

Prioritizing Tasks Using User-Support-Worker's Activity Model (USWAM)

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Abstract. Service desk has been widely deployed to cater user-support in an organisation. However, in the field of e-Research there are only few studies conducted to enhance the user-support services or user-services. Little has been done to improve the motivation of the employees of e-Science infrastructures to service incoming user requests known as incidents. In this paper, User-Support-Worker's Activity Model (USWAM) is presented that enhances the interactivity of the employees of cyber-infrastructure with the incidents. Furthermore, the model enhances not only the handling of the incoming user requests but also the management of the core activities assigned to the employees via visualization queues and matrices in the UI. Subsequently, USWAM aids the employees to remain interested in supporting users, similar to playing a game. Accomplished tasks can be rewarded in the form of money/gifts or recognitions. Finally, USWAM can be transferred to other service-oriented domains where prioritization or management of tasks is required.

Keywords: e-Research · Cyber-Infrastructures (CI) · Help desk · Service desk · Prioritization of tasks · Employee's activity model · Task management · Employee motivation

1 Introduction

The utility and importance of user-support (also known as service desk or help desk) in any organisation cannot be underestimated. However, the resources of an organisation, especially a research institute are mostly limited. This is the case in the field of research as well as e-Research, where the employees of multiple organisations form a cyber-infrastructure and have a limited time and budget to answer arriving incidents [1, 2]. The user requests are also known as incidents, especially in Information Technology Service Management (ITSM) [3].

In most of the cases it is difficult to automatically process the incoming user-requests (incidents) because the application of intelligent technologies to automate the process either has limitations or is too expensive to implement [4]. Therefore, in

e-Research, the employees of organisations that constitute a particular cyber-infrastructure handle incoming incidents in addition to their core activities, mostly on voluntarily basis [5, 6]. As per observations in the Earth System Grid Federation (ESGF), some employees participate in user support activities more than others [7]. ESGF is a well-known climate cyber-infrastructure [8, 9]. Normally, the employees of cyber-infrastructures, for instance in ESGF (and also in other cyber-infrastructures), are over-whelmed by their core tasks/activities and normally find little time and concern to process incidents [5].

The core activities of cyber-infrastructure employees include: Research, programming, system administration, data curation, data management and others [4]. These core activities are necessary to advance technology, cultivate standards and maintain the operations of a cyber-infrastructure. They are part of the planned tasks which is part of the job description of the employees. However, processing an incident is not formally part of the job description of the employees and is considered as an interrupting event by the employees. Handling incidents depends on the time factor i.e. extra time available to the employees to treat them. Besides, it also depends on an employee's interest and motivation to get indulged in supporting users¹. In order to generate an interest and motivate the employees to process incidents a suggestion has been forwarded to the governance (i.e. the organisational committee) of the ESGF cyber-infrastructure to recognize handling of incidents as part of the job description [10]. However, in addition to this suggestion, a user-support-worker's activity model (USWAM) has been proposed and elaborated in this paper. USWAM provides an overview of the planned tasks as well as the incidents using GUI. Furthermore, a user-support-worker's or an employee's interest can be aroused with the USWAM-based GUI. In addition, the employee is able to process these activities in an optimum manner.

This paper is organized as follows: Sect. 2 describes the background of the concepts of e-Research, user support, the significance of user support in e-Research and the existing models in optimizing employee/workers activities. Section 3 describes the contemporary user support practices in ESGF from various sources of data that were gathered by the author. Moreover, the significance to introduce USWAM has also been described in Sect. 3. Section 4 elaborates the USWAM including its visualization via the GUI, followed by discussion and future work regarding USWAM in Sect. 5. Finally, the paper concludes in Sect. 6.

2 Background

The related work of this paper is divided into the four main areas given in the following subsections:

2.1 E-Research

E-Research is collaborative, relies on grid computing technologies to share and use data to perform research in different fields including humanities and science [4, 10–12].

¹ The word "customers" can be replaced.

