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From ambiguity to action: integrating collective sensemaking and rational decision making in management pedagogy and practice

Journal:	*Management Decision*
Manuscript ID	MD-06-2021-0804.R4
Manuscript Type:	Original Article
Keywords:	Decision making, Uncertainty, Management education, Sensemaking, Ambiguous problems

ABSTRACT:

Managers are increasingly presented with complex, ambiguous decision problems that affect multiple stakeholder groups. Such problems cannot be tackled solely by classical approaches that prescribe rational methods to weigh evidence and select an optimal course of action. Yet most courses on decision making still focus on these methods. This paper draws attention to the complementary nature of rational decision making and sensemaking techniques in management decision making, and describes a practical pedagogy that demonstrates how the two can be integrated into management curricula.

Based on an in-depth review of relevant research, the authors propose a conceptual model that highlights the complementary nature of rational and sensemaking methods for making decisions relating to complex and ambiguous problems. They then describe a course on decision making as an illustration of how the model can inform decision making pedagogy.

Decision makers need to think of their decision problems in terms of two distinct types of uncertainty: those for which uncertainty can be quantified and those for which it cannot. When faced with the latter, decisions are best made by working with relevant stakeholders to collectively frame the problem using practical sensemaking tools prior to applying rational decision making techniques to address it. Decision making under ambiguity is an iterative, social process requiring a combination of rational decision making methods and sensemaking techniques.

CUST_RESEARCH_LIMITATIONS/IMPLICATIONS__(LIMIT_100_WORDS) :No data available.

The paper seeks to increase awareness about the complementary nature of sensemaking and rational decision making. It emphasizes the need to integrate the two in management curricula, and provides details on how this can be done via an example of a course implemented at an Australian Business School. The techniques described will also be of interest to practitioners.

CUST_SOCIAL_IMPLICATIONS_(LIMIT_100_WORDS) :No data available.

The paper describes a practical pedagogy that blends rational decision making and collective sensemaking techniques in a way that fosters managersâ€™ decision making skills in contexts characterized by ambiguity.

From ambiguity to action: integrating collective sensemaking and rational decision making in management pedagogy and practice

Abstract

Purpose – Managers are increasingly presented with complex, ambiguous decision problems that affect multiple stakeholder groups. Such problems cannot be tackled solely by classical approaches that prescribe rational methods to weigh evidence and select an optimal course of action. Yet most courses on decision making still focus on these methods. This paper draws attention to the complementary nature of rational decision making and sensemaking techniques in management decision making, and describes a practical pedagogy that demonstrates how the two can be integrated into management curricula.

Design/methodology/approach – Based on an in-depth review of relevant research, the authors propose a conceptual model that highlights the complementary nature of rational and sensemaking methods for making decisions relating to complex and ambiguous problems. They then describe a course on decision making as an illustration of how the model can inform decision making pedagogy.

Findings – Decision makers need to think of their decision problems in terms of two distinct types of uncertainty: those for which uncertainty can be quantified and those for which it cannot. When faced with the latter, decisions are best made by working with relevant stakeholders to collectively frame the problem using practical sensemaking tools prior to applying rational decision making techniques to address it. Decision making under ambiguity is an iterative, social process requiring a combination of rational decision making methods and sensemaking techniques.

Practical implications – The paper seeks to increase awareness about the complementary nature of sensemaking and rational decision making. It emphasizes the need to integrate the

two in management curricula, and provides details on how this can be done via an example of a course implemented at an Australian Business School. The techniques described will also be of interest to practitioners.

Originality/value – The paper describes a practical pedagogy that blends rational decision making and collective sensemaking techniques in a way that fosters managers' decision making skills in contexts characterized by ambiguity.

Key words: decision making, ambiguous problems, sensemaking, uncertainty, management education

Introduction

Decision making is a core managerial skill (e.g., Bratianu *et al*., 2021; Mintzberg, 1989) and might be the most crucial part of a manager's role (Elmuti, 2004). As such, it is an important element of executive and management education (Ickis *et al*., 2014; Elmuti, 2004). The predominant approach to teaching decision making is based on rational techniques that assume decision options can be specified upfront (Sadler-Smith and Shefy, 2004; Simon, 1997). These options are then assessed against criteria such as cost, time, etc. (e.g., Triantaphyllou, 2000).

Concerns have been expressed about the limitations of rational approaches when decisions are made in highly complex and ambiguous environments (Elmuti, 2004; Pfeffer and Fong, 2002). Academics and practitioners have recognized the importance of distinguishing between complex and simple decision problems, referring to these as wicked/tame (Rittel and Webber, 1973), non-programmed/programmed (Cyert *et al*., 1956), mess/problem (Ackoff, 1981), ill-structured/structured (Orasanu and Connolly, 1993), complex/complicated (Snowden and Boone, 2007), while pointing out the need for a more nuanced approach to

addressing these different types of problems (Vroom, 2003; Klein 2008). Rational decision making techniques cannot be applied to complex problems for the following reasons: a) the options available may not be obvious upfront; b) in cases where options are known, they might be difficult to rate or quantify meaningfully; c) even if options can be rated, the ratings themselves may be highly subjective; and d) possibly most importantly, the problem may be complex and multifaceted to the extent that different stakeholder groups have different opinions about what exactly the problem is and how it should be tackled (van Gelder, 2010; Franke, 2011).

