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Multi-Criteria Decision Aid for Group Facilitator Election:

Application to a Collaborative e-Maintenance Process

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ABSTRACT

Group decision support system (GDSS) can be appropriate if used in e-maintenance decision-related meeting as a medium for them to share, extract and analyze the information, and making decision. In addition, in any GDSS, facilitation process is capital, since a facilitator makes meetings more productive and efficient, by managing the content. However, the election of the expert's group facilitator has been only based on networks quality between the expert and the breakdown site, while, according to case study and maintenance expert interviews, facilitator election consists in identifying and choosing alternatives to find the best solution based on different factors. Therefore, in this article, to formalize the problem of facilitator election using multicriteria decision aid concepts, knowing that the difficult point is the multiplicity of the criteria set for judging the alternatives in the group coordination election problem.

KEYWORDS

CMMS, CSCW, e-Maintenance, GDSS, Leader Election, MCDM

1. INTRODUCTION

Maintenance is a domain widely penetrated by information and communication technologies (ICTs), notably with concepts of remote maintenance and e-maintenance. These new maintenance approaches consist of maintaining a functional unit, ensured by Internet or a direct telecommunication between this unit and a specialized center (Laredj & Bouamrane, 2011). The alarms interpretation during monitoring phase can be divided into three steps. The first step consists of filtering the information, which limits the alarms information load and presents only "interesting" information. The second step is the localization, which characterizes or identifies the detected dysfunction situation. The last step is the diagnosis phase, which proposes the most credible sources of the observed dysfunction.

Many research (Hogan et al., 2003; Campos & Prakash, 2005; Muller et al., 2007) and frameworks (Levrat et al., 2005) (Bangemann et al., 2006) make it possible to improve the speed and the reliability

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of the remote maintenance actions. However, it doesn't exploit (or partially) the cooperation and collaboration between e-Maintenance experts (Jardine et al., 2006). Till today, the developed platforms often insist on computerized maintenance management system (CMMS), or on the communication between the physical sensors through a supervisory control and data acquisition (SCADA). However, the human aspects have been forsaken and were summarized in expert systems, more adapted to a preventive maintenance process than corrective one.

Consequently, to improve the cooperative work in e-maintenance, it is essential to develop a new cooperative e-maintenance system, integrating new tools and new protocols for collaboration and negotiation as in the group decision support system (GDSS) where facilitation process takes a central place. This process has been well studied for several decades, but several questions stay to answer. Among these questions, we can cite the following: What characteristics are required to facilitate e-maintenance meetings according to the proposed cooperation process? Can Collaborative Decision Processes be conducted with no human facilitation at all?

The remainder of this paper aims at answering these questions and it is organized as follows: Section 2 identifies the new challenges of maintenance in industrial world by the introduction of a collaborative decision-making, and displays the state of the art on GDSS concept and the different types of tools used in group decision making. This section also presents the role of the facilitator, which we will call in the whole paper, coordinator, in e-maintenance expert's group and the problematic of coordinator election. Section 3 presents the main contribution of this paper by formulating the problem of coordinator election using multi-criteria decision aid concepts. Finally, Section 4 concludes the paper and presents future work.

2. COLLABORATIVE DECISION MAKING IN E-MAINTENANCE

The collective decision processes are central in e-maintenance process. Thus, it is important to better understand them and improve them, if possible. One common view of group decision processes is that they should offer participants the opportunity to confront and resolve the differences in points of view (Zaraté et al., 2013; Smoliar & Sprague, 2002) discuss how interactions involving several actors are input into decision processes in organizations at achieving a joint understanding among the decision makers. (Zaraté et al., 2013) have demonstrated that the use of ICTs to support decisions within the increasing complexity of organizations implies a modification of decision processes, which become more complex and involve more actors. Consequently, new kinds of decision processes, which could be called Collaborative Decision Making, are thus required (Zaraté et al., 2016). For these Collaborative Decision Processes, the use of GDSS is called for *Kindling, Ideascale, Dialogr, JamespotPro, Expert Choice*, etc. However, these group decision making tools are generally only appropriate for relatively simple problems, in which the consensus does not require many factors (Moulin 1991) and even if the facilitation process takes a central place in a collaborative decision processes, it was not or fairly treated by these tools.

2.1. Coordinator's Role in GDSS

The coordinators contribute to the effectiveness of GDSS, making meetings more productive and efficient, by managing the content, the process, or the use of software. (Bostrom et al., 1993) proposed a solution to the question: "Is a coordinator necessary in GDSS environments?" Other researchers have promoted GDSS as a substitute for a human coordinator, as (Ackerman, 1996), who proposed Strategic Options Development and Analysis (SODA) to group members (participants), using a GDSS for organizational decision making. Indeed, SODA is a methodology to guide participants during meetings. However, (Bostrom et al., 1993) concluded that a human coordinator is definitely required. They find that the important question is "How can facilitation effectively design and support meetings?" We aim to answer this question in the context of e-maintenance group decision and we