E-Research is conducted via cyber-Infrastructures (CI) also known as e-Science infrastructures that are deployed to access and share the data, high performance computing (HPC) facilities and human resources to facilitate intra-disciplinary and inter-disciplinary research to harvest knowledge. A CI is formed through collaboration of many organisations across national and international boundaries. It is the synchronized integration of software, hardware and other technologies, as well as human expertise, required to support current and future discoveries in science, humanities and engineering [13]. Networks that constitute CI are complex: Users need an interface to access its resources usually data [14]. The interface includes command line tools, web portals and Graphical User Interface (GUI) to access data assets which are the main resources hosted [15, 16]. However, during an interaction of a user with a CI, a user may require help due to outages of some resources e.g. servers or any other anomaly [15]. In other case: a user requires particular scientific or technical information. In order to meet these user support challenges, CI offers user support in the form of a help-desk, which even being a core activity has not received adequate attention since inception of cyber-infrastructures [1, 17, 18].

2.2 User Support in e-Research

In the last decade, the user-support in ESGF has been evolving mainly due to the changes in the service-oriented architecture of ESGF CI. For instance; looking at the history of the ESGF development, the technological and organisational change has been constant. Moreover, the number of users and their needs have been changing as well [18–21]. Consequently, up until now the employees of ESGF are performing the user support by handling incidents, on a free will basis i.e. on top of their core infrastructure development activities/tasks [5]. A recent survey questionnaire and mailing list analysis conducted revealed that up to 15 % of the incidents were ignored by the employees [4, 7, 12]. Therefore a need to enhance ESGF user support was felt and as a part of result USWAM is suggested amongst other changes in the organisation and governance of ESGF.

2.3 Support Employee/Workers Activity Modelling

There are existing models that may be used to model CI employee's support activities. In software engineering, activity diagram in Unified Modelling Language (UML) [22] as well as Business Process Modelling Notation (BPMN) [23] can describe human activity in a sequential process. However, these methods are helpful in analysing stable and common processes in a non-dynamic environment other than CI. Moreover, they help to replace them via automated processes by employing IT-systems. Likewise, there are analysis and modelling methods on characteristics of human behaviour. For instance; information processing of humans is useful to provide standards of IT-systems such as responsiveness [24].

There is work done by Watanabe et al. that provides a basis of employee's activity model for support of interpersonal services in nursing care environment [25]. However,

this proposed employee's activity model is used in a solitary, non-dynamic environment for the nursing staff, care workers and occupational therapists. It does not include team based coordination steps, multiple pools, point counters and a reward system. Therefore, there is a need to extend this model to suit other environments such as in user support environments such as a help-desk or a service-desk, where multiple human agents are supporting users. This is especially the case in an e-Research environment such as ESGF, our case study [18].

Thus, keeping with the previous work of Card et al. about information processing of humans and Watanabe et al. proposed guidelines of employee activity model, USWAM is proposed. Furthermore, on top of it, USWAM incorporates the findings from informal interviews, participatory observations and survey questionnaire based on feedback from stakeholders of ESGF; especially employees as well as users. USWAM supports from 1 to N tier user support model in e-Research and can be applied to other fields. A user support model defines the number of levels of workers involved in servicing an incident. For instance; two or three level tiers in user support models are popular [26].

3 Investigation of Contemporary User Support Practices in e-Research

An investigation of the current user support practices of the employees of a cyber-infrastructure: ESGF is carried and is described in the following three subsections:

3.1 Significance of the Case Study: ESGF

An important practical use-case in the field of climate science cyber-infrastructures is ESGF (Earth System Grid Federation) project [27]. ESGF is the first inter-agency and international effort in the domain of Climate Science used for Earth Science Modelling (ESM) [21, 27, 28]. At the moment, more than twenty-seven thousand researchers are accessing huge amount of climate data for climate-model inter-comparison purposes from ESGF distributed data-archive worldwide that makes ESGF a key cyber-infrastructure that supports ESM [12]. This is one of the main reasons to take ESGF as a use-case for this research.

Moreover, ESGF facilitates to study climate change and impact of climate change on human society and Earth's eco system [21]. Since physical phenomenon that govern Earth's climate are so complex and diverse, it is the most important scientific challenges of our time to undergo sophisticated model simulations that generate huge amount of data, collect observational data from various sources and share that data at a global scale. This is made possible by ESGF to discover, analyse and access the climate data sets which are stored at multiple geographic locations across the globe [8, 10, 21, 29, 30].