The limitation of rational decision making methods is also related to Simon's notion of individuals as boundedly rational cognitive agents (Simon, 1997). Bounded rationality means that "[human] abilities to comprehend and compute in the face of complexity and uncertainty" are limited (Simon, 1979, p. 501). Approaches to decision making should take into account bounded rationality and how decisions are actually made in organizations (March 1991). Since Simon, many more researchers have called for the development of practical methods to tackle complex decision problems (e.g., Klein, 2008; Klein *et al*., 2003). Addressing complex problems requires decision makers to take into account the context of the problem and frame it in light of the level of uncertainty (e.g., Schrader *et al*., 1993) by seeking and synthesizing diverse perspectives on the problem (e.g., Mintzberg *et al*., 1976).

One approach to decision making that focuses on how decisions are made in specific contexts is naturalistic decision making (see, e.g., Klein *et al*., 1993; Banning, 2008; Wu and Barnes, 2011). It recognizes that many decisions are made by rapid, quasi-intuitive processes (Smith, 2003). A popular pedagogical approach to develop these tacit decision making skills is to use simulations to build managers' experience in dealing with specific decision contexts (e.g., Means *et al*., 1993). However, while simulations are a useful pedagogical tool, their

applicability is limited to problems that are similar to the ones being simulated. They do not help managers learn the skills required to address novel, ambiguous problems (Smith, 2003).

Another approach that has gained prominence in explaining how decision makers frame complex problems is sensemaking (Weick, 1995; Weick *et al*., 2005). As noted by Cristofaro (2020), sensemaking is about interpreting a complex scenario via a process of bracketing the problem space in terms that can be understood, and then categorizing the elements of the situation in a manner that enables the framing of a decision problem. In other words, it is about defining the problem and an acceptable set of options. Thus, decision making and sensemaking are complementary (Cristofaro, 2020; Rudolph *et al*., 2009).

Researchers have discussed how case study-based approaches can be used to develop managers' sensemaking skills (Ickis *et al*., 2014; Franke, 2011). However, this research does not address how managers can be trained to combine rational decision making methods with sensemaking. This is a significant gap, as they are both required when tackling complex problems (e.g., Cristofaro, 2020; Rudolph *et al*., 2009). Furthermore, the primary focus of these case-based approaches is on cultivating individual rather than collective sensemaking skills. The latter are critical in addressing complex problems involving diverse stakeholder groups (e.g., Cristofaro 2021; Ancona, 2012).

Based on the above gaps in existing research, we ask: a) How can collective sensemaking be incorporated into management curricula? And, b) how can it be combined with existing rational methods to decision making?

Drawing attention to the need for managers to integrate the two in the broader process of decision framing and decision making, we propose a model that highlights the complementary nature of rational decision making methods and collective sensemaking techniques. Based on the model, we contribute a practical pedagogy that blends rational

decision making and collective sensemaking techniques in a way that fosters managers' decision making skills in contexts characterized by ambiguity.

Literature review

Strategic decisions and sensemaking

Strategic decision making is at the core of any managerial work (Bratianu *et al*. 2021; Elmuti, 2004; Mintzberg, 1989). It includes fundamental decisions which impact organizational health and survival (Eisenhardt and Zbaracki, 1992).

It has long been recognized that the prevailing conceptualization of strategic decision making in the literature is that of cognitive evaluation and rational choices. In an influential paper on decision processes, Mintzberg *et al*. (1976) note that existing research on strategic decision making has focused largely on decisions where managers make choices between known alternatives. This is typically conceptualized as a three-stage process of *defining* options, *evaluating* them and *selecting* an option based on the evaluation (e.g., Fellows, 2004). In Western culture, such cognitive evaluation has taken on a normative character (Ericson, 2010). Yet, researchers have stressed that in practice rational decision making is far less prevalent (Simon, 1997; March, 1991; Klein 2008; Tsoukas 2016). In particular, the multitude of perspectives and the associated uncertainty significantly impact how managers make decisions (Mintzberg *et al*., 1976; Langley *et al*., 1995).

One approach that an increasing number of scholars have identified as being useful for elucidating multiple factors impacting complex decisions is sensemaking (e.g., Weick *et al*., 2005; Elbanna *et al*., 2020; Cristofaro, 2020). Sensemaking includes the generation of, "a plausible and workable interpretation for reaching an understanding of and adhere meaning to turbulent occurrences" (Ericson, 2010, p. 133), thus entailing an articulation of the unknown. It is, therefore, especially relevant in the context of complex, adaptive problems (e.g., Ancona, 2012; Bajwa *et al*., 2020) such as strategic decisions.

The process of sensemaking is triggered by a sense of discrepancy between actual and expected events, and involves collecting, selecting and retaining "cues and/or the mental models applied for enacting the situations and building meaning through schemata" (Cristofaro, 2021, p. 3). The perceived discrepancy, if taken seriously (and with due regard to context), can lead to positive outcomes. For example, Spinosa *et al*. (1995) frame entrepreneurial thinking as a response to perceived anomalies that need to be resolved (see also Maitlis and Christianson, 2014). The recognition of anomalies also forms the basis of naturalistic decision making proposed by Klein and colleagues (Klein and Klinger, 1991; Klein *et al.*, 1993), which focuses on how individuals cognitively evaluate complex situations based on their prior experience and generate the most suitable plan of action.

