Participatory Design and Usability: A Behavioral Approach of Workers' Attitudes in the Work Environment

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Abstract. The present exploratory study on design and usability was developed to understand the user's participation in the design process, the concept of attitude and its outcomes (as a result of a participative process) and positioned in a contextual framework. The main focus was to explore the link between workers' participation and attitudes when design improvements are introduced in the workplace. Participants in the study were 15 oil drillers working in offshore drilling rigs and engaged in oil and gas exploration and production (E&P). They completed a set of tools covering the nine attitude dimensions, and five scales of satisfaction. The results showed a low level of participation within the two groups involved and attitude toward their participation and the outcomes of the engineering design intervention.

Keywords: participatory design, usability, behavior, attitude, oil industry.

1 Introduction

One of the goals of this exploratory study on design and usability originated with a feeling that to understand the user's participation in the design process, the concept of attitude and its outcomes (as a result of a participative process) should be positioned in a contextual framework [1]. The primary motivation for this research is to develop an understanding of how the workers' participation may influence their attitudes, intentions and behavior towards the technical system. The potential effects of participation stem from the assumption that the component structure of the attitude construct conceived at individual and organizational level.

The attitude and trust toward an object, system or environment depends upon the ways in which the individual interacts with and acquires information about it [2]. The information accumulated by the individual may come from a close relationship with the object or past environmental exposure and has a selective but direct effect on the individual's attitude. That is, the individual is more likely to make use of that which as learned in the past to confer trust and interpret the object or setting of concern.

2 Literature Review

The literature review has identified that the concept of attitude, as a dimension, based on social and psychological field should be considered carefully and is of direct

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relevance when applied to technical and engineering design matters. The starting point is the model of *Attitude to Act* developed by Fishbein [3] also Fishbein and Ajzen [4]) and the model of *Trust in Machines* proposed by Muir [5], [6]. In order to translate attitude and trust from their models into the design field, with an emphasis on the participatory approach and ergonomics, a review was undertaken in order to identify possible contributions from other research. The design of complex systems, which requires the involvement of many individuals with different backgrounds and knowledge, demands the integration of technical information and systems requirements at each stage of the design process for design decisions [7]. The technology-centred approach of reducing, in a static way, the interaction's effects of the specific task environment, the workload and the social and organizational environment, gives little attention to the behavioral component ([8], [9], [10]. Fortunately, two works following the groundwork developed on the problem of trust in machines [6], were developed by Lee [11] Lee and Wei [12] . Given that the concern of this research is about the problem of workers' attitudes in a changing work environment by the introduction of new devices and equipment for automation, the issue of personal beliefs or trust in machines is highlighted. From the original concept of trust as a sociological construct, Muir ([5], [6] formulated a hypothesis which states that trust is an important factor in determining user's behavior whilst interacting with automated systems.

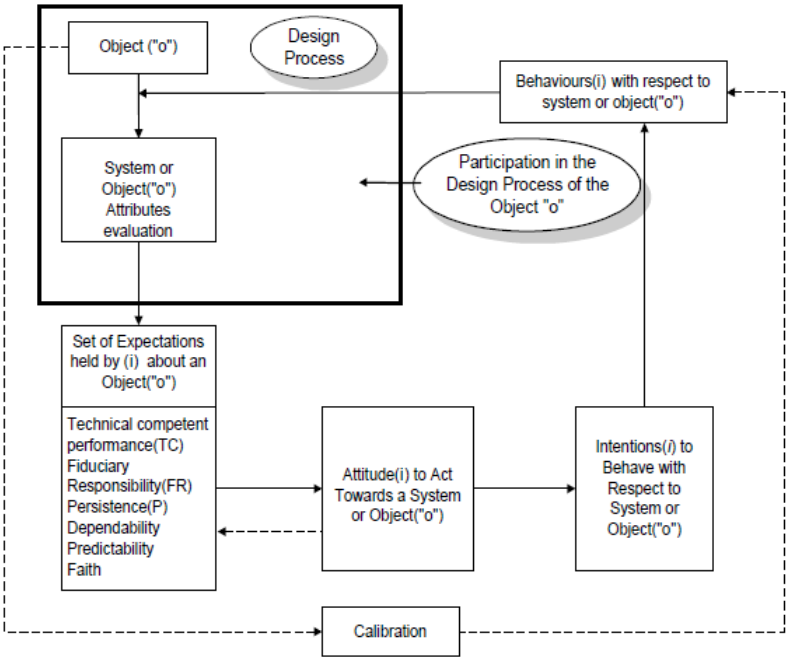

Fig. 1. Attitudes and Participation in the Design Process (Source: Silveira,1999b)

