Journal of Engineering and Applied Sciences 14 (Special Issue 6): 9272-9277, 2019
ISSN: 1816-949X

Human Centered Design Approach as a Technology Capability: Integration of the Management Perspectives in the Human Centered Software Developemnt Process

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Abstract: The Human Centered Design (HCD) approach is the approach that integrates Human Computer Interaction (HCI) requirements into the system development phases. However, the adoption of HCD among software practitioners faces several problems. Among the problems cited by the software related organizations that have adopted HCD is the lack of guidelines to guide the HCD adoption and the difficulty to understand the interaction factors among task, organizational and situational factors which implies issues related to the resources such as human, financial and infrastructure. This study attempts to provide an understanding of the HCD adoption of the operational, tactical and strategic management perspectives to view the interaction factors to gain some insight on the guidelines to adopt the HCD approach. To present this view a HCD model was selected and used to illustrate the integration of the management perspectives of the HCD processes. The HCDP model that was selected was developed based on the ISO TR 18529 and was considered to be good choice to illustrate the management view integration as it covers the HCD activities from the project planning to the implementation stage of the software development process and it emphasizes on the larger scope of human factors and require broader skills in software development process. The resulting conceptual model of management view integration of the HCD adoption emphasizes on the importance of managing the resources and long term strategic planning for the organization. This integration presents a new view of HCD as a technology capable of software development.

Key words: HCD, management perspectives, organization resources, integration, software, technology

INTRODUCTION

The approach of integrating Human Computer Interaction (HCI) requirements in software development can be accomplished through the Human Centered Design (HCD) approach. However, organizations that have attempted to adopt HCD in their software development process cited several problems. Among the problems cited are the inability to address the interacting factors of task, organizational and situational factors that can influence the development of the software (Boy, 2011; Murphy, 2010), the lack of HCI and usability experts (Cardella *et al*., 2012), the lack of a systematic approach, inadequate knowledge and unclear responsibilities among the practitioners (Viikki and Palviainen, 2011) and the lack of guidelines to guide the software practitioners to adopt HCD in the software development process. This study addresses the concern with the first problem which relates to the interacting factors between task, organizational and situational factors in software development in the attempt to position HCD adoption from a technology management perspective rather than merely addressing it as a software engineering process. This argument follows the research in that position the HCD approach as a technology for integrating user requirement ranging from the top management to other stakeholders in the software development process. This is further affirmed by (Murphy, 2010) who stated that the HCD approach is to ensure "The abilities of the humans involved in the activities of engineering the software" in order to produce usable software for the users. In addition, this new positioning of the HCD approach may be able to address other problems that surfaced in organizations that have adopted HCD. These include problems of managing the resources such as human, financial and infrastructure in the organizations (Yamada *et al*. 2009).

Therefore, this study attempts to present a new view of the HCD adoption approach that is anchored in the technology management perspective where HCD is positioned as a technology capability in producing

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quality software. To present HCD as technology capability the approach of Creswell (2007) was taken to give a multi-perspective view of technological capability. Three theoretical perspectives that represent the different perspectives of HCD adoption in the organization were identified to gain a better understanding of the relationship between operational, tactical (management) and strategy component in software development process. To illustrate the HCD as a technology capability, a model of how the HCD approach is integrated into the software development process was selected and dissected. The following sections consecutively cover description of the management perspective considered, the HCD Model used and the positioning of the technology management perspectives within the HCD Model. The result of this research is a conceptual model of the HCD integration.

Viewing SDLC from three management perspectives: Three management perspectives that are discussed in this study are the operational, tactical and strategic perspective. The operational perspective refers to the organizational activities that transform inputs into final outputs while the tactical perspective view the organizational activities of managing resources to achieve specific organizational goals within the Software Development Life Cycle (SDLC). In other word from these two perspectives a view that explains how practitioners incorporate the HCD approach in the software development process and how HCD activities should contribute to developing the software can be conveyed.

