Forum

Obstacles and Avenues to Promoting the Use of Multi Criteria Decision Aiding

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Introduction

In a 2009 address at Université Paris-Dauphine, Philippe Vincke said that preference aggregation is part of any human activity involving decision making [5]. This stresses how important is Multi Criteria Decision Aiding (MCDA), as human activities are now widely acknowledged to have a significant impact one the Earth climate [8]. The Kyoto Protocol, signed and ratified by 187 states aims at achieving the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would minimize dangerous anthropogenic interference with the climate system" [10]. This common objective turns out to be formulated in a way that sounds familiar to decision aiding and operational researchers, as the problem is to make appropriate decisions at different stages and in different places so as to meet economical performances while satisfying constraints due to climate protection. In a more modest scale yet, companies face challenges of the same decisional nature as bad decisions can make the difference between success and bankruptcy. In such a context, it is very surprising to observe that multiple criteria decision making aiding specialists still have relatively few interactions with industrialists and international institutions. This paper hypothesizes some of the reasons for such a situation based on industrial project collaborations in France, and suggests some ideas for promoting MCDA beyond research centers and universities.

Knowing about MCDA

At first sight, it could be thought that the main reason for which MCDA experts are not more involved in industrial projects is probably because industrialists are simply not aware of the existence of scientific approaches to decision aid. This is undeniably true, but is far from being the only reason. As a matter of fact, even when industrial practitioners are informed that advanced approaches are available for addressing some of the problem they face daily, they generally do not use them. This is not only true for decision aiding: many researcher working in the field of scheduling can see while visiting companies that planning and scheduling are most of the time managed by employees relying on their experience, using Microsoft Excel or Microsoft Project, with no particular knowledge of theoretical approaches. When asked about not using more advanced techniques, managers often reply that they view scientific scheduling techniques as a matter of experts, or something that would require a long training and a costly investment. Even when qualified personnel is available, these techniques are generally not being used whereas a worthy benefit could be taken from them.

Decision making as a personal prerogative

Unlike scheduling, which is a well-circumscribed activity sometimes regarded as mostly technical-focused, decision making is more often connected to long term strategic aspect of the company management. Not only executive decision makers rarely express the need for any assistance, but they are also reluctant to share sensitive information on the strategy of their company with researchers, who are willing to publish their work internationally. Moreover, in projects led by scientists, like ANR research projects in France [1], decision makers often have little experience of decision-making in such a context, and they tend to make decisions alone, as they view their decision making role as a personal prerogative endowed by their acknowledged expertise in the project's field.
Consequently, providing decision aiding for managing an industrial activity or a scientific project is not easy first because the need for assistance is rarely expressed, and second because most decision makers whether rightly or wrongly, are not willing to share information or decision making power.

Trust is the key

Provided that the decision maker is willing to be assisted in the decision making process, another, and not least obstacle should be overcome: the nature and meaningfulness of result provided by MCDA techniques. At this point, the analogy with scheduling is no longer straightforward. Indeed, production managers are quite often bound to accept and to use a complex scheduling approach that they do not understand, provided that they can interpret the results and check that the new approach outperforms the one they used to rely on.

However, whereas advanced MCDA techniques provide a deep insight in the risks and consequences of a series of decisions, they return results which requires good mathematics background they usually lack for interpreting them. As the decisions and their consequences deeply commit the decision maker, he will not be likely to give up his common sense or the decision making procedures he is familiar with for an advanced approach that yields results that he does not fully understand. In such a case the process intended to provide assistance is very likely to be perceived as intrusive, and may be regarded with defiance.

The need for a progressive introduction to MCDA

For this reason, coming up with the latest MCDA approaches may be counter-productive, and it might be preferable to focus on what is really intelligible and hence helpful to the decision maker. For instance, robustness approaches based on the min max regret criterion [6] have long been considered to be "over conservative" measures by the scientific community because the numerical value of such a criterion exclusively depends on the worst case scenario, leading to draw the decision maker attention to this single scenario, that may hopefully be very unlikely. However, such results on a robustness problem have the significant advantage of being easy to understand, and to provide a valuable piece of information to the decision maker. Indeed, one should not forget that decision makers that do not use advanced tools or softwares have just no quantitative measurements to the robustness of a solution. Consequently, a first approach that provides global information on the behavior of a solution in the worst case is already something new that the decision maker must get used to integrate in his usual decision making processes. Moreover, providing light and easy-to-use information on robustness also introduces the decision maker to MCDA in a progressive way, letting him understand that decision aiding is a tool that is not intended to replace his skills and expertises nor to remove or hamper his decision making power. As a consequence, when a MCDA expert designs a decision aiding tool or software, he should maybe be paying a particular attention to the decision aiding acceptability aspect of his proposal, as a rather modest assistance is probably the best trade-off between unintelligible results to the decision maker and no decision aiding at all.