Collective sensemaking

A key characteristic of sensemaking is its explicit focus on the socially constructed and collaborative nature of problem framing. As Cristofaro (2021) stresses, sensemaking is driven by individuals' identity and action but is also socially constructed as individuals' identity and mental models are influenced by their interactions with other people. This influence is channeled through processes such as emotional and cognitive contagion (Cristofaro, 2020, 2021) as well as through relationships of power and authority that are embedded in organizational contexts (see also Schildt *et al*., 2020).

The socially constructed nature of sensemaking has been emphasized by a range of researchers (e.g., Hultin and Mähring, 2017; Cristofaro, 2020). Sensemaking is seen as a collective endeavor in which the efficacy of ideas, plans or strategy are determined largely by how well others in the organization buy into them (see also Ancona, 2012).[1] This leads to the notion of collective or collaborative sensemaking: "organization members interpret their

[1] In this way, sensemaking is similar to entrepreneurial learning by doing. As Hoyte *et al*. (2019) stress, sensemaking exchanges enable entrepreneurs to 'test' their thoughts and ideas with others and iterate these constantly, which is extremely useful in developing the venture idea.

environment in and through interactions with each other, constructing accounts that allow them to comprehend the world and act collectively" (Maitlis, 2005, p. 21). Thus, making sense of strategic situations includes developing a "cognitive understanding prior to action with the social aspect of sense-making considered particularly important for facilitating change through collective and consistent action" (Ericson, 2010, p. 136).

The primary task of collective sensemaking is to help a group of diverse stakeholders get to a shared understanding of the situation (Maitlis and Sonenshein, 2010; Calton and Payne, 2003; Gioia and Thomas, 1996). This is challenging because there can be significant differences in worldviews of participants and hence a range of views on the problem. Indeed, individuals will perceive a situation (bracket and decompose it) in unique ways and come to their own conclusions about how to proceed based on their own experiences and perceptions of risk or opportunity (Cristofaro, 2020). Developing a shared understanding entails a negotiation between these multiple, possibly conflicting perceptions. Open dialogue in which stakeholders can freely debate aspects of the situation is an effective way to achieve such shared understanding (Conklin, 2006). If done right, this can influence stakeholders to change their perceptions of the situation, and thence their affective states relating to it (Cristofaro, 2020).

There are two aspects to collective sensemaking via dialogue. The first is to make the reasoning of participants explicit. This can be done using a variety of argument visualization and knowledge cartography tools (Okada *et al*., 2008, Kirschner *et al*., 2013). Examples include Argument Mapping (van Gelder, 2003), Issue-Based Information System (Kunz and Rittel, 1970; Culmsee and Awati, 2013), Questions, Options Criteria (MacLean *et al*., 1991) and Decision Representation Language (Lee and Lai, 1991). These tools help clarify complex situations by providing: a) visual representations of various stakeholder viewpoints and the

relationships between them (e.g., van Gelder, 2003), and b) a means to deliberate these viewpoints in an objective manner (e.g., Awati, 2011).

The second is to put in place the conditions for open dialogue to occur. These conditions are articulated in Habermas' theory of communicative rationality (Flyvbjerg, 1998, Culmsee and Awati, 2013). Culmsee and Awati (2012, 2016) argue that it is sometimes possible to create a "holding environment" within which open dialogue can take place [the term "holding environment" is borrowed from the work of the psychologist Donald Winnicott (1960)]. They demonstrate this through a range of case studies that illustrate how sensemaking tools and facilitated dialogue can help in building shared understanding of strategic issues in contexts ranging from public policy implementation (Culmsee and Awati, 2012) to global projects in multinational organizations (Awati, 2011).

A key factor that makes it challenging to create a holding environment are power relations and power structures in organizations. As Weick (1995, p. 135) points out, "collective sensemaking represents an arena for argumentation and therefore also an arena for political influence". Schildt *et al*. (2020) emphasize that studies of sensemaking need to take both episodic and systemic forms of power into account as they influence sensemaking in different ways. We will say more about this in the discussion section.

Sensemaking, uncertainty and ambiguity

In the management literature sensemaking is often presented either as something managers do informally or intuitively (Sonenshein, 2007, Locander *et al*., 2020), or as a mediated or facilitated process that can help a group to better understand a problem situation (Strike and Rerup, 2016; Gray *et al*., 2010). It is rarely acknowledged as a legitimate aid to decision making, on par with analytical methods. We contend this is largely because the connection between sensemaking and decision making processes is not clarified. As Cristofaro points out (2020, p. 344), there have been only a few attempts to link sensemaking and decision making

which "leaves academics and practitioners unaware of what the mechanisms are that connect the two and how to improve decisions by considering their entire progress".

We propose that to make the connection between sensemaking and decision making clear, we need to start by considering the different types of problems decision makers face. To do so, we start with the tame/wicked problem distinction (Rittel and Webber, 1973).