The tactical perspective refers to the management of resources to gain efficiency and effectiveness of the organization. Resources can be divided into physical equipment such as facilities (equipment, tools), financial and human resources (knowledge and skills) in order to gain competitive advantage. Managing resources include planning, organizing, motivating, staffing and controlling. In the software development industry, management refers to the planning, evaluation and coordination of the operation in the software development process. Here, the role of the IT manager is at the management or tactical level that include project management, budgeting, managing the operation and dealing with new technology (Yamada *et al.* 2009). At this management level the responsibilities include the management of human resource, facilities and finances of the organization. The management of these organizational resources is vital as this contributes towards the competitive advantage of the organization as well as to the increased performance of the organization (Creswell, 2007). From the organizational strategic perspective, the concern will be on how the organization should strategies to improve its competitive advantage. The organization can concentrate on strategic thrusts such as product differentiation through their technology capability which can lead to profit maximation and increased customer satisfaction. The organization has to make a decision how to use their resources and create something better than their competitors to gain the competitive advantage in the industry. In the case of the software organization, the strategic thrust of product differentiation can be achieved through the technology capability of the HCD approach which aims at producing quality software that places human as a central focus. This will require the organization to practice strategic planning in their resource acquisition and utilization. Eser *et al.* 2012 and Holtsnider and Jaffe (2011) defines strategic planning is a process in which the organization evaluates capabilities, opportunities and risk of the resources in order to carry out the mission of the organization. The organization is responsible to plan their resources at corporate, business and functional level.

MATERIALS AND METHODS

The HCD approach: case of the Human Centered Design Process (HCDP): To illustrate how the HCD approach is incorporated into the software development process, a HCD model was selected. The Human Centered Design Processes (HCDP) was developed by Earthy (1999) and Ismail *et al.* (2012). HCDP was developed based on the HCD lifecycle process proposed by the ISO TR 18529. The development begun with the identification of the processes for each of the components in the ISO TR 18529 standard and the HCDP Model emerged as shown in Fig. 1.

The HCDP Model is defined as the processes or activities that are carried out based on the human centered approach at each level in software development process (Eser *et al.*, 2012). The HCDP Model is employed because it is argued to offer "Better defined user and organizational requirements, design support, usability testing procedures and post-delivery feedback" (Earthy, 1999). HCDP covers the HCD activities from the project planning stage to the implementation stage of the software development lifecycle process. The HCDP Model emphasizes on the larger scope of human factors and require broader skills in software development process. The HCDP Model consists of seven set of base practices. The practices illustrate the activities or processes that have to be done which focuses on the human centered process during software development life cycle. Based on the ISO TR 18529 standard (Jones and Earthy, 1998), Earthy has refined and categorized the HCDP processes into three components, namely