Among some possible questions posed in this area is: *How does the user's participation and involvement level in design influence the user's attitude to act towards a new technical system design?* A hypothetical model is proposed to be tested by assuming that participation as an external variable influencing attitudes and behavior, through a set of expectations and an evaluation of consequences. As the participation influence may change over time and from one group of concern to another, the effects of participation can enhance the understanding of a given behavioral situation [1].

3 Materials and Methods

Participants in the study were 15 oil drillers working in offshore drilling rigs and engaged in oil and gas exploration and production (E&P) involved in the redesign and operational upgrade in two offshore drilling platforms. They completed a set of tools covering the nine attitude dimensions, and five scales of satisfaction. The approach was accomplished through the remaining research instruments applied such as survey results, informal feedback and verbalizations of the subjects involved in the present study.

The factors observed were age, job experience, length of experience within the company, length of experience in the oil rig, as well as the confrontation between the groups of the drillers working within two different platforms (Group I: Platform PETROBRAS 10 and Group II: Platform PETROBRAS 23), which adopted distinct approaches for the design intervention. Three different questionnaires were applied to collect data regarding demographic background of the samples, to assess satisfaction with participation and to evaluate attitudes within two groups of users. The data were analyzed using descriptive statistics, cross-tabulations with the SPSS for Windows version 8.0 program.

4 Results

Both groups responded to an identical questionnaire to assess outcomes such as satisfaction with participation and attitudes. The overall mean value for age of the subjects was 42.2 years (SD±1.03 years) with a range of 37-49 years. The 37-45 years age range accounted for more 75% of the sample. The drillers' skills and knowledge in oil drilling operation may be characterized by the experience acquired along their career path. It highlights the importance of the background that they possess for contributing with suggestions towards design improvements in the workplace. The average for length of job in the oil rig was 8.6 ± 4.15 years, while the mean value for job experience as a driller was 9.41 ± 6.03 years. The data collected is shown in Table 1 below.

Table 1. Demographic Data: Job Experience (Group I and Group II)

		N	Mean	Std Deviation	Std Error	95% Confidence Interval for Mean		Min.	Max.
						Lower Bound	Upper Bound		
Job length in the company	PETROBRAS-23	8	18.67	2.44	.86	16.63	20.72	15.50	23.50
	PETROBRAS-10	7	18.07	2.40	.90	15.90	20.27	13.60	21.00
	Total	15	18.39	2.35	.61	17.10	19.70	13.60	23.50
Job length on the rig	PETROBRAS-23	8	7.59	3.01	1.10	5.07	10.11	2.30	10.00
	PETROBRAS-10	7	9.73	5.20	1.95	4.95	14.51	2.50	16.00
	Total	15	8.60	4.15	1.07	6.30	10.90	2.30	16.00
Work experience in the job	PETROBRAS-23	8	9.82	6.50	2.30	4.40	15.26	.40	18.00
	PETROBRAS-10	7	8.94	5.92	2.24	3.46	14.42	1.10	14.50
	Total	15	9.41	6.03	1.56	6.07	12.75	.40	18.00

With respect to training the demographic information collected through the *Questionnaire I* the results reveal that the totality of drillers received training for exerting their jobs. The same pattern was not verified regarding specific training for operation computer-based drilling systems.

