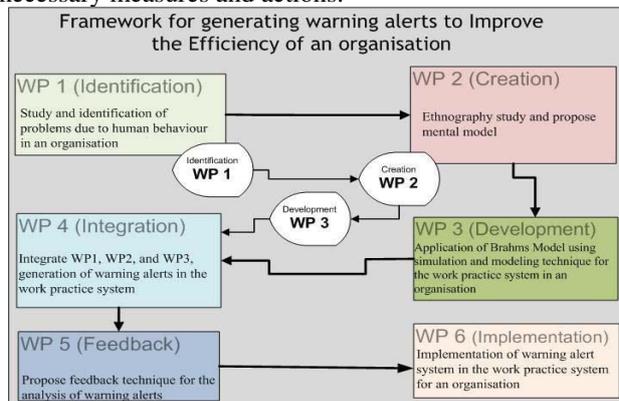

Fig.2. Work Packages in development stages [4]

*WP2:*Mental model for the customer service improvement could be designed using the concept of ethnography study [16], [17]. This would be achieved by using personal observation, conducting interviews, recording sounds and videos, and taking pictures of live events in an organization. Every employee is supposed to deliver and perform his job activities by using different artifacts, objects and machines, communication and knowledge. Every bit of detail is recorded in the customer service department with the help of ethnography study.

*WP3:*In this work package, we shall focus on the development of mental model for the work practice system using the concept of Brahms Modeling and Simulation. Every employee has different scenario and possess different responsibilities in the work practice system, based on his existing job scenario, his job pattern is defined by considering Brahms Modeling and Simulation [23]. It would be a great importance, how an employee is handling his job matters e.g. dealing with agents, objects, artifacts, activity, timing, geography, communication and knowledge etc. [23].

Brahms provides us the deep insight about human-machine interaction system which helps us to understand how human actually interact with colleagues, documents, and machine, communicate and behave, while performing various job activities at certain interval of time [23]. Brahms Process Model comprise of various independent related models which provide us an opportunity to perform modeling job in an easier and efficient way [23]. These independent models are:

Agents Every work practice system comprised of different group of people and individuals based on mutual interest and relationships. Agent Model shows the relationship of different group of people and their relationships [23].

Objects Employees perform their job activities using different tools and objects like documents, forms, desks, telephone, fax machine and computer. Object model is designed in an hierarchic form by using these tools and objects [23].

Activity Agents and objects perform different activities at certain interval in an organization. All these activities can be monitored and observed using activity model [23].

Geography The geography model reflects the location of agents and objects to perform certain activity at certain interval [23].

Timing The Timing model is based on situation-action rules called work-frames. These workframes depends on certain conditions and considered as situation dependent [23].

Knowledge The Knowledge model depends upon the agents reasoning and is based on forward-chaining production rules called throught frames. These thought frames can be inherited [23].

Communication The communication model is based on exchanging beliefs and information among different agents and objects. The communication is performed by using different methods like telephone, email, face to face or by paper work [23].

Brahms Simulation engine process the complete model which is created during ethnography study. Consequently, relational database is generated which constitutes all the activities and tasks in an organization. Brahms display tool called Agent Viewer tool provides complete overview of different activities at different intervals [23]. Consequently, Warning Alert Generation System would be activated and warning alerts would be sent to the workpractice system to rectify the human errors in the customer service department in an organization.

WP4 All the employees work towards the direction of set goals and targets, it is extremely important for each employee to achieve targets in time to meet the predefined objectives. It has been observed in many organizations which turned into the failure state or become inefficient and do not come up with positive results, besides, there is no one accepting his mistakes or held responsible providing the reasons for the failure of an organization. For example, Maryland Rail Commuter (MARC) train 286 collided with National Railroad Passenger Corporation (Amtrak) passenger train 29 near Silver Spring [15], Nigeria Air Crash 2013 [3], Civil and Military accidents [21]. Therefore, it would be extremely important to detect the human errors in time and perform rapid action to save the organization.

