Factors affecting the appreciation generated through applying human factors/ergonomics (HFE) principles to systems of work

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ABSTRACT

This retrospective study examined the levels of appreciation (applause) given by clients to Human Factors/Ergonomic (HFE) specialists after they have modified the systems of work. Thirteen non-academic projects were chosen because the HFE interventions involved changed the way workers work at their workplaces. Companies involved range from multi-national corporations and military organizations with thousands of employees to small trading companies with less than 10 employees. In 5 cases the HFE recommendations were fully adopted and well appreciated. In 4 they were largely ignored and not appreciated, with partial adoption and some appreciation in the other 4 cases.

Three factors that predict appreciation were identified: (i) alignment between the benefits HFE can provide and the project's key performance indices; (ii) awareness of HFE among the client's senior management; and (iii) a team organization appropriate for applying HFE recommendations. Having an HFE specialist on the client's side can greatly increase levels of appreciation, but lack of such a specialist will not affect levels of appreciation. A clear contractual requirement for HFE intervention does not promote appreciation significantly, but its absence can greatly reduce levels of appreciation. These relationships are discussed using the Kano's model of quality. Means to generate greater appreciation of the benefits of HFE are discussed. Partial finding of this study was presented at the keynote address of the 1st Human Factors and Ergonomics Society of Philippines Conference held in Nov., 2012.

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1. Introduction

1.1. What is system HFE and what do we mean by 'appreciation'?

Within the context of this paper, the term system HFE will be used to describe the application of HFE principles to change a system (or systems) of work. Such a broad definition would have covered almost all aspects of HFE and one could ask why another definition is necessary. The intention is to shift attention from specific HFE techniques or methodologies (e.g., anthropometry, usability validations, graphical user interface checklists, etc.) to the holistic impacts of HFE interventions. Dul has reported that HFE involves a unique combination of three characteristics: "(1) it takes a systems approach; (2) it is design driven; and (3) it focuses on two closely related outcomes: performance and well-being." (Quoted from Dul et al., 2012 p.377). Under the current definition,

practicing system HFE will inevitably involve all three characteristics. Practicing system HFE is also consistent with principle of participatory ergonomics as suggested by Kogi which stresses on implementing HFE principles through users involvement and leading to some measurable improvement in productivity (2006). While both Dul and his colleagues' suggestions and Kogi's suggestions highlighted the need for improvement in performance (or productivity), this study focuses on another outcome which is the level of appreciation or applause to be given by a client to an HFE specialist after the implementation of a HFE intervention. In other words, we investigated whether the clients welcomed the implementation of the HFE intervention. Emmons and McCullough (2004) suggested that appreciation is a key component of human gratitude and can be actively generated and sustained. The authors believe that a successful system HFE project should be associated with clients who would show much appreciation to the HFE specialists. Consequently, understanding factors affecting the generation of such an appreciation is valuable and useful to the HFE professional.

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1.2. An overview and the six rated attribute scores

This study reviewed thirteen projects in which HFE principles were applied to change the systems of work. All projects were conducted in the industry and the systems of work were real. Further explanation of project selection can be found in Section 1.2. In 2012, Dul and his colleagues proposed that all system ergonomics has three characteristics: (i) it has a system approach, (ii) it is design driven, and (iii) it is outcome focused. Hence, this paper reviewed the 13 selected projects in the following five aspects: (i) the system(s) of work; (ii) the approach adopted to apply the HFE principles; (iii) the implementation plan; (iv) the outcomes; and (v) levels of appreciation. The first four aspects correspond to the three key characteristics proposed by Dul and his colleagues (Dul et al., 2012) and the last is this study's unique contribution as explained in Section 1.1.

In order to provide some levels of quantitative analyses, aspects (ii) to (v) were further evaluated by six project attributes. For each project, these six attributes were numerically rated by the author who conducted the projects, respectively. More details on how the ratings were done can be found in Section 1.3. These six attributes were: (a) did the client have an HFE specialist? (b) the level of clarity of HFE requirements as written in the contract; (c) the level of team organization to facilitate the application of HFE intervention; (d) the level of HFE awareness at senior and working level of the client's company; (e) how close are the HFE requirements to the key performance index (KPI) of the project; and (f) the level of appreciation received in response to the HFE intervention. The first four attributes were associated with the approach and the implementation of HFE principles and attribute (f) was the level of applause given to the HFE specialist by the clients. As there are 13 projects and six attributes, 78 ratings were given. How and why a particular rating had been assigned is explained in Sections 1.3 and 2.