4.1 Satisfaction with Participation: Results and Data Analysis

The dimensions considered in the *Questionnaire II* addressed the level of satisfaction with participation. *Selected dimensions* of satisfaction with participation included in the present study give emphasis to the salient results obtained in the field study. The first dimension *workplace design involvement (Questions 1.1 to 1.6 in Questionnaire II)* provided some insights. The subjects expressed equal desire for participation. The drillers in the Group I scored fairly their desire for participation even if they did not receive promotion or recognition to their contributions (*Question 1.1*). Being involved in initiatives for design improvements in the workplace was the highest scored aspect (*Question 1.2*). Figure 2 below shows the results.

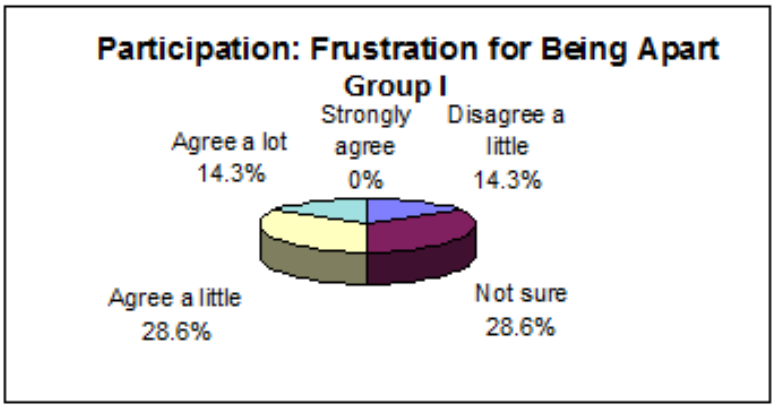

Fig. 2. Frustration for being apart of design decisions/Group I

The drillers among those working within Group II scored highly their desire for participation. To them, being involved in design decisions for improvements in the workplace and their desire for participation were the highest scored factors (*Question 1.2*). They expressed their concern in giving opinions and suggestions for workplace improvements. These results are shown in Figure 3 below.

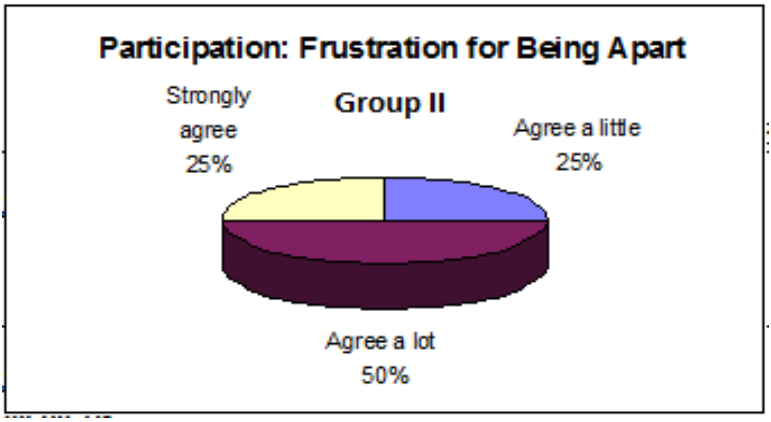

Fig. 3. Frustration for being apart of design decisions/Group II

It was observed that being involved in improvements in the design of the workplace was equally scored in both groups (*Question 1.2*) within the Group I and Group II (mean value 6.42±.53 and 6.37±.52, respectively). When confronting the scores concerning satisfaction levels if the subjects were apart of design modifications in their own workplace (*Question 1.3*), the subjects gave more importance to this factor among those individuals within the Group II (mean value 6.12 ± .83) than among those individuals within the Group I (mean value 4.14±1.8. The results from

the dimension *workplace design satisfaction* (*Questions 3.1 to 3.6* in *Questionnaire II*) provided evidence that in both groups the subjects were satisfied with the changes implemented in their workplace (mean value 6.0 in both platforms). Nevertheless, they recognized that there was just a moderate chance to participate and to apply their skills in initiatives for improvement in the workplace (mean value 3.57 ± .97). When asked about their role as supervisors and their commitment to ergonomic aspects (*Questions 5.1 to 5.6*); the subjects in both group I and II (Platform Petrobras - 10 and Platform Petrobras – 23 respectively) rated highly their concern about being involved in ergonomic interventions (mean value 6.0 ± 1.15 and 5.87 ± .64, respectively). Scores from the *Questionnaire II* (Questions 1.2 and 1.4) regarding the importance of being involved in design decisions and boredom for non-participation provided an insight to the extent to which the individuals want to be engaged in workplace design decisions.

