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1. INTRODUCTION

This study issue is ergonomics part in design processes. We will describe how ergonomics tackle acceptability and usability during the design of a forecasting help work tool.

First, we will present the study context and objectives. Next we will explain the employed methodology. Finally, we will set out our results and ambitions.

2. CONTEXT AND OBJECTIVES

2.1 Context

The present ergonomic study has been realized within the framework of SIGOONS. It is concerned with the design of nowcasting thunderstorms tool. This tool will be used by various Météo-France forecasters in diverse contexts of work (ex. : tools, organization, responsibility area). The data presented in this abstract have been collected within the context of ergonomic analysis.

In order to design a tool which really suit to work situations, we have to know them. Therefore, we analyse nominal, "usual", situations in order to know the work processes of the forecasters. Nevertheless, the SIGOONS tool will be used during critical thunderstorm phenomenon. Thus, we also analyse critical situations, that means extreme situation, emergency, crisis and disaster. Since the early use of SIGOONS, we started ergonomic analysis in experimental situation of use.

2.2 General objective

The goal of ergonomics is to specify the best conditions of tool acceptability, usability and

usefulness. To reach this conditions and suggest pertinent recommendations, we must approach the diverse dimensions of human work :

- the cognitive dimension,
- the emotional dimension,
- the social dimension.

2.3 Operational objectives

Because of the very important number of information they have to treat and the very important decisions they make, the cognitive analysis leads us to approach specially the forecasters know-how. It appears that decision making is based on these informations, but not only. Forecasters have an experience of work that also induce their decision making.

Concerning the emotional dimension, the analysis of critical situations shows that the forecasters are nervous and their temporal and spatial framework is modified (ex. : they don't see the time evolution ; their interest is reduced to a particular area). This behaviour is a stress indicator called "attentional focus" (Easterbrook, 1959 ; Ellis & Ashbrook, 1988). Observation of forecasters work reveals that stress is pregnant during critical situations. So, we decide to take it into account.

Cognitive and emotional dimensions are included in global work situation which influences them. Actually, the context of work and, in particular, the needed interactions to analyse forecasted weather and to inform, to warn or to alert people act upon cognitive and emotional behaviour.

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3. METHODOLOGY

3.1 *Several types of analysis*

We aim at approaching cognitive dimension of work. Thus, we realized a cognitive analysis. Beyond cognitive behaviour, we were interested in semantic/terminological and temporal aspects. Concerning the semantic/terminological side, we note that forecasters use words to describe the weather event or forecast. We try to know what is the exact meaning of these words for the forecasters. In this way, we access to their representation of the weather situation.

About the temporal aspect, we note forecast work is subjected to different ranges.

In order to take stress into account, we analyse individual behaviour : level of stress evaluation that is perceived stress (Lindsay & Norman, 1980), stress actors. We also analyse work conditions : technical conditions, interruptions (ex. : phone), the grade of the people in the room, noise ...

Finally, we analyse behaviour of interaction in order to approach the global situation. Interactions can happen inside the service, in the forecasting room, with others forecasters of the room, with superiors in the hierarchy or with others workers of Météo-France paying forecaster a visit (e.g.:research and development people, administrative people...). Interactions can also happen with external people, who are outside the forecasting room (e.g.:others regions forecasters, firemen, subscribers). These interactions occur between distant interlocutors and/or are distributed because they generally take place on phone or by fax.

3.2 *Data collection techniques*

Ergonomics employs various techniques to collect data. In this study, we use observations, experimentations and interviews. Often, verbalizations take place With observations in real situations of work and with experimentations.

We observe activity in real situations of work. In order to carry out observations, we go in regional and national centres.

Our observing intention is:

- to identify the forecasters behaviour in nominal and critical situations,
- to underscore differences between the two types of situations.

These observations are often recorded on audiovisual tape.

We proceed to experimentations : forecasters use the SIGOONS artefact within the framework of simulated weather situation. This situation really happened in the past and was quite critical.