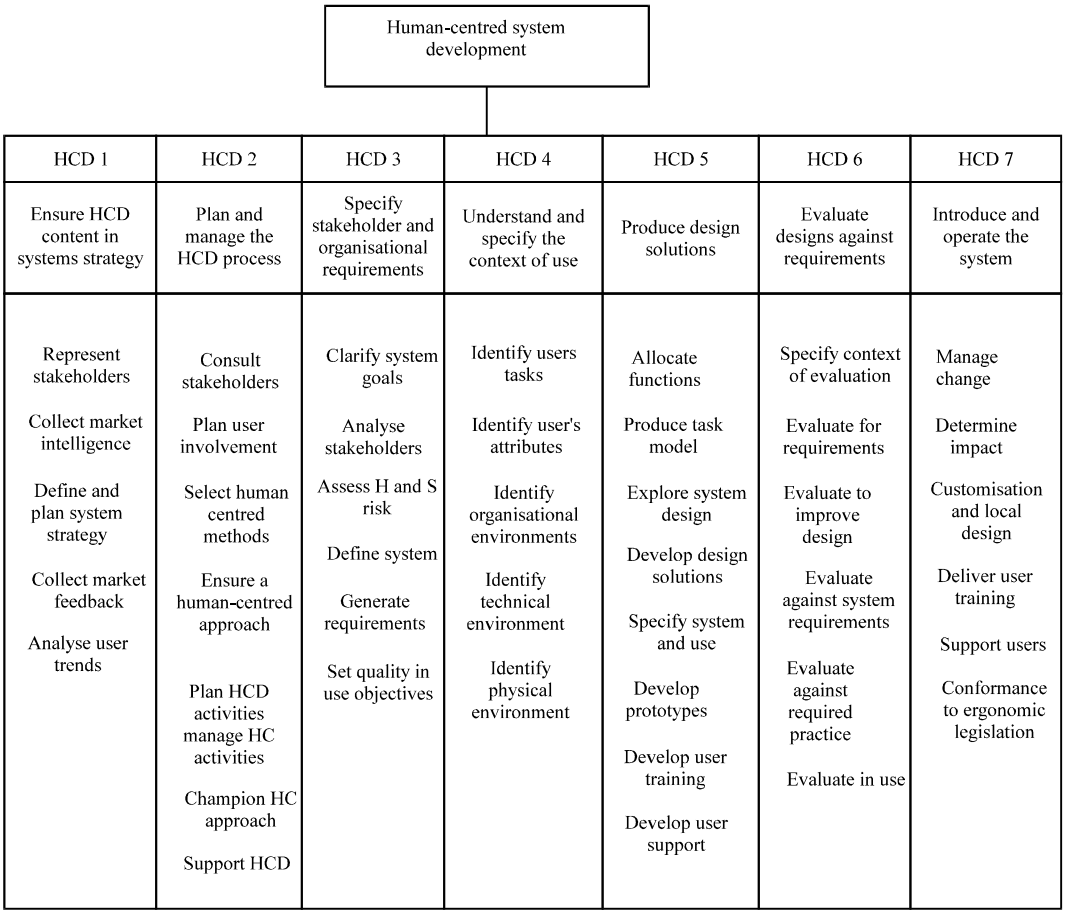

Fig. 1: The Human Centered Design Processes and their base practices (HCDP) (Earthy, 1999)

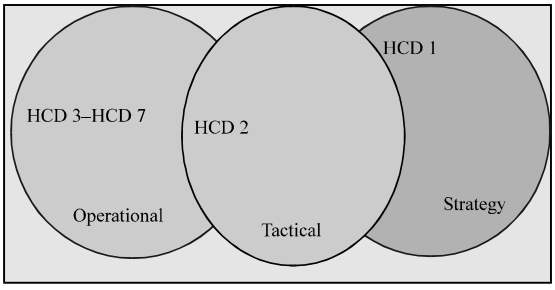

Fig. 2: Inter-related between operational, tactical and strategy components

operational, tactical and strategic (Fig. 2). Figure 2, it can be seen that HCD1 is focused on human centered processes at the strategic management level, HCD2 is focused on human centered processes at the tactical management level and HCD3-HCD7 are focused on the human centered process at the operational level.

The inter-related between operational, tactical and strategy components is also shown in Fig. 2. In the tactical component, the HCDP model addresses on plan and manage the HCD process (HCD 2) which is also part of operational components. On the other hand in a strategy component Earthy address in ensuring HCD content in system strategy (HCD 1) which only focus on software development process which is also part of tactical component. This is due to the strategy focuses on high level decision making.

RESULTS AND DISCUSSION

HCD integration with the management perspectives: From the inspection of the HCDP Model, it is observed that even though the HCDP Model covers the human centered processes at the operational, tactical (management level) and strategic (higher management) levels but its focus more on the operational level of the human centered activities. In other words in the HCDP, the human centered process gives a higher focus and attention to the operational perspectives rather than the tactical and strategic perspectives. The HCDP process

overlooks the importance of managing the resources such as Human Resource (HR), finance and facilities and strategic planning for the organizations and failed to discuss on the resource management aspect. This is a concern that needs to be addressed to position the HCD approach as a technology capability.

It is now argued that to position the HCD approach as a technology capability the resource-based view framework needs to be used as the strategic framework. As widely known, the resource-based view framework places a strong emphasis on resource acquisition, utilization and retention (Baradhwaj, 2000). The vital resource in the HCD approach to be acquired, utilized and retained will be the HCD expertise and skills. This then will be addressed through tactical management of resources which include the human resource (HCD experts and practitioners), the facilities (standardized or internalized HCD tools and instruments, HCD standards and best practices) and the financial means to acquire and retain two of the former resources described. At the strategic level, the management can strategize on sharing of best practices among HCD experts and their sub-ordinates and peers which should eventually lead towards retention of expertise and skills. The human resource management should now consider looking into HCD related competency, specifically or HCI related competency in general. In the current situation such competency model is lacking. One known competency model will be the newly developed user centered design competency model (Niemine, 2015). At this point it should be noted that HCD expertise are not restricted to ICT-trained experts but also covers a range of expertise from outside the ICT domain, such as cognitive science, psychology, sociology, business and graphic design which may be rare in the ICT industry. This requires some strategic move that includes practicing the strategic planning at regular terms and ensuring some kind of strategic alignment is attained. The conceptual model of the HCD integration with the management perspectives is illustrated in Fig. 3.