3.2 Research Methods Applied

In this study, case study method is chosen as a research method. The information about current user support practices in ESGF, and similar cyber-infrastructures, was captured via; survey-questionnaire, participatory observation of the first author [4]. Moreover, twelve interviews with stakeholders that included employees and users of ESGF and C3Grid cyber-infrastructures were conducted. All interviewees had different backgrounds and roles. Furthermore, relevant documents such as reports, publications and archival analysis of user and staff communication within the user's mailing list of ESGF were also observed [4]. The triangulation of sources of information was chosen to capture different perspective to validate and to contrast the findings [31–33]. The development of USWAM is partly based on these research findings as well as the research methods applied [4–6, 15].

3.3 Findings (Related to USWAM User Support)

This empirical qualitative cum quantitative investigation revealed a number of issues where attention of ESGF team is needed to improve the existing user-support process in cyber-infrastructure. The issues about the existing user-support process in climate cyber-infrastructure projects include allocation of time, human resources, time to solve the user-problems, characteristics of user requests, support tools, support structure and many others [4, 5, 7]. From the analysis of data collected in this study; it is found that the employees of ESGF are supporting users by handling the incidents on a free-will basis spontaneously [5]. Moreover, some employees show more engagement than others. It was observed that this and other factor is leading to more than 15 % of user requests that remain unanswered [15]. In order to create interest amongst the employees who perform multiple tasks including handling incidents, USWAM is suggested. Based on data there was a strong wish of the support workers in ESGF to visualize the tasks, prioritize them, set deadlines, track the workflow of the incidents and forward them to co-workers [34]. These factors lead to the development of USWAM to be introduced in the arena of user support in cyber-infrastructures.

4 User-Support-Worker's Activity Model

The details of the USWAM are described in the forthcoming sub-sections:

4.1 Description of USWAM

USWAM is a basic framework to visualize and manage incoming user incidents by the employees². It arouses employee's interest by providing a point count system and encourages an employee to respond to incidents flexibly. According to the point count

² However, USWAM is not only limited to employees rather to whoever who is interested in supporting users.

system, if the support worker handles an incident within a set time³ (i.e. recommended time which is set 72 h in ESGF after reception of an incident), s/he gets one point. S/he gets a half point if the incident is handled outside the set time. S/he may get an extra point if the solution is appreciated by a user. Collecting points is connected with a reward system i.e. more points collected, the bigger reward one can collect. USWAM provides a support to employee’s for performing activities that include planned and incident tasks. USWAM is meant to create a value through a human and human interaction via a communication channel in a collaborative environment. Figure 1 depicts the USWAM in detail.

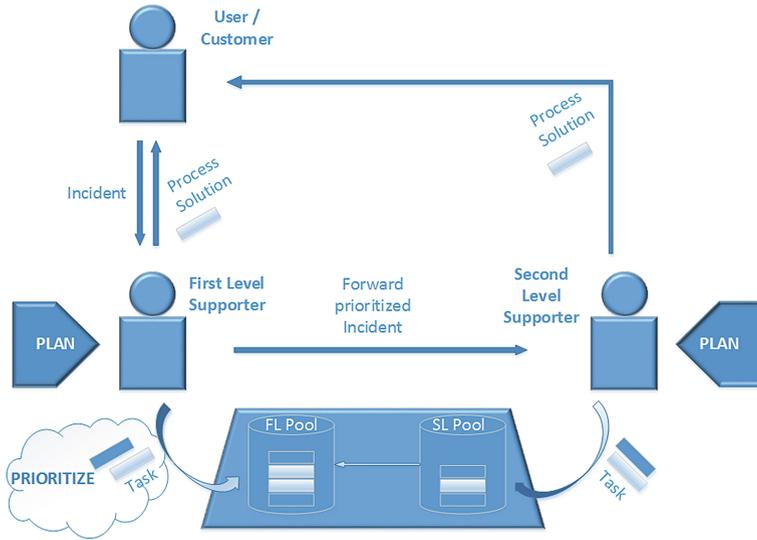


Fig. 1. The User-Support-Worker’s Activity Model (USWAM) and the steps carried out by the supportors to process user’s incident based on task pooling and the priority mechanism (Color figure online)