Tame problems are those that can be formulated unambiguously. An example is the estimation of a project. Although estimates may be hard to obtain depending on the project, everyone will agree on what exactly the problem is (it is to get an accurate estimate). Let us assume, perhaps unrealistically, that we have a situation in which historical data is available and the local project management office has developed probability distributions of completion times for the tasks that comprise the project. Given this, it is possible to use an analytical approach, such as Monte Carlo simulation[2], to develop a principled estimate for project completion time (Kwak and Ingall, 2007). By principled we mean that one can quote completion times with associated uncertainties – such as there is a 90% chance of finishing within three weeks. If the distributions are a reasonably accurate reflection of reality, the problem is in principle solvable because the completion times are entailed by the data. The key characteristics of this type of problem are: a) the variables are known (completion times for individual tasks), and b) there is data available to compute the probability distributions for task completion times. The problem has uncertainty associated with it, but it is a quantifiable uncertainty.

On the other hand, there are ambiguous or complex problems which are characterized by unquantifiable uncertainties. Following Rittel and Webber (1973), we refer to these as wicked problems (see Table 1). An example of a wicked problem is the formulation and

[2] Monte Carlo simulation is a general analytical technique that can be applied to any decision problem that can be broken down into components for which it is possible to derive or estimate probability distributions. We further discuss how it works in Table 2.

implementation of a business strategy (Camillus, 2008). Depending on who is at the table, views on the focus areas of the company strategy can vary considerably. Hence, Rittel and Webber (1973) highlight the importance of shared understanding as a precursor to tackling wicked problems.

Insert Table 1 About Here

In contrast to the problem of estimating a project where the key variables in question (cost and time) are known upfront, in strategy formulation the variables are unknown. Indeed, the key variables in the latter depend on the perspectives of the stakeholders and one needs to make these explicit prior to formulating the strategy. Although there will likely be a lot of data available to assist the strategy team – the current financial situation of the organization, the market outlook, the wider economy, etc. – the data will be of limited value until the decision makers collectively agree what to focus on. Unlike the case of project cost/time estimation, data can inform a strategy but cannot entail it. We call such problems ambiguous because the key variables that we wish to optimize are unknown upfront and hence we do not know what data might be relevant. Following Culmsee and Awati (2016), we summarize the above distinctions in Figure 1.

Insert Figure 1 About Here

The two problems discussed in the foregoing paragraphs are idealizations. Most real-life decision problems have a mix of uncertain and ambiguous elements – for example, some variables on a project will invariably be harder to quantify than others. Indeed, it is more accurate to view the above as describing an *ambiguity spectrum* along which the relative position of decision problems can be qualitatively plotted, depending on the level of ambiguity (see Figure 2).

Insert Figure 2 About Here

By focusing managers' attention on the unknowns in their decision problem, the ambiguity spectrum helps managers distinguish problems that are directly amenable to rational methods from those that might benefit from sensemaking prior to quantification. This distinction is key to the proposed conceptual model which we turn to next.

Integrating sensemaking and decision making - a conceptual model and its implications

The initial inspiration for the model we describe came from the first author's experience with facilitating decisions in the context of diverse stakeholder groups (Author, 2011; Another and Author, 2012). He noticed that for such decisions, using sensemaking techniques and rational decision making methods, appropriately sequenced, led to better decisions than using rational methods alone. Indeed, for decisions with high levels of ambiguity, the use of collective sensemaking techniques at the front end of a decision invariably helped him construct a broader understanding of the problem context than would otherwise have been possible, thereby leading to a better (i.e., more inclusive and complete) framing of the decision problem. Turning to the literature, he noted that many researchers had commented on this constructionist aspect of organizational decision-making, emphasizing the need to (socially) construct an understanding of a messy problem on which there are diverse perspectives (e.g., Gosling and Mintzberg, 2004; Etzioni, 2001; Langley *et al*., 1995).

These works and others along similar lines suggest that sensemaking has a key role in the early stages of the problem formulation and, as such, complements rational decision making (Sadler-Smith and Shefy, 2004; Cristofaro, 2020). The conceptual model we propose below highlights the complementary nature of the two and provides a basis for the pedagogy that follows. The model emphasizes the complementarity of rational decision making and sensemaking by stressing that strategic matters are always contingent, so decisions associated

with them are necessarily iterative, requiring decision makers to go back and forth between sensemaking and rational methods (see also Rudolph *et al*., 2009; Bratianu *et al*., 2021; Wright, 2005).

The starting point for our model is the ambiguity spectrum shown in Figures 1 and 2, which helps decision makers think of their decision problem in terms of ambiguity. Is the problem technically complicated, yet the goal clear and relatively unambiguous? If so, it is a tame problem that lies towards the left of the figure. For such cases, the decision options are known upfront, and the problem can be tackled using rational decision making methods such as multi-criteria weighting techniques, analytic hierarchy process or Monte Carlo methods.