This model emphasizes on the importance of managing the resources such as Human Resource (HR), finance and facilities. Managing human resource is referred to managing staff competency. Staff competency is referring to staffs that have knowledge, skill, attitude and behavior and other personal attributes that the organization expected to have to contribute successfully within the organizational context. This is due to the staff who has competency with the organizational leadership will contribute to the success of the organization (Earthy, 1998). Financial management is management of

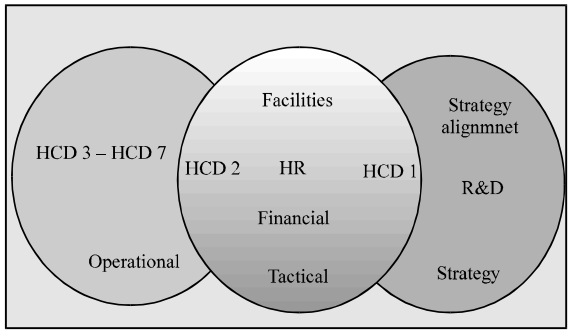

Fig. 3: Conceptual model of HCD integration

organization funds to create wealth for the organization by allocating the budget to manage the resources in the organization. This is because financial management is important for the organization to keep track the resources and allocate them efficiently (ISOT., 2000). Furthermore, financial management has a great influence on the decision of the organization.

On the other hand, management has responsibility in providing the allocation of infrastructure in the organization. Managing the facilities including managing the equipment, systems, software and services used in common within the department in the organization. It is much cheaper to have in-house tools and facilities that can be used by all the staffs in the organization. The availability to assess the infrastructure of the organization will make HCD adoption is cost effective, efficient and effective (Tripathi and Agrawal, 2014).

Furthermore, the DHCP model does not take into account the trend of the technology and long term planning in order to be sustained in the software development industry. Therefore, this study will address on the strategy of the organization to align HCD with current technology and organization strategy in Research and Development (R&D) as shown in Fig. 1. The strategic alignment is referring to the strategy of the organization to align HCD with current technology. The capability of the organization to set alignment between HCD and current technology can be a factor for competitive advantage and can improve business performance (Tripathi and Agrawal, 2014). Furthermore, aligning HCD strategy with current technology, the organization can maximize their investment which can give positive impact of the organizational business performance (Ciuhureanu *et al*., 2009). This was supported by Chan *et al*. (2006) and Hooper (2006) claimed that there is a strong relationship between strategy alignment and business performance in the organization. The organization has to continue on searching for new opportunities through Research and Development

(R&D). This is because exploring human centered approach in R&D will lead to the creation of valuable innovation that can be commercialized and socialized (Hooper, 2006). Furthermore, the organization has to take advantage of existing resources to continue improving knowledge and process (Kotrlik and Redmann, 2009) of HCD implementation. This due to through R&D, organizations can change and use the resources to continue innovating (Herting, 2002) in HCD in order to be sustained in competitive advantage.

CONCLUSION

The problem of HCD adoption in the software development process is of guidelines to guide the software practitioners to adopt the HCD approach in software development process. This in turn leads to other problems such as the inability to relate to the interacting factors such as task, organizational and situational factors that can influence the development of the software. This has become a motivating factor for this research that is to address the HCD adoption from a strategic point of view. A position was taken to pose the HCD approach as a technology capability that can help software development organizations attain its competitive advantage through the resource-based view strategy framework. The result of this research is the conceptual model of the integration of the management perspective in the HCD approach.

RECOMMENDATIONS

Future research will be focused on the refinement of the model through existing capability frameworks such as the CMM and its verification which will eventually emerge as a HCD capability framework. This will probably be translated into the production of guidelines to assist software practitioners and managers to adopt the HCD approach in software development. However, in the present situation there are some limitations that hamper the swift development of the HCD capability framework. Progress on the HCI competency model is slow and needs to be intensified as the competency model will be an important component of the HCD capability model. This will offer more opportunities for research development in HCI in general and in HCD specifically.

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