Flexibility as a technological-only concern

Robustness is a notion close to flexibility, as evidenced in this book [3]. In the field of decision making, flexibility may sound as an even more appealing feature as it allows for on-line adjustments to fit the context, while robustness has a more static connotation. However there is a quite common misunderstanding about flexibility when this feature is intended to provide opportunities to adjust the solution (which can be a schedule, or more generally any decision to be applied in the future) to the actual context of its execution. Indeed, if flexibility is undeniably useful for facing uncertainty, it remains an unexplored potential if it does not come along with a reflection on how to use it appropriately for facing context changes and disturbances. As an example of misunderstanding, some people think about flexibility as a technological asset only, and neglect or underestimate the on-line decisional aspects attached to this feature, as well as the actual management of this flexibility. Whenever technology allows for fast and cheap reconfiguration (this is typically the case for embedded electronic systems), the available options for overcoming the effects of unexpected events and disturbances appear to be numerous. This often leads to think that the more potential solutions to a problem, the easier it can be addressed, which is unfortunately not true in general as any operational researcher knows. However, most of the efforts devoted to flexibility as a mean to overcome context changes remain chiefly focused on technical aspects, and this trend is drastically accentuated by the fact that in the concurrent engineering method (also known as integrated product development) [7], which is very popular in industry and also in scientific project management, hardware and software are not developed by the same team of designers. Consequently, once flexibility capabilities have been successfully designed and implemented at the hardware level, the problem of facing disturbances is considered to be nearly closed, as it is just a matter of using it appropriately in the control software, while this "appropriate use" is exactly the point of MCDA, and is of course far from being as easy as it looks from the technological experts' point of view. Another drawback originating in the use of concurrent engineering is that technical choices are likely to be put in question all along the design process. This has not only an impact on flexibility, but also on the whole decisional organization of the system. As a slight modification in the constraints of a combinatorial optimization problem is known to have a potentially drastic impact on the solution process for addressing it, the formulation of MCDA problem is also subject to the same "sensitivity" to technological changes or adjustments. This is likely to turn the problem modeling and the implementation of solutions into a very time- and energy-consuming process.

Flexibility as a tool for robustness

There exists another way to developing flexibility for facing unexpected events or fitting to the context on-line. The authors in [2] propose to maximize flexibility for ensuring robustness, by using the ordered group assignment representation. They show that by minimizing the number of groups of permutable operations, the number of different solutions is maximized, providing the decision maker with a large choice of options for overcoming unexpected events. The number of different schedules that can be represented may be huge (up to 4.7×10^{21} in one of the computational experiments they performed), but the actual usefulness of the offered flexibility is not assessed. Flexibility appears to be developed as an end to itself, without connecting it to its practical usefulness for facing disturbances. Indeed, it may happen that the huge number of alternative solutions offered by flexibility is useful for a restricted class of scenarios, and useless in all other situations. The point is that the decision maker has no precise idea of which perturbations or events the flexibility he is provided with protects him from.

Getting into projects

If the need for decision aiding is not explicitly expressed, MCDA researchers may rely on their skills in operations research for getting involved in industrial and scientific projects. Indeed, algorithmics and combinatorial optimization are undoubtedly more popular than MCDA, and skills in operations research can constitute an access point to collaborations as well as an opportunity to convince project members that mathematical-based methods can outperform the algorithms or common sense-based approaches that are considered as references in some technical fields (this has been shown to be particularly true in electronics [4], [9]). Moreover, this indirect approach has also the significant advantage of managing time for introducing decision makers to MCDA, as well as to provide the MCDA specialist with a deeper knowledge of the decisional structure of the system to be designed by the project team. The MCDA researcher is then able to identify interesting decision-aiding issues in the project, and to submit specific and convincing proposals for using his decision-aiding skills, which is preferable to having to respond to a request with no preliminary knowledge on the context.

Managing concurrent engineering

Concurrent engineering may be perceived as a source of nuisance to a MCDA expert working on a project, as it is likely to bring his work back to square one several times. However, a reflection on flexibility and robustness with the project team may mitigate the side-effects of this project leading methodology. Indeed, once the objectives in terms of robustness and flexibility are clearly stated, some technological platform changes or updates may be avoided. Whenever they occur, the two following situations may occur. First, the new platform prevents to meet the flexibility and robustness objectives. This is not very likely to happen, but the argument may be sufficient to reject the platform change, or to negotiate down flexibility and robustness features. Second, the new platform has higher flexibility and robustness capabilities. In that case, the system requirement should stick with its features, and the project team should refrain from investing time and energy for taking advantage of the system update as it would just lead to "over"-quality. If technology (and hence flexibility) is agreed not to be an end to itself, then it becomes clear that the pursuit of the optimal exploitation of the system technological characteristics may generate additional development costs and delays when technical updates are as frequent as in concurrent engineering.

Conclusion

The obstacles to the use of MCDA in the industry and even in scientific projects are numerous, and should not be underestimated. They mostly originate in the ignorance of MCDA in most of those who would take benefit from it, as well as in the fear of losing decision making power, especially when the results of MCDA are not intelligible to their potential users. All these reasons stress the need for an introduction to MCDA, that requires time and efforts for adapting the decision aiding to what the decision maker is willing to accept. Thus, it should be useful to refrain from using the most advanced MCDA techniques, at least in the first place. The misuse of flexibility, that may be the result of an excessively technological-oriented vision may also be avoided as it is likely to lead MCDA researchers to the pursuit of the unnecessary exploitation of all technical features at the expense of deadline meeting. But finally, the fact that the use of MCDA requires time can also be seen as an advantage, as it provides the opportunity to gather information on the decisional aspects of the project, and to submit relevant proposals to project leaders, which can only increase the probability of MCDA acceptance.

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