A user, in this case a climate e-Researcher shoots an incident as an e-mail to the ESGF user-support system or service-desk (see Fig. 1). The employee, usually a first level support person (FLS) gets these incidents, processes it and sends back the answer or solution (see Fig. 1). Alternatively, if FLS is unable to address the user’s issue s/he may add some information (i.e. enabling information sharing) and forwards it to another employee, usually a specialist second level support person (SLS) for further treatment. This is the example of the 2-tier user support model which is the agreed (by the stakeholders to be suitable) in ESGF user support system. Nevertheless, USWAM can be applied to 1-tier to N-tier user support models in any environment whether research-oriented or commercial set-up, as the need may arise according to a particular situation. The employee (whether FLS or SLS) have two types of inputs, namely:

³ A set-time to process an incident is mutually agreed by user support task force which is part of a governance of a cyber-infrastructure.

- **Planned activities**; which are already planned, analogous to “To-Do” list both for FLS and SLS (on the right and left hand side of the Fig. 1). Planned activities are the core activities scheduled beforehand (on a daily basis).
- **Unplanned activities or incidents**; which are incidents, can be thought of as events; i.e. they occur spontaneously at any point in time and need to be addressed at a certain point in time (i.e. meeting the priority level). Incidents are non-core activities which are not scheduled beforehand. An incident is an information request from a user e.g. a system outage that triggers a new activity which is not planned. However, they may initiate (or be the cause of) core or non-core planned activities at any instance in time; in this it may either transform into a planned activity, thus ceasing to be a spontaneous interruption or an employee has to plan some extra activities to cater the original incident.

Eventually, each activity is called a task i.e. planned task and an incident task. An incident task depends on the information embedded in the incident e.g. the situation that a user is facing that leads to a problem or an information needs that determines the urgency of the incident. It is important to take into consideration and anticipate that there can be *implicit incident tasks* that can be performed by an employee on his/her own awareness or knowledge of the situation within the environment of a cyber-infrastructure.

In service industry, interruptions to employee or workers task normally occurs quite often [34]. Similarly, different nature of tasks may pile up, making hard for a worker to remember specific details about them. Since human memory has a limited capacity therefore, there is a risk to forget the task and specific details about them [34]. Consequently, it is vital to externalise the memory to deal with interruptions and variety of tasks. Hence, in USWAM, externalisation of tasks stored in human memory is suggested via a ‘pool’. The pool represents the externalisation of tasks stored in worker’s memory graphically on a UI. In Fig. 1, the two pools namely First Level (FL) pool and Second Level (SL pool) are depicted that contain both event tasks and planned task in the form of a pile known as queue task in the form of a pile known as queue. The principle this queue works is FIPO (First In Prioritised Out) meaning all planned tasks are piles and events received during a work day are piled on top. But the way these tasks are processed depend on the prioritisation judgement of the support workers.

If there are N levels in a user support model then N level pools are possible. This *memory pool of an employee* is represented in the Fig. 1 for each of the employee that processes the tasks. The incident tasks are represented as light blue and planned tasks as dark blue in the Fig. 1. An employee processes these tasks based on his/her judgement. The employee’s judgement is based on some background information and experience which makes up “a priority rule” to prioritize and process incidents, depicted in the Fig. 1 as a cloud (on the right bottom). Alternatively, this priority rule can be automated via an algorithm that can be introduced to a user support system for the facility of employee. However, designing a priority rule algorithm is set aside as a future work in this study.

Currently in ESGF governance or organisation, FLS position is not specified or fixed as yet but it is recommended to be specified soon. Furthermore, it is recommended that the position of FLS shall be given to multiple people (at least 6 distributed

in different continents) who may be students or technicians. Their job is to process incidents and further develop user support system. Apart from processing incidents their job is to automate parts of user support process and make relevant help or support information available to users. It is not necessary for them to have a high profiled portfolio of top computer/climate scientists. Thus, dividing the simple and routine incidents to be treated by them and forwarding only the incidents which cannot be treated to the SLS with some diagnostic information (that probably may help in solving user's concern).