We can design different categories of warning codes based on the error generated in the work practice system using Brahms Model. Any rule which is violated in the work practice system must be converted into the form of warning alerts using Brahms Model and Warning Alert Generation System. Sometimes improper warning codes are not only misleading but also cause serious damage to the users [8], [9]. Once warning codes are generated using Brahms Model, warning alerts can easily be generated using Warning Alert Generation System as shown in Table 1. This would help the work practice system to take rapid action against human errors performed during job activities.

WP5 We shall design the feedback loop based on the errors generated in the work practice system which can detect the human behavioural errors with the help of mental model design. Feedback loop would be generated based on the analysis of warning codes generated by considering the efficiency of employees performing different job activities in the work practice system.

WP6 Agent Viewer can display on the screen all the human centered activities after modeling and simulating work practice system in the customer service department using Brahms Model. Warning alert messages can be displayed or communicated once any activity at any interval goes wrong.

3. PROPOSED SOLUTION

Customer Service in an organizational work practice system faces different challenges in order to achieve set goals and targets due to human behavioural errors. These regular human behavioural errors not only resist customer service improvement but also cause of failure in an organization. Brahms Model alongwith Warning Alert Generation System provides us an opportunity for the detection and correction of human behavioural errors related to customer services but also maximize the efficiency of an organization.

Work practice system takes years and years to get matured. Official procedures and protocols are established on daily experiences faced by an organizational people. Brahms Modeling and Simulation Technique possess a real potential to capture human behavioural activities in any work practice environment [27], [23], [22]. Brahms Model is further sub-divided into various models like Agents, Objects, Activity, Timing, Geography, Knowledge and Communication which are applied in the work practice environment [27], [23], [22]. These sub-models are used by Brahms which are essential to capture all the human-centered activities in a work practice environment. Warning Codes based on human errors would be generated using Brahms Modeling and Simulation Technique which would be further used as an input by Java-based Warning Alert Generation System. Consequently, warning alerts would be generated due to human errors in the work practice system and delivered to the concerned individual and management team via cellular network for taking corrective measures.

4. RELATED WORK

4.1 Overview

Computer security warnings are designed to protect the users and their computers [8].These security warnings must be designed properly so that user can respond effectively in order to avoid any loss or damage in their part [8], [7]. It becomes extremely important to have warning alert system in case of some activity error going on in an organization. We can monitor the human activities in an organization using Brahms Modeling and Simulation concept [23], [20], [2], [27]. Following literature review would help us to reach to the conclusion that we can generate warning alerts in an organization in order to monitor human based activities.

4.2 Review of past research

Josie Hunter et. al May 6-10, 2013 presented an idea about the framework which provides an opportunity to focus on different properties of different Multi-Agent-Systems (MAS). Brahms Modeling and Simulation Language was used as an input and it generated different representations which was given as an input to different verification tools like PRISM, SPIN, and NuSMV. They validated their concept by considering a case study of Air France AF447 flight which was crashed in the equatorial Atlantic on June 1, 2009 [14].

Andy Pasztor and Drew Hinshaw 2013, pointed out the human error in the form of pilot failure in the deadliest Nigeria Air plane crash [3]

Asadullah Shaikh 2012, resolved the problem of scalability of complex UML/OCL models in his thesis. Model defects are a significant concern in the Model-Driven Development (MDD) paradigm, as model

transformations and code generation may propagate errors to other notations where they are harder to detect and trace. Formal verification techniques can check the correctness of a model, but their high computational complexity can limit their scalability [4].

Geong Sen Poh*et.al* 2012, presented an idea about HBSF called Human Behaviour Security Framework which deals with security related issues in an organization. Security framework was designed which addresses different issues like information leakage and its causes [12].

Jim Blythe and L. Jean Camp 2012, presented an idea about the implementation of mental models for users security. We can improve the communication and warning systems through proper user behaviours. Mental model approach has been implemented in agents which could simulate human behaviours in the network security system. It has been proved that agents-simulation behaviour is same as we have users behaviour, in the network security system [7].