If the problem is on the right side of the spectrum, however, some key aspects of the issue will not be immediately apparent. Applying the tools of rational decision making without attempting to synthesize diverse perspectives is likely to lead to suboptimal outcomes. In such cases, one is generally better off using sensemaking techniques to collectively frame the problem prior to using rational decision making methods. The sensemaking phase has the effect of clarifying issues and options, thereby helping the group reach a shared understanding of the problem. Once this is done, the problem becomes amenable to rational methods. This process, which is illustrative of the complementary roles rational decision making and sensemaking play in complex decision making, is summarized in the conceptual model shown in Figure 3.

Insert Figure 3 About Here

The double-headed arrow linking rational decision making to sensemaking emphasizes the contingent and iterative nature of strategic decisions making: strategies and plans must evolve as the decision context evolves. When conditions change, the decision maker may have to go back to the sensemaking phase to gain a shared understanding of the changes prior to using

rational methods to decide on a course of action (see also Rudolph *et al*., 2009). As Sadler-Smith and Shefy (2004, p. 88) stress, "[a]llowing one's thinking to iterate between [sensemaking] and rational analysis may allow each mode to reinforce the other until an optimal judgment can be made".

Culmsee and Awati (2012) present a detailed case study that is illustrative of this model. The decision problem was about the development of a precinct in a suburban area in Australia. Because of the diversity of stakeholders involved (residents, developers and local government), a collective sensemaking technique (Issue Mapping) was first used to surface multiple perspectives. This helped the group come to a shared understanding of the options, thereby reducing ambiguity. The collective sensemaking session was then followed by an analysis of the surfaced options using pairwise comparison. The latter step was uncontroversial because the options had already been thoroughly canvassed in the sensemaking phase.

The example highlights the key distinction between rational decision making and sensemaking: the former assumes the problem is well-defined and a decision can be made based on objective facts whereas the latter assumes that the decision problem must be framed, or *constructed* on the basis of different stakeholder perspectives. The examples and the conceptual model discussed above highlight the fact that this dichotomy is nuanced (see also Sadler-Smith and Shefy, 2004; Rudolph *et al*., 2009), at least in the context of complex decisions. On the one hand, there are facts which all stakeholders accept; on the other, there are a range of opinions, some of which may conflict with each other. The viability of a decision in such a situation hinges on the ability of the decision maker to: a) help stakeholders distinguish facts from opinions, b) take necessary sensemaking actions to find common ground between holders of conflicting opinions, and c) build a base of shared understanding from which a commonly agreed set of "facts" emerge. These "facts" will not

be absolute truths but contingent ones. This is often true even of so-called facts used in rational decision making: a cost quotation does not point to a true cost, rather it is an estimate that depends critically on the assumptions made in its calculation. Such decisions therefore cannot be made on facts alone but ought to be co-constructed with those affected by the decision (see also Vroom, 2003).

Next, we outline a pedagogical approach we designed based on the key elements of the conceptual model to illustrate how it can inform courses on decision making.

Pedagogical approach: an illustrative case

The proposed pedagogy is problem-based and structured in a way that encourages inquiry and reflection on the nature of decision problems (Hmelo-Silver *et al*., 2007). This is a specific instance of problem-based learning, a form of social inquiry which uses real-world problems that reflect the complexity and ambiguity that managers face and encourages them to reflect on their practices (Smith, 2003).

Based on the outlined conceptual model, we designed and delivered a course on Decision Making Under Uncertainty (DMUU) as part of an Executive MBA at our Business School. Over the last three years, the course has been delivered to mid-level managers from a variety of professional backgrounds including large international consulting firms, multinationals and government. About hundred students have taken the course so far. We use the course as an illustration of how the conceptual model outlined above can inform decision making pedagogy (see Houston, 2008 for an example of using an illustrative case).

The course is delivered in three face-to-face block sessions complemented by a range of learning materials and resources provided via the university's learning management system (see Table 2 for a step-by-step outline of the course including the two course assignments).

Insert Table 2 About Here

Most managers are well-schooled in rational decision making techniques. Our pedagogical approach is therefore aimed at helping managers appreciate the usefulness of developing practical sensemaking skills and give them a feel for how they might use these in ambiguous decision contexts. We also demonstrate how educators can combine rational and sensemaking techniques when teaching decision making. We do this by starting with decision problems that can be tackled by analytical methods and gradually increasing ambiguity to the point where rational methods have to be complemented by sensemaking techniques.

Our intent is not to turn students into expert sensemakers; that is not possible in the time available. Instead, it is to help them develop a couple of key sensemaking skills that complement rational decision making methods. The first is the ability to draw out and summarize the key issues around a complex decision problem, especially the different and possibly conflicting viewpoints that stakeholders hold on how the problem should be addressed. The second is to develop a proclivity for looking for points of agreement, however small, from which common ground can be built. By participating in this process, decision makers can start to develop decision options and criteria that are informed by diverse perspectives. The final decision will invariably be a compromise from the perspective of any given party, but the inherent fairness of the process reduces conflict and thus paves the way towards a decision (see Awati, 2011 for a detailed case study).

Our experience in the classroom suggests that this structure, which starts with rational methods that are familiar to students and gradually introduces problems of increasing ambiguity, helps students appreciate that sensemaking is a critical skill that is *complementary* to rational decision making. Indeed, they start to see that the two are essential aspects of decision making that work in tandem, often iteratively, as in the model described in Figure 3 (see also Sadler-Smith and Shefy, 2004).