4.2 Attitudes: Results and Data Analysis

The first dimension considered in the attitude assessment was 'intention' (*Questions 1 to 4*). The individuals working within both platforms scored highly their intentions to work with confidence (*Question 1*) in the new driller's workstation (mean value 3.0±.00 and 2.0±2.07, respectively). The subjects in both groups felt that they should work cautiously (*Question 2*) in the new workstation (mean value 2.71±.50 and 2.25±.90, respectively). To the subjects among those within Group I *confidence to work* (*Question 3*) was not seen as a result of participation (mean value 1.14±1.57), while among those individuals within the Group II the opinions were neutral (mean value .37±2.70), but with an expressive variance (′= 5.12) in the response scores.

Table 2. Measurement of distribution: Intention and Attitude (Group I)

Central Tendency - Intention and Attitude Statistics - platform Petrobras 10

		Intention : Work with Confidence in the New Workstation	Intention: Work Cautiously in the New Workstation	Intention: Confidence to Work as a Result of Participation	Intention: Work Cautiously Due to Reduced Participation	Attitude
N	Valid	7	7	7	7	7
Mean		3.0000	2.7143	1.1429	1.1429	.8571
Mode		3.00	3.00	.00[a]	.00[a]	1.00
Std. Deviation		.0000	.4880	1.5736	1.7728	1.0690
Skewness			-1.230	.037	.205	-.772

a. Multiple modes exist. The smallest value is shown

Table 3. Measurement of distribution: Intention and Attitude (Group II)

Central Tendency - Intention Statistics - Platform Petrobras 23

		Intention : Work with Confidence in the New Workstation	Intention: Work Cautiously in the New Workstation	Intention: Confidence to Work as a Result of Participation	Intention: Work Cautiously Due to Reduced Participation	Attitude
N	Valid	8	8	8	8	8
Mean		2.0000	2.2500	.3750	.7500	1.5000
Mode		3.00	3.00	3.00	2.00	3.00
Std. Deviation		2.0702	.8864	2.2638	2.3755	2.0000
Skewness		-2.576	-.615	-.226	-.714	-1.071

The dimension '*beliefs*' (*Questions 19 and 20*) was aimed at the elicitation of salient beliefs. The results have shown that the subjects within the Group II (platform Petrobras-23) did not associate '*beliefs*' to a positive participation's effects towards their confidence (*Question 19*) to engage in a new work situation (mean value -.12±2.16), while among the individuals within the group I (platform Petrobras-10) was reported a neutral score (mean value 0.0±1.73). These scores highlighted their predisposition to keep performance even without participation in the design intervention (mean values 6.28±.49 and 6.25±.71, respectively). Table 4 below summarizes these results for Group I.

Table 4. Measurement of distribution: Normative Beliefs and Motivation (Petrobras 10)

Central Tendency - Normative Beliefs and Motivation to Comply Statistics - Platform Petrobras 10

		Normative Beliefs: Past Experience	Normative Beliefs: Supervisor and Managers Opinion	Motivation to Comply: Management Expectations	Motivation to Comply: Co-workers Expectations	Motivation:Keep Performance Even Without Participation
N	Valid	7	7	7	7	7
Mean		1.5714	1.8571	6.1429	6.2857	6.2857
Mode		2.00	2.00[a]	6.00	6.00[a]	6.00
Std. Deviation		2.0702	1.7728	.6901	.7559	.4880
Skewness		-2.351	-2.215	-.174	-.595	1.230

a. Multiple modes exist. The smallest value is shown

5 Conclusions

Since the beliefs related to technical systems deals with prescribed expectations such as technical competence, persistence and predictability, trust in the technical systems may be influenced by the participation in the design improvements. The effects of a participative role in workplace improvements played by the users may influence their behavioral intentions and satisfaction levels. Further research should be conducted to amplify the present research.

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