In USWAM, a point counter, which is a step towards gamification⁴, is also embedded for both FLS and SLS but especially for the SLS. This is because SLS are top climate or computer scientists who on top of performing their core tasks related to their job description, may perform incident tasks referred to them by the FLS. So, if SLS processes incident tasks i.e. incidents they acquire recognition for their additional services i.e. supporting end-user concerns or problems. Since they put in additional effort they acquire additional recognition in the form of certificates of appreciation/recognition, extra remuneration in the form of salary bonus, free hours or holidays, gifts, give-aways or promotions. So in case SLS has a free time, SLS can carry forward additional incidents from FLS thus releasing the burden of FLS, thus collecting extra points and working in a free time. Apart from the rewards mentioned above rich gamification techniques similar to can be applied at the UI level to experience support workers to experience gameness at a later stage. The reason for using gamification techniques in ESGF user support system is because there is empirical evidence that gamified system does produce positive effects on workers [35].

4.2 Integrating USWAM in the Bigger Picture of User Support System of CI

User-support-worker's activity model (USWAM) is designed after examining the current user support process in ESGF which is a use case of climate cyber-infrastructure. The data is collected from the stakeholders of ESGF in the form of interviews and survey questionnaires. It was found out that the current user support process in ESGF has some limitations and can be improved. Amongst the other changes suggested to improve the user support system, USWAM was also an outcome of this analysis.

It was suggested to introduce something like a user social networking & support system, in which the users can connect to other users and initiate incidents using a web-form. This web form once submitted transfers the incident to an employee or a worker who is supporting users. Now these support workers are employees of an organisation which is part of a CI. They have planned tasks as well as incidents. In order to manage these tasks and save time USWAM is suggested. Its visualization through GUI is meant to be part of the bigger user support system. This UI is normally visible to an employee or someone who is interested in processing/handling incident

⁴ Gamification is "a process of enhancing a service with affordances for gamely experiences in order to support user's overall value creation." [36].

tasks. At a later stage, this can be done by users themselves too (who have a login and are verified).

5 Discussion and Future Work

At the moment, an ESGF user support system is under development where the employee-facing UI shall be integrated based on the USWAM to support employees in managing tasks (planned and incidents). Moreover, in the long run this UI can also be used by users who are willing to support other users. This will be made possible at a later stage. It is important to analyse the worksheets i.e. doing auditing in the longer run to determine user value from this model as well as cost of employees in processing tasks. It is vital to gauge or test USWAM that to up to what extent it promotes teamwork and arouses interest of support worker in the real environment. However, to accomplish these goals, further study is a must. Therefore, it is recommended to conduct experiments as a future work to prove or reject the predictions. In addition to it, computational methods such as simulation or multi-agent simulation can be applied to test the data gathered from the workers and their priority rules. The algorithm designed to re-prioritize or prioritize tasks can be designed in future and can be developed for a specific domain of a CI. This can be a dynamic simulation between a team of support workers.

Processing tasks enables the support workers to learn from processing incidents. More incidents a worker processes, more learning s/he gain in the longer period about user issues and in turn can contribute to the design and development of the CI. This is because the incidents comprise; information requests, problems such as system outages, data errors, data access failures, user feedbacks and requests for future features. The learning effect amongst support workers can further be observed in future.

Currently, application of USWAM in the user support environment in CI is intended to make the tasks manageable within a specified time thus knowing the priorities. It further facilitates better planning of tasks, providing visual assistance and motivation to process the incidents. USWAM can also be used as it is, or with some amendments to other fields such as patient treatment in medical science, servicing customers in government or commercial departments and other support areas.

6 Conclusion

In a nutshell, it is anticipated that implementation of USWAM in a dynamic, team-oriented, distributed environment such as cyber-infrastructures makes planned tasks as well as incidents more manageable. However, this claim is needed to be tested in the real environment, which is proposed as a future work. Application of USWAM in a use case of a climate cyber-infrastructures; ESGF, intends to create motivation and interest amongst the support workers using gamification. This can be achieved by introducing the point assignment system along with a reward system that would push employees to work efficiently and process incidents in their free time. Therefore, USWAM tends to optimize the schedule of support workers. Consequently, the

introduction of USWAM is aimed at creating value and effectiveness for the whole user support system or service-desk. In future, the authors will refine this model and test it further. Finally, they will validate it through actual data and system development in the real environment.

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