In 2011, Lorrie Faith Cranor expressed her views about human decision making which is based on human educational background, psychology, emotions, knowledge and motivational factors. Human behaviour is observed under certain circumstances for decision making called human in the loop framework (HILF) [11].

Jim Blythe *et. al* 2011, presented an idea about the reflection of human behaviour in cyber security testing system. Human behaviour is fully monitored while dealing with cyber security systems. Security risk is always observed whenever cyber security is dependent on human behaviour [5].

Jim Blythe USC *et. al* 2011 proposed an idea about risk factors while dealing with cyber security alerts. There is a common practice observed from users, warning alerts and messages against possible cyber threats are misleading and confused. If proper guidance is provided to communicate the risk factors involved in cyber security, user might be able to be rescued against possible cyber threats [6].

Cristian Bravo-Lillo *et. al* 2011, presented an idea that security warning dialogues are not taken seriously and not well understood by most of the people, and sometimes even misunderstood. People often take wrong decisions even security dialogues appear on their screen. People also do not differentiate between low risk and high risk security warnings [8].

L. Jean Camp 2009, discussed about Privacy and Security issues which depends upon policies and normally people do not follow. One of the main reason is lack of risk communication about security and privacy. Risk communication is mainly concerned with medical, financial, environmental and life's style [9].

Chin Seah*et. al* 2005, discussed about the idea of using Brahms Model tool for Mission Operations System. The idea is to observe people work practices by using Brahms Modeling and Simulation tool. Brahms Modeling and Simulation tool was used in NASA Mission Exploration Rover (MER) [20].

Scott Shappell and Doug Wiegmann2004, presented an idea about the major reasons for the civil and military accidents is mainly due to the human skilled-based errors. They analysed 16000 US civil and military accidents and found that human error is the major cause of these accidents [21].

Maarten Sierhuis2003, described the application of Brahms tool in case of Mission Operation System. He focused on the human-machine interaction system and apply Brahms tool to observe and monitor human based activities in the Rover Mission [24].

Alessandro Acquisti*et. al* 2002, focused on the use of agent-based activity tool called Brahms Language specially in case of space stations where they have to monitor different activities of astronauts and crew members on board. They studied deeply, how work practice system can be monitored deeply using Brahms Language [2].

Maarten Sierhuis*et. al* 2002, presented an idea about work practice system using Brahms Model. It was proved that work practice system could be modeled using Brahms Modeling and Simulation Technique. The real work practice system can be observed and relationship of human behaviour is defined using different models like artifacts, communication, location, geography, timing and knowledge [23].

William J. Clancey 2001, explained about Haughton-Mars expedition that how scientist and engineers might live and work together. He explained how data can be collected with the help of photography and video tapes and how it can be organised. Ethnographic approach is used that how people live while performing job and perform different activities [10].

Maarten Sierhuis*et. al* 2001, described an idea about multi-agent approach for simulating and modeling activities of human and systems in an organization. He considered a work practice system for Apollo 12 astronauts during the ALSEP offload activity [26].

M. Sierhuis2001, presented an idea about modeling and simulating human behavioural activities in a work practice system using Brahms tool. Brahms is an abbreviation of "Business Redesign Agent-based Holistic Modeling System" [22].

Chris Johnson 1999, gave an idea about the relationship between human error and organizational failure. Most of the accidents are caused by the human errors [15].

Maarten Sierhuis*et. al* 1999, presented an idea about Brahms language which can monitor human activities in an organization. They explained clearly, keeping in view human as center, how human perform their job roles and interact with things like phone, fax machines, computers etc. [25].

Brigitte Jordan 1996, she presented an idea of ethnography study as a holistic model of an organization to understand the work practice system. She also focused on the distributed work practice system where data collection is important at the same time using distributed team work practice where a team of ethnographers are placed at different locations in an organization and records the information at the same time as it happens and then analyse the whole information at later stage [16].