The experimentation purpose is :

- to evaluate the artefact adaptation level to nowcasting work,
- to identify the adaptation gaps and to collect the forecasters comments about the SIGOONS artefact.

In the context of experimentation, data are collected via audiovisual recordings and via paper drawings.

In the future, interviews will be done in order to collect more data about the forecasters know – how and abilities. We will try to evaluate what forecasters can do in critical thunderstorms as far as nowcasting is concerned.

4. RESULTS

4.1 *Obtained results*

The semantic/terminological side of cognitive analysis, based on experimentations, reveals new concepts. Within the context of critical situation simulation, forecasters describe their forecast using, for example, the yet-defined concepts :

- thunderstorm,
- thunderstorm system,
- thunderstorm risk area.

Nevertheless, forecasters create new own concepts :

- thunderstorm area is composed of areas including existing thunderstorms and areas where thunderstorms may appear,
- thunderstorm axis : violent thunderstorm line. The thunderstorm axis is frequently included in a thunderstorm risk area or in a thunderstorm area,
- shower of rain area is composed of recognized showers and of possible thunderbolts,
- shower of rain risk area is an area where showers of rain may appear.

Forecasters yield a modified ontology. Actually, they increase the area ontology and create the axis ontology. Although it has been developed via discussions between technical designers and forecasters, the first operational common

system of reference (De Terssac & Chabaud, 1990) evolves with practical experience.

The temporal aspect of cognitive analyse, stemming from observations and experimentations, shows a technical and organizational determinism of the work ranges. For example, technical determinism is due to radar laps (every 5 or 15 mm) or model runs (every 3h). Considering organizational determinism, we note work is under influence of numerous ranges : phone meeting with others regional centres and national centre, forecast bulletins or maps. Forecast chosen ranges in nowcasting experimentation (2-3h are in the majority) might be under the influence of usual ranges.

Observations allow us to analyze individual behaviour and work conditions. This analysis reveals stress factors due to :

- weather situation : risk, danger, graveness, uncertainty about phenomenon violence and/or localization, mediatization.

- technique : technical incidents, uncertainty about models.
- organization : temporal pressures, collective work with superiors in the hierarchy, collective work with different trade associations, interruptions, mediatization.
- task : task conjunctions, workload.

4.2 Aimed results

We aim at identifying behaviour of interaction that may yield consequences such as responsibility feeling for the population and for one self. Future interviews could help us in better understanding the link between responsibility feeling and work behaviour : how they influence each other.

5. AMBITIONS

We want an optimal design for SIGOONS. Therefore, we must guarantee acceptability of SIGOONS and interest in ergonomic concepts (Fig. 1).