Although we do not have data to judge the efficacy of the outlined pedagogy, we can get a sense of its effectiveness by analyzing the feedback received from students who have taken the course. After the course is completed, students are invited to provide feedback via a survey administered by our university which asks seven course-related questions and one teacher-related question. It also asks students to provide additional reflections on their experiences including what elements of the course they found most or least helpful. The students' reactions to the course design could be seen as a proxy indicator of the practical relevance of the proposed pedagogy.

Two survey questions are relevant to the effectiveness of the pedagogy as they focus on the relevance of the course for practice (see Table 3). The average score across two years demonstrates that students largely found the course relevant for their professional practice.

Insert Table 3 About Here

Some of the comments received from students over the two years, 2019 and 2020, on the practical relevance of the course are provided in Table 4. These comments demonstrate that students appreciated the practical relevance of the tools and techniques covered in the course (e.g., Monte Carlo simulations, IBIS mapping). They also noted an increased confidence in their ability to address complex problems.

Insert Table 4 About Here

The course we describe illustrates one possible way to integrate rational decision making methods and practical sensemaking techniques in order to better prepare managers to make decisions in a range of contexts. We do not claim to provide a formula to be followed (see also Houston, 2008). Nevertheless, the feedback suggests that the conceptual model underlying our pedagogy provides a possible foundation for those interested in designing courses that integrate sensemaking with rational decision making.

Discussion

We have proposed a novel conceptual model that brings together rational and collective sensemaking methods for making decisions and illustrated its relevance by discussing a pedagogical approach that can inform courses on decision making.

Researchers have emphasized that in contexts characterized by different degrees of ambiguity, decision makers need to combine rational decision making and sensemaking (Sadler-Smith and Shefy, 2004; Cristofaro, 2020). There is a need to go back and forth between sensemaking and rational methods in order to adapt to changing circumstances and information (Rudolph *et al*., 2009; Bratianu *et al*., 2021; Wright, 2005). The pedagogical approach proposed here offers one example of how managers can be trained to do this.

There are three novel pedagogical aspects of our course, each of which highlights the relevance of the conceptual model described earlier. First, we demonstrate that sensemaking and rational decision making techniques are complementary in that decision makers often need to use both when making complex decisions (see also Bratianu *et al*., 2021; Sadler-Smith and Shefy, 2004): sensemaking to frame the problem and clarify options; rational-analytical methods to choose between options (see Chapter 11 of Culmsee and Awati, 2013 for examples). Second, we discuss how the two are distinct ways of resolving qualitatively different kinds of uncertainty. As noted earlier, strategic decisions are ambiguous and therefore require both sensemaking and rational decision making for an optimal resolution. Third, a unique feature of our course is that it focuses on building practical sensemaking skills and dispositions through knowledge mapping and argument visualization tools that can help build decision context collectively, particularly for complex issues. These tools make the practice of sensemaking tangible, thus helping professional managers appreciate its relevance to strategic decision making.

Additionally, the pedagogy sensitizes academics to pay attention to techniques that can create a "holding environment" within which open dialogue between multiple decision makers and stakeholders can take place (see e.g., Culmsee and Awati, 2012, 2016). Calton and Payne (2003, p. 38) note that Habermasian dialogue can help managers "work more effectively and ethically with stakeholders to address the paradoxes of pluralism." While we recognize the importance of power considerations when discussing how collective sensemaking takes place (e.g., Schildt *et al*., 2020), we argue it is still worthwhile to teach managers tools and techniques that help them create a holding environment that stimulates open dialogue, even if only on a small scale (Awati, 2011, Culmsee and Awati, 2013). It has been recognized that such small-scale actions can be a first step towards a more global change in mindset (Singh, 2018). Moreover, managers can use their episodic power to initiate sensemaking in groups of decision makers in order to overcome existing interpretations and open up space for new meanings to emerge. Investigating the impact of power on collective sensemaking and how it can be simulated in the classroom remains a fruitful avenue for future research.

The proposed pedagogical approach also has implications for practice. It emphasizes that managers need to approach complex decision making in a manner that encourages open dialogue between decision makers and stakeholders which, in turn, enables inclusive and ethical decision making (Culmsee and Awati, 2013). The approach described also offers academics who teach decision making a concrete example of how one might combine rational decision making with sensemaking in a classroom environment. Additionally, it highlights the value of training in practical tools and techniques that enable collective sensemaking. Managers who aspire to improve their decision making skills need to: a) be trained in both sensemaking and rational decision making techniques, and b) recognize the

need to clarify the nature of the problem they are facing before they select an appropriate decision making technique.

Limitations

Our approach has limitations, the biggest one being that sensemaking skills are best learnt experientially. Consequently, much depends on students' willingness to experiment with these in their workplaces. Related to this is the fact that the data we collected from students in our course is limited to a period of time during which students completed the course. We are therefore not able to conclude whether our students have indeed adopted the proposed tools and techniques past the course completion and/or whether students' learning has a long-term impact on their attitudes, behavior and practice. That said, a few do come back to us with examples of how they have used the techniques in their workplaces. Conducting longitudinal research studies with students who completed this or similar courses will provide valuable insights into the interplay between this pedagogy and competing discourses, goals, and identities in practice (Bansal *et al*., 2018).