Relationships among these key factors and levels of appreciation of HFE interventions were found to conform to the prediction rules as described in a Kano's model of quality. That model was introduced by Dr Noriaki Kano to explain and predict the relationships among product attributes and customers' satisfaction (Kano, 2001; Kano et al., 1984). More details about how this model can predict levels of appreciation of HFE intervention can be found in Section 3. A review of the literature reveals no previous application of Kano's analyses to factors associated with the appreciation of HFE interventions. Part of the material reported in this paper was verbally presented by the first author at the keynote speech of the First Human Factors and Ergonomics Society of Philippines Conference held in Manila.

1.3. How were the 13 projects selected and who rated the project attributes?

The 13 projects were selected and filtered from all the HFE related projects conducted by the two authors using the following filtering criteria: (i) all academic research projects were excluded as the focus of this paper was on industrial projects; (ii) projects focused on the development of a specific product was excluded when the scope of such projects was not board enough to study the impact of such a product on a system of work; and (iii) projects purely involved HFE training were excluded. Regarding the third exclusion criterion, the authors acknowledge that HFE training would eventually make an impact on the systems of work. However, this paper focuses on HFE interventions through participation with real workforce (Kogi, 2006). After applying the exclusion criteria, 7 and 6 projects conducted by the first and the second authors remained, respectively. All selection was done before the

rating was conducted. In other words, the authors did not exclude any project because of their rated results.

The author who implemented the HFE intervention was the one who rated the project. The first author rated projects IT1, IT2, Console 1, Console 2, Stress 1, Hearing 1 and Fall 1 and the second author rated the rest of the 6 projects. Cross rating was not done because only the HFE specialist who implemented the HFE intervention would have enough knowledge to assign the ratings. The authors acknowledge that the ratings had been subjective. Consequently, essential details to support the ratings were documented in Section 2 and in Tables 2–6. In addition, credentials of the authors in the field of HFE can be founded in Authors contribution. Furthermore, sensitivity analyses of the findings to possible inter-rater variation were conducted (Section 3).

2. Essential project details to support the rated attributes

2.1. The scope and objectives of the review

The focus of the review was not on specific outcomes of individual projects. Rather, the objective was to identify common factors influencing the level of appreciation received after applying the HFE interventions. In some of the cases reviewed, HFE principles had been correctly implemented but the related outcomes generated little or no appreciation. A change in the levels of appreciation was observed throughout the course of the project, but this was not the focus of this study. For this study, the rated level of appreciation refers to the final appreciation given to the HFE specialist after the project has been completed.

2.2. An overview of the selected projects

The projects reviewed in this study covered a range of industries and organizations from trading firms to multi-national companies, and systems of work ranged from software databases to control consoles and quality assurance systems.

A total of thirteen HFE-related projects were reviewed. Four of them were related to the design and development of information technology systems (projects IT1 to IT4) and another four to the design and development of control consoles (Console 1 to Console 4). There were also projects related to stress (Stress 1), hearing (Hearing 1) and fall hazard (Fall 1). The remaining two projects had broad scopes and are best described as a risk management system (System 1) and a communication system (System 2). Key project attributes with rated levels are summarized in Table 1. The rated levels were assigned by the investigators (authors), who also directly implemented the HFE interventions.

2.3. Criteria used to rate the six attributes

Details of the six attributes (a to f) can be found in Section 1.2. The first attribute (attribute a) was whether the client had an HFE specialist. The answer was either 'yes' or 'no' and the criteria had been very straight forward. For the rest of the five attributes, the authors used a rating from 1 to 10 to represent the different levels of fulfillment. The anchoring points for the 10-point ratings used to represent attributes b, c, d, e and f are summarized in Tables 2–6, respectively. Most of the attributes were multi-dimensional and were represented by more than one descriptor. For example, in Table 2, contractual HFE requirement (attribute b) was represented by written commitment to (i) board HFE issues; (ii) HFE implementation; and (iii) HFE requirement. These descriptors were developed, clustered, and extracted from descriptions of the 13 projects.