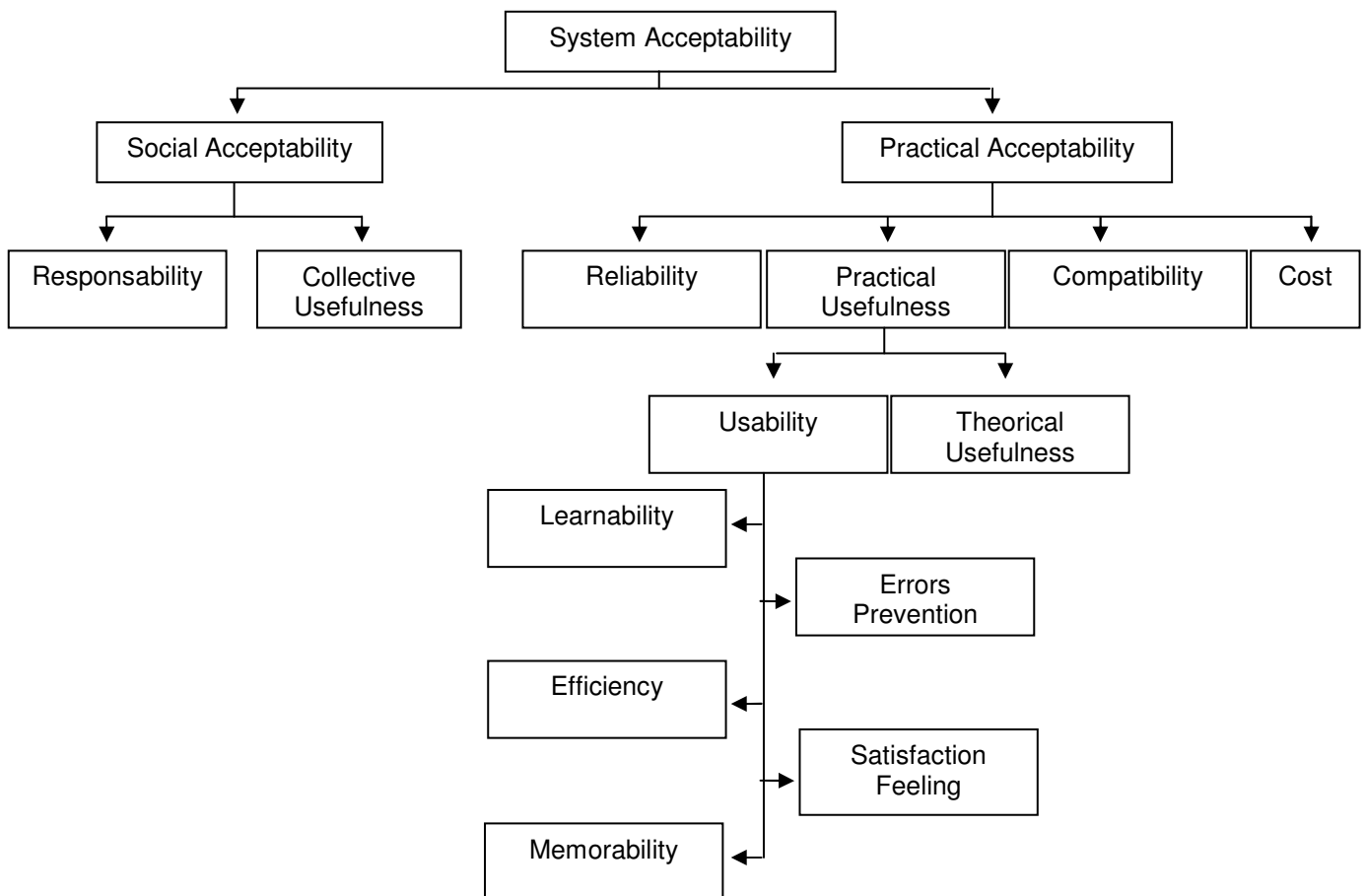


Figure 1: Issues of ergonomic ambitions

On the one hand, we will still study social acceptability and specially forecasters responsibility (ex. : forecaster is responsible for alert bulletins even if he doesn't define it directly, he doesn't write it) and collective usefulness. Interviews will help us to go deeper into these concepts.

On the other hand, we must guarantee practical acceptability of SIGGONS. We are still interested in :

- reliability approached via ergonomic inspection,
- compatibility attained via cooperative evaluation,
- cost for the human (cost global assessment, cost reduction) approached during experimentations in simulated or real situations of work,
- practical usefulness, that is to say theoretical usefulness and usability (Eason, 1984 ; Nielsen, 2003) evaluated via experimentations in simulated or real situations of work.

Concerning usability, we must pay careful attention to :

- errors prevention since within the framework of violent thunderstorms an error might induce a disaster,
- training easiness since violent thunderstorms happen rarely, so forecasters will use rarely SIGOONS,
- efficiency since shift work yields tiredness and critical situation yields overload and stress. Then, SIGOONS does not induce too much forecaster interventions,
- memorization since forecasters yet memorize a lot of information and they are often interrupted,

- satisfaction feeling.

We are interested in all these ergonomic concepts in order to give pertinent recommendations to technical designers and try to design, all together, an acceptable SIGOONS tool that is to say suited to the work situation and also to forecasters features.

6. REFERENCES

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