Conclusion

In addition to learning rational methods to decision making, managers need to be given opportunities to develop sensemaking skills that can help them tackle the increasingly complex and ambiguous contexts and problems they face in their workplaces. Most courses and programs on decision making focus largely on the former while neglecting the latter. While rational methods can undeniably lead to effective decisions in contexts in which cause-effect relationships are clear, they are less suitable for problems characterized by ambiguity. Ambiguous problem contexts call for collective sensemaking in order to develop shared understanding of problems before trying to solve them. We have argued that managers can achieve a more balanced perspective on complex decisions by considering rational decision

making methods and practical sensemaking tools as complementary and mutually reinforcing components of a decision strategy (see also Sadler-Smith and Shefy, 2004). Such an approach can support managers in addressing strategic problems more effectively.

We have proposed a conceptual model that integrates rational decision making methods and sensemaking techniques in a way that highlights their complementarity and described a practical pedagogy that is based on this conceptual model. Our classroom experiences and feedback from students suggest that the pedagogical approach can help managers better understand and cope with ambiguity in their professional work. We therefore offer our work in the spirit of an "existence proof" that management academics, educators and practitioners may wish to experiment with and elaborate on.

References

Ackoff, R. L. (1981), "The art and science of mess management". *Interfaces*, Vol. 11 No. 1, pp. 20-26.

Ancona, D. (2012), "Framing and Acting in the Unknown", S. Snook, N. Nohria, and R. Khurana (Eds), *The Handbook for Teaching Leadership: Knowing, doing, and being*, Sage, pp. 3-19.

Awati, K. (2011), "Mapping project dialogues using IBIS: a case study and some reflections", *International Journal of Managing Projects in Business*, Vol. 4 No. 3, pp. 498-511. https://doi.org/10.1108/17538371111144193.

Bajwa, S. U., Waseem, A., and Ahsan, A. A. (2020), "Making sense of sensemaking process in the face of organizational environment", *Business & Economic Review*, Vol. 12 No. 3, pp. 97-122.

Banning, M. (2008), "A review of clinical decision making: models and current research", *Journal of Clinical Nursing*, Vol. 17 No. 2, pp. 187-195.

Bansal, P., Smith, W. K., and Vaara, E. (2018), "New ways of seeing through qualitative research", *Academy of Management Journal*, Vol. 61 No. 4, pp. 1189-1195.

Bratianu, C., Vătămănescu, E. M., Anagnoste, S., and Dominici, G. (2021), "Untangling knowledge fields and knowledge dynamics within the decision-making process", *Management Decision*, Vol. 52 No. 2, pp. 306-323.

Calton, J.M. and Payne, S.L. (2003), "Coping with paradox: multistakeholder learning dialogue as a pluralist sensemaking process for addressing messy problems". *Business & Society*, Vol. 42 No. 1, pp. 7-42.

Camillus, J. C. (2008). "Strategy as a wicked problem". *Harvard Business Review*, Vol. 86 No. 5, p. 98.

Cristofaro, M. (2021), "Organizational sensemaking: a systematic review and a co-evolutionary model", *European Management Journal*, in press. https://doi.org/10.1016/j.emj.2021.07.003.

Cristofaro, M. (2020), "I feel and think, therefore I am": an affect-cognitive theory of management decisions", *European Management Journal*, Vol. 38 No. 2, pp. 344-355.

Colville, I., Pye, A., and Brown, A. D. (2016), "Sensemaking processes and Weickarious learning". *Management Learning*, Vol. 47 No. 1, pp. 3-13.

Conklin, J. (2006), *Dialogue Mapping. Building Shared Understanding of Wicked Problems*. West Sussex, England: John Wiley & Sons.

Cornelissen, J.P. and Clarke, J.S. (2010), "Imagining and rationalizing opportunities: Inductive reasoning and the creation and justification of new ventures", *Academy of Management Review*, Vol. 35 No. 4, pp. 539-557.

Culmsee, P. and Awati, K. (2012), "Towards a holding environment: building shared understanding and commitment in projects", *International Journal of Managing Projects in Business*, Vol. 5 No. 3, pp. 528-548.

Culmsee, P. and Awati, K. (2013), *The Heretic's Guide to Best Practices: The Reality of Managing Complex Problems in Organisations*. iUniverse Star.

Culmsee P. and Awati K. (2014), "The map and the territory: a practitioner perspective on knowledge cartography. In: Okada A., Buckingham Shum S., Sherborne T. (eds) *Knowledge Cartography. Advanced Information and Knowledge Processing*. London: Springer. https://doi.org/10.1007/978-1-4471-6470-8_12

Culmsee, P. and Awati, K. (2016), *The Heretic's Guide to Management: The Art of Harnessing Ambiguity*. Heretics Guide Press.

Cyert, R. M., Simon, H. A., and Trow, D. B. (1956), "Observation of a business decision", *The Journal of Business*, Vol. 29 No. 4, pp. 237-248.

Eisenhardt, K. M., and Zbaracki, M. J. (1992), "Strategic decision making", *Strategic Management Journal,* Vol. 13 No. S2, pp. 17-37.

