**Systematic Review: “Large-Scale Group Decision Making” by García-Zamora, Labella, Ding, Rodríguez and Martínez Essay**

The comprehensive review “Large-Scale Group Decision Making: A Systematic Review and a Critical Analysis” by García-Zamora, Labella, Ding, Rodríguez and Martínez (2022) is, without a doubt, one of the largest and most detailed efforts to evaluate the state of art of large-scale group decision making (LSGDM) from its historical origins to the current state of research and major theoretical, methodological and technological challenges. The key idea of the paper is that the era of digitisation has ushered a range of novel types of collective decision processes with distributed and large-size participation, beyond the “traditional” small expert groups. In such contexts, it is becoming essential to offer decision support systems, which can harness a fair balance between algorithmic efficiency, human-centricity and fairness, while operating in a complex, online-mediated environment (García-Zamora et al., 2022).

**Scope and Terminology**

Reviewing a set of 241 contributions from the Web of Science database and pruning them down to the final 87, the authors build a coherent mapping of the LSGDM-related work, categorising it under four main perspectives: preference structures, group decision rules, quality evaluation, and real-world case applications. In particular, García-Zamora et al. (2022) highlight that classical group decision making (GDM) models have been traditionally concerned with achieving consensus among a small number of experts (Daniels, 2013). At the same time, current large-scale scenarios, be it e-democracy, crowdsourced innovation, or online co-creation, routinely need to account for thousands, if not millions of participants. At the same time, LSGDM introduces not just “scale” challenges (data, computation), but also “sociology” issues (representation, diversity, participation inequality) that go beyond technical performance.

Furthermore, the paper introduces a main conceptual definition – the m-LSGDM model (Definition 1). This term refers to a broad taxonomy for all GDM models on the scale continuum, indicating a set of key parameters that stipulate the demonstrated capacity for solving problems with m decision makers (DMs). As pointed by the authors, for a system to qualify as a true large-scale model, it is critical to not just presume scalability from a theoretical standpoint, but to also exhibit stable performance for hundreds or thousands of DMs (García-Zamora et al., 2022, p. 959).

**Major Theoretical Conclusions**

The authors draw attention to a terminology gap in the LSGDM literature in the form of the expert vs. stakeholder (decision maker) distinction. The main point is that, while all experts are by definition also stakeholders, the reverse does not hold – a term “expert” is conceptually incorrect if used in a context of thousands of crowd participants in e-democracy or other LSGDM cases. In other words, being an expert and being a stakeholder (decision maker) are two different things, and labelling them in a system interchangeably can potentially lead to more bias (García-Zamora et al., 2022, p. 959).

In a similar fashion, a traditional GDM concept of consensus is not very well-defined, at least in the scale-specific context, with many studies assuming by default that all participants are willing to move closer to the collective preference in some way. García-Zamora et al. (2022) state that this assumption is also unrealistic in large-scale settings because people have different motivations, different levels of trust and commitment to the process, and, as a result, different incentives to achieve convergence. Furthermore, given the high volume and rate of LSGDM processes, the authors hold the position that consensus is no longer a binary indicator, but rather a fuzzy construct that does not require unanimous agreement to facilitate collective action.

**Methodological and Application Problems**

In the following sections, García-Zamora et al. (2022) cover a number of promising consensus building algorithmic frameworks and models that have been proposed in LSGDM literature. These include, for example, uninorm-based aggregation operators for GDM (Quesada, Palomares, & Martínez, 2015), the k-core decomposition for identifying leaders in group decision networks (Gao, Huang, & Xu, 2020), and cluster-based trust graphs for online communities (Du, Luo, Lin, & Yu, 2020). Despite technical novelty, the authors assert that many of the existing models remain only partially satisfactory with respect to two main criteria:

theoretical scalability vs. the empirical reality, and

domain breadth vs. the relative niche focus of most cases.

In other words, what is labelled as a “large-scale” study often involves a sample of 20–100 participants, hardly being representative of the “open” social reality of participatory decision systems. To address this issue, the authors also identify three major challenges of LSGDM that remain to be researched and resolved.

First, most datasets and problems suffer from data incompleteness, heterogeneity and noise, with not all users providing their preferences, either due to lack of knowledge or interest.

Second, a clear consensus definition and appropriate measures of performance, applicable to LSGDM, are still missing, leading to the lack of uniform evaluation criteria.

Third, despite many studies focusing on trust modelling or recommendation, the social aspects of LSGDM, such as fairness, influence, credibility, and emotional trust, have remained insufficiently investigated to date.

In this respect, the critical analysis provided by the authors can be interpreted as indicating that future development of LSGDM is less likely to be determined by efforts to improve algorithmic consensus modelling per se, but more by a paradigm shift toward social computing, trust engineering, and human-in-the-loop design. With this in mind, the next-generation of LSGDM systems will be predominantly hybrid ones, requiring some sort of human oversight and qualitative fine-tuning and enrichment.

**Relation to TripRace**

The key findings of García-Zamora et al. (2022) have the potential to affect the conceptual and ethical grounding of TripRace, our social mobile prototype for fair and collaborative travel group coordination. First, just as the reviewed paper speaks about fairness and transparency in large-scale systems, we can make sure that our app for group voting is providing it as well. By gamifying the process of group decision through the race mechanism, and making every single move of each participant visible and equally weighted, TripRace can operationalise fairness as a tangible and dynamic process.

Second, García-Zamora et al. (2022) also talk about the importance of visibility and inclusiveness of such digital environments. This can be directly implemented in TripRace design by, for instance, considering those voters who are less vocal and more likely to yield to others, and making sure they also receive their share of power to influence the final outcome. This allows us to show that, like a large-scale group decision in principle, a trip planning coordination in real life needs the same degree of attention to participant equity.

Third, some of the references from García-Zamora et al. (2022) discuss, in more detail, the issues of trust and even non-cooperative behaviour (Du, Yu, & Xu, 2020; Zhang et al., 2021). For the TripRace app, this translates into a simple and intuitive mechanism for lessening social friction when managing multiple partners in travel coordination. Wherever algorithmic LSGDM systems are vulnerable to the behavioural unpredictability, TripRace can rely on the real-time human interaction and perception as a proven medium for creating shared awareness and accountability.

**Conclusion**

In conclusion, it can be stated that García-Zamora et al. (2022) produced a work of decisive influence in the rapidly advancing LSGDM field. In providing a clear and informative synthesis of its technical progress and social gaps, and in suggesting, albeit implicitly, a number of possible trajectories to fill the latter, the paper has both driven and will continue to drive the scholarly community forward. The more we recognise the need for transparent, scalable, fair and trust-enhancing LSGDM, the more we can guarantee that the future will be filled with systems of this type, be it academic or commercial. In many ways, these guidelines also apply to TripRace, whose user-centric core vision can expand, as already discussed in the TripRace Body Concept 4 paper, on the theoretical resources of social computing research, including the abovementioned LSGDM. In particular, by reconceptualising group consensus as an emotional, even playful process that can be more or less inclusive, experiential, or fair, TripRace becomes an extension, a human-scale materialisation of the LSGDM vision, beyond a simple, discrete decision system.

**Reference**

García-Zamora, D., Labella, Á., Ding, W., Rodríguez, R. M., & Martínez, L. (2022). Large-Scale Group Decision Making: A Systematic Review and a Critical Analysis. *IEEE/CAA Journal of Automatica Sinica, 9 (6),* 949–966. <https://doi.org/10.1109/JAS.2022.105617>