Brigitte Jordan 1994, explains the different methods

about Ethnography Study to analyse the work practice system in an organization. She presented an idea about data collection methods while being part of the work practice system using different techniques like Interviews, Observations, Questionnaire, Voice Recordings and Video Recordings. She also describes about emic data, etic data and importance of an objective for data collection including Person Oriented Record, Object Oriented Record, Task Oriented Record and Setting Oriented Record [17].

Nevertheless, existing research is focused on the mutual relationship between human behaviour and security technologies. It doesn't give us a way out plan or model a work practice system which can detect its own errors and generate the warning alerts as per requirements. Warning Alert Generation System would be added along with Brahms Modeling and Simulation technique in order to detect human error in the work practice system related to customer services department and generate warning alerts timely to improve the organizational work practice system.

5. CONCLUSION AND FUTURE WORK

Its a great challenge to check the actual behaviour of an employee while performing his job activities in the customer service department as human behaviour is associated with feelings and emotions. Brahms Model can be applied in such a work practice system where organizational objectives are compromised due to human behaviour problems. Human behaviour could be monitored and corrective measures could be taken once human error in the customer service department is detected. A framework including Brahms Model and Warning Alert Generation System is used to detect human behavioural errors and provide a feedback loop for taking corrective measures in the customer service department. Most of the human behavioural errors can be detected and monitored but human feelings or emotional behaviour is unpredictable. It would be a great success, if most of the human behavioural errors are detected and corrective measures are taken to rescue the customer service department for further damage and loss.

Future work needs more improvements in terms of Brahms Model so that human behavioural errors could be well identified and monitored. The more we go in depth of human behaviour analysis better results could be expected in terms of corrective measures as a result of feedback loop. Warning Alert Generation System is based on the output of Brahms Model, therefore, once there is in-depth analysis of human error detection using Brahms Model, effective warning alerts could be generated.

6. ACKNOWLEDGMENT

REFERENCES

[1] A. Ghaffar, M. R. Wahiddin, A. Shaikh. (2013, May). Computer assisted alerts using mental model approach for customer service improvement. *Journal of Software Engineering and Applications 2013*, Volume 6(No. 5B), Pages 21-25, Available: http://www.scirp.org/journal/PaperInformation.aspx?PapeD=37824.

[2] A. Acquisti, M. Sierhuis, W. J. Clancey, and J. M. Bradshaw. (2002). Agent based modeling of collaboration and work practices onboard the international space station. *In Proceedings of the Eleventh Conference on Computer-Generated Forces and Behavior Representation*, volume 8, pages 315–337.

[3] A. Pasztor and D. Hinshaw. (2013, February). Human error seen in Nigeria air crash. *The Wall Street Journal*, Available: http://www.wsj.com/articles/SB10001424127887323511804578298311522137492.

[4] A. Shaikh. (2012). Methods and concepts for efficient verification of UML/OCL Models. PhD Thesis.

[5] J. Blythe, A. Botello, J. Sutton, D. Mazzocco, J. Lin, M. Spraragen, and M. Zyda. 2011. Testing cyber security with simulated humans. *Association for the Advancement of Artificial Intelligence*. Available: www.aaai.org.

[6] J. Blythe, J. Camp, and V. Garg. (2011). Targeted risk communication for computer security. *In Proceedings of the 16th international conference on Intelligent user interfaces*, *ACM*, Pages 295–298.

[7] J. Blythe and L. J. Camp. Implementing mental models. (2012). *In Security and Privacy Workshops (SPW), 2012 IEEE Symposium, IEEE*, Pages 86–90.

[8] C. B. Lillo, L. F. Cranor, J. S. Downs, and S. Komanduri. (2011). Bridging the gap in computer security warnings: A mental model approach. *Security & Privacy, IEEE, Volume 9(No. 2)*: Pages 18–26.

[9] L. J. Camp. (2009). Mental models of privacy and security. *Technology and Society Magazine, IEEE, Volume 28(No. 3)*, Pages 37–46.

[10] W. J. Clancey. (2001). Field science ethnography: Methods for systematic observation on an arctic expedition. *Field Methods, Volume 13(No. 3), Pages* 223–243.

