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Gaining consensus in a moderated group: A model with a twofold feedback mechanism

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ABSTRACT

The group Analytic Hierarchy Process (AHP) is an effective tool to collect experts' wisdom to evaluate complex decision making problems. Because judgments are always diverse in the real world, it is crucial to adequately support the consensus reaching process. In this paper, we develop a convergent group AHP consensus reaching model with a twofold feedback mechanism, which consists of both a judgment and a weighting feedback mechanism. In each round of this dynamic and interactive model, the most incompatible expert is asked to revise her judgment according to the judgment feedback mechanism. If the expert rejects the suggestion, her weight of importance will be adjusted downward based on the compatibility within the group by the weighting feedback mechanism. The proof of convergence of this consensus reaching model with the twofold mechanism is also provided and discussed. Hence this proposed consensus reaching process supports the leader or client in reaching a successful decision with a dispersed group of experts. The proposed consensus reaching model is applied to the brake pad supplier selection problem of Chery Automobile Co., Ltd. The empirical example demonstrates that the proposed methodology provides an operational decision framework for companies to select suitable suppliers in the supplier involvement under the environment of collaborative product development (SICPD) through its successful application in that context

1. Introduction

The Analytic Hierarchy Process (AHP), a method to deal with complex decisions which involve both tangible and intangible elements (Saaty, 1977), has become one of the most popular decision making tools (Barker & Zabinsky, 2011; Pedrycz & Song, 2011). It has also been extended to group decision making because of its flexibility and robustness (Escobar & Moreno-jiménez, 2007; Ossadnik, Schinke, & Kaspar, 2015; Scala, Rajgopal, Vargas, & Needy, 2015). There are two common ways to use the AHP in a group decision making problem: (1) The experts in the group build the hierarchy collectively. Because the same hierarchy is used by all experts, under this scenario, the pairwise comparison matrices (PCMs) from the individuals also provide diversified but helpful information. (2) The other way is that each individual expert in a group builds his/her own hierarchy (all of which must include the same alternatives). Under this scenario only the final priority vector for his/her ranking is provided to and meaningful to the group. Then in either case the different rankings are combined into a single group ranking. In this paper, we follow the process outlined in the first method explained above.

To make a successful group decision, a certain level of consensus within the group must be achieved (Cabrerizo, Perez, & Herrera-Viedma, 2010; Tapia GarcíA, Del Moral, Martínez, & Herrera-Viedma, 2012). Consensus is commonly referred to as a level of agreement or convergence that is measured by the: distance, compatibility index, or proximity index of the opinions, of all the experts with respect to all the judgments (Palomares, Rodríguez, & Martínez, 2013; Xu, Wu, & Zhang, 2014). However, the opinions in a group are almost always diverse. Thus it is crucial to measure and improve the consensus level in group decisions (Chen, Lee, Yang, & Sheu, 2012; Gong, Forrest, Zhao, & Yang, 2012; Zhang, Dong, & Xu, 2014). The process of improving consensus is usually defined as an interactive negotiation and

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discussion process with several rounds, typically a moderator supervises and leads the consensus process towards success (Dong & Saaty, 2014; Mata, Pérez, Zhou, & Chiclana, 2014; Parreiras, Ekel, & Bernardes, 2012; Xu & Wu, 2011). There is considerable literature on improving group consensus. Herrera, Herrera-Viedma, and Verdegay (1996) defined the degree of consensus and presented a consensus model based on linguistic preference. Considering the cost of negotiation, Ben-Arieh and Easton (2007) presented several consensus models to reach group consensus at a minimum cost. Xu (2009) proposed a convergent consensus method to achieve a group consensus where the preferences are expressed by direct rating. Each of these methods do not allow for the expert to accept or reject the suggested improvements nor do they provide a formal mathematical proof to guarantee consensus.

A challenge that arises when using the group AHP is that experts from different departments or fields may have different and/or even conflicting judgments; this presents the challenge of how to make a successful group decision and guarantee a certain level of consensus. In such a group it is essential there be a presiding leader. In the context of group AHP decision making, Bryson (1996) proposed a framework to measure the group consensus level and then used such information to support the process of consensus building. Dong, Zhang, Hong, and Xu (2010) proposed a consensus reaching model for the group AHP under a row geometric mean prioritization method. The model first defines the consensus indices among the PCMs and then the moderator suggests the expert adjust his/her PCM. Wu and Xu (2012) presented a model to improve both the consistency and the consensus in group AHP, in which the consensus was measured by the compatibility index of two PCMs and the expert would revise his/her PCM according to the suggestion.