Elbanna, S., Thanos, I. C., and& Jansen, R. J. (2020), "A literature review of the strategic decision-making context: A synthesis of previous mixed findings and an agenda for the way forward", *M@n@gement*, Vol. 23 No. 02, pp. 42-60.

Elmuti, D. (2004), "Can management be taught?" *Management Decision,* Vol. 42 No. 3/4, pp. 439-453.

Ericson, M. (2010), "Towards a sensed decision-making approach: From déjà vu to vu jàdé", *Management Decision*, Vol. 48 No. 1, pp. 132-155. https://doi.org/10.1108/00251741011014490

Etzioni, A. (2001), "Humble decision making", working paper, *Harvard Business Review on Decision Making. Harvard Business School Press: Boston, MA,* pp. 45-57, Available at SSRN: https://ssrn.com/abstract=2157020.

Fellows, L. (2004), "The Cognitive Neuroscience of Human Decision Making: A Review and Conceptual Framework", *Behavioral and Cognitive Neuroscience Reviews*, Vol. 3 No. 3, pp. 159-172.

Flyvbjerg, B. (1998), "Habermas and Foucault: thinkers for civil society?", *British Journal of Sociology*, Vol. 49 No. 2, pp. 210-233.

Franke, V. (2011), "Decision-making under uncertainty: using case studies for teaching strategy in complex environments", *Journal of Military and Strategic Studies*, Vol. 13 No. 2, pp. 1-21).

Gioia, D.A. and Thomas, J.B. (1996), "Identity, image, and issue interpretation: sensemaking during strategic change in academia", *Administrative Science Quarterly*, Vol. 41 No. 3, pp. 370-403.

Gosling, J. and Mintzberg, H. (2004), "The education of practicing managers", *MIT Sloan Management Review*, Vol. 45 No. 4, pp. 19-22.

Gray, D., Brown, S. and Macanufo, J. (2010), *Gamestorming: A Playbook for Innovators, Rulebreakers, and Changemakers*. O'Reilly Media, Inc.

Hmelo-Silver, C. E. (2004), "Problem-based learning: what and how do students learn?" *Educational Psychology Review*, Vol. 16 No. 3, pp. 235-266.

Ho, W., Xu, X., & Dey, P. K. (2010), "Multi-criteria decision making approaches for supplier evaluation and selection: A literature review", *European Journal of Operational Research*, Vol. 202 No. 1, pp. 16-24.

Houston, D. (2008), "Rethinking quality and improvement in higher education", *Quality Assurance in Education*, Vol. 16 No. 1, pp. 61-79.

Hoyte, C., Noke, H., Mosey, S., and Marlow, S. (2019), "From venture idea to venture formation: The role of sensemaking, sensegiving and sense receiving", *International Small Business Journal*, Vol. 37 No. 3, pp. 268-288.

Hultin, L., and Mähring, M. (2017), "How practice makes sense in healthcare operations: studying sensemaking as performative, material-discursive practice". *Human Relations*, Vol. 70 No. 5, pp. 566-593.

Hubbard, D.W. (2020), *The Failure of Risk Management: Why it's Broken and How to Fix it*. Hoboken, New Jersey: John Wiley & Sons.

Ickis, J. C., Woodside, A. G., and Ogliastri, E. (2014), "Executive learning through case discussion", *Management Decision*, Vol. 52 No. 9, pp. 1552-1563. https://doi.org/10.1108/MD-07-2014-0447.

Kirschner, P.A., Buckingham-Shum, S.J. and Carr, C.S. (eds.) (2012). *Visualizing Argumentation: Software Tools for Collaborative and Educational Sense-making*. Springer Science & Business Media.

Klein, G. (2008), "Naturalistic decision making", *Human Factors*, Vol. 50 No. 3, pp. 456-460.

Klein, G. A., and Klinger, D. (1991), "Naturalistic decision making human systems", *IAC Gateway*, Vol. 11 No. 3, pp. 3-19.

Klein, G.A., Orasanu, J., Calderwood, R. and Zsambok, E. (Eds) (1993), *Decision Making in Action: Models and methods*. Norwood, NJ: Ablex.

Kunz, W. and Rittel, H.W. (1970), "Issues as elements of information systems", Working Paper, Berkeley, California: Institute of Urban and Regional Development, Vol. 131, pp. 14, University of California.

Kwak, Y.H. and Ingall, L. (2007), "Exploring Monte Carlo simulation applications for project management", *Risk Management*, Vol. 9 No. 1, pp. 44-57.

Langley, A., Mintzberg, H., Pitcher, P., Posada, E. and Saint-Macary, J. (1995), "Opening up decision making: The view from the black stool", *Organization Science*, Vol. 6 No. 3, pp. 260-279.

Lee, J. and Lai, K.Y. (1991), "What's in design rationale?" *Human–Computer Interaction*, Vol. 6 No. 3-4, pp. 251-280.

Lichtenstein, S. and Fischhoff, B. (1980), "Training for calibration", *Organizational Behavior and Human Performance*, Vol. 26 No. 2, pp. 149-171.

Locander, D.A., Locander, J.A. and Weinberg, F.J. (2020), "How salesperson traits and intuitive judgments influence adaptive