[11] L. F. Cranor. A framework for reasoning about the human in the loop. (2008). *UPSEC 8*: Pages 1–15.

[12] G. S. Poh, N. N. Abdullah, M. R. Zaba and M. R. Wahiddin. (2012). Reasoning of Collaborative Human Behaviour in Security-Critical Work Practices: A Framework. *Atlantis Press, 8, Square des Bouleaux, 75019 Paris, France.* Trustworthy Ubiquitous Computing edited by Ismail Khalil, Teddy Mantoro, Volume 6, Page 99–106.

[13] A. R. Hevner, S. T. March, J. Park, and S. Ram. (2004). Design science in information systems research. *MIS quarterly, Volume 28(No. 1),* Pages 75–105.

[14] J. Hunter, F. Raimondi, N. Rungta, and R. Stocker. (2013). A synergistic and extensible framework for multi-agent system verification. *In Proceedings of the 2013 international conference on Autonomous agents and multi-agent systems, International Foundation for Autonomous Agents and Multiagent Systems*, pages 869-876.

[15] C. W. Johnson. (1999). Visualizing the relationship between human error and organizational failure. *In Proceedings of the 17th International Systems Safety Conference, The Systems Safety Society*, Unionville, Virginia, United States of America, pages 101–110.

[16] B. Jordan. (1996). Transforming ethnography-reinventing research. *Groupware-Software fur dieTeamarbeit der Zukunft: GrundlegendeKonzepte und Fallstudien,* pages 200– 212.

[17] B. Jordan. (1996). Ethnographic workplace studies and CSCW. *Human Factors in Information Technology*, Volume 12, Pages17–42.

[18] J. Morrison and J. F. George. (1995). Exploring the software engineering component in MIS research. *Communications of the ACM*, Volume 38(No.7), Pages 80–91.

[19] S. Purao. (2002). Design research in the technology of information

systems: Truth or dare. *Pennsylvania State University,* Available: http://purao. ist. psu. edu/workingpapers/dare-purao. pdf.

[20] C. Seah, M. Sierhuis, W. J. Clancey, and M. Cognition. (2005). Multi-agent modeling and simulation approach for design and analysis of MER mission operations. *In Proceedings of 2005 International conference on human-computer interface advances for modeling and simulation (SIMCHI 2005)*, Citeseer, pages 73–78.

[21] S. Shappell and D. Wiegmann. (2004). HFACS analysis of military and civilian aviation accidents: A north american comparison. *In Proceedings of the Annual Meeting of the International Society of Air Safety Investigators.*

[22] M. Sierhuis. (2001). Modeling and simulating work practice: BRAHMS: A multiagent modeling and simulation language for work system analysis and design.

[23] M. Sierhuis and W. J. Clancey. (2002). Modeling and simulating practices, a work method for work systems design. *Intelligent Systems, IEEE, Volume 17(No. 5),* Pages 32–41.

[24] M. Sierhuis, W. J. Clancey, C. Seah, J. P. Trimble, and M. H. Sims. (2003). Modeling and simulation for mission operations work system design. *Journal of Management Information Systems, Volume 19(No. 4)*:85–128.

[25] M. Sierhuis, W. J. Clancey, and R. V. Hoof. (1999). A multi-agent programming language for simulating work practice.

[26] M. Sierhuis, W. J. Clancey, R. V. Hoof, and R. D. Hoog. (2000). Modeling and simulating human activity. *In Autonomous Agents 2000 Workshop on Intelligent Agents for Computer Supported Cooperative Work: Technology and Risks.*

[27] M. Sierhuis, W. J. Clancey, and R. V. Hoof. (2007). Brahms: a multi-agent modelling environment for simulating work processes and practices. International Journal of Simulation and Process Modelling, Volume 3(No. 3), Pages 134–152.

[28] V. Vaishnavi, and B. Kuechler. (2012, November). Design science research in information systems. Available: desrist.org/desrist/article.aspx.

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