The previous studies, which were just discussed, regarding consensus models focused on revising or updating the experts' judgments. However, the weights of the experts which are usually associated with the quality of their judgments were kept fixed in the negotiation and discussion process. This raises a question about how the leader could address and incentivize the mavericks within the group. It is well-known that in democratic group decision making (e.g. a presidential election, congressional vote) it is inadvisable and infeasible to change the weight of an expert simply because his/her opinions are incompatible with those of the other member in the group. However, with a group of experts commissioned to fulfill a specific objective is a feasible approach for the leader to utilize; for example, in the case of the decision about the date of D-Day (Ben-Arieh & Chen, 2006; Shyi-Ming & Bing-Han, 2015). The proposed twofold approach also has similarities to the solution that was proposed during the constitutional convention in the United States of America known as the "Great Compromise." In short, a bicameral legislature was suggested wherein each state (expert) would have different representations (weights) in each assembly, thus ensuring a balance of representation (weights). Even within this type of representation there are examples of impasse like recent government shutdowns in the United States in 1995, 1996, and 2013. Expert decision making during disaster relief efforts has also been criticized under the context that by the time a decision is made by the experts about how to respond it already too late because either lives are already lost, the dangers have since passed, or in other cases unsophisticated citizens made a decision and brought relief to those in danger (Arnold, 2016; Chideya, 2016; Harrald, 2006).

In business decisions, time and expertise are scarce nonrenewable resources. If consensus cannot be achieved within the group someone will need to take responsibility for this potential outcome and give some direction because a decision must still be made. Inaction, or "not deciding," is still a decision and one with tremendous potential consequences. Another possible reaction to the lack of consensus is that a single individual or a smaller subgroup still makes a decision; however, it is very likely that this decision will incorporate either less or even no weight on the information that many of the experts provided.

As the group is formed a moderator should be selected. This individual could be called an executive, coach, team captain, manager, coordinator, judge, mediator, or moderator. The specific title used is tangential to this paper and herein this individual will be referred to as the moderator. The moderator can be elected by the group or appointed by an outside expert. Similar to the title, the specifics of how the moderator is identified will be unique to the specific details of each decision and is not the focus of this paper. Going forward we assume that a moderator has been selected. What if there was a twofold way for the moderator to motivate the group members and to aggregate their valuable input? Such an approach could also help the experts to weigh and prioritize their responses to suggested revisions in a new and meaningful light that is very different from the way they approached the initial decision.

If the moderator had the ability to change the importance of an individual's weight vector in a group, then this can encourage the group members to reach consensus. The advantages are not only because of the mathematical traction that such an approach could provide; but more importantly the group members must now reflect on and prioritize their decision in another way. At the outset, the decision was to prioritize the alternatives and criteria. When revisions are needed to obtain consensus the question for the group member now becomes what is more important: the value from my overall decision/analysis or the value of this particular component where currently there is the least amount of consensus within the group? This question can also alter the negotiation process amongst the group when that option is available to the group. Before discussing this concept further it is worth highlighting from the literature that changing the experts weights in and of itself is not new. Ben-Arieh and Chen (2006) proposed a consensus model for an autocratic decision making problem. In this model, the weights of experts are adjusted according to their contributions towards group consensus and then the judgments are kept fixed. Parreiras, Ekel, Martini, and Palhares (2010) presented a consensus scheme where the moderator can suggest to an expert to update his/her judgment, or can adjust his/her weight by using either a nonlinear optimization model or the moderators' judgment. For the heterogeneous group, Perez, Cabrerizo, Alonso, and Herrera-Viedma (2014) proposed a heterogeneity guided consensus reaching model, in which the recommendations to the experts are generated according to their importance or level of knowledge.

The consensus model presented in this paper provides a twofold feedback mechanism for each expert: the opinion feedback mechanism and the weight feedback mechanism. The opinion feedback mechanism provides feedback and a suggested update for the expert. The weight feedback mechanism is straightforward and easy to execute in each round and updates the weights of the experts in each round. In this twofold approach with the ability to change either or both the opinion and the weight feedback mechanisms has additional advantages over methods that only use one or the other. First, it is important to emphasize that an expert is able retain his/her own judgment in the model. The expert may also fully or partially update his/her judgment based on the judgment feedback suggestion. In either case his/her weight can also be adjusted according to his/her choice in the negotiation process. On the one hand, the judgment feedback mechanism can show the incompatible experts the right direction of improvement to improve consensus and help them update their judgment. On the other hand, the weight feedback mechanism will reallocate the weight of importance in a group when the incompatible expert rejects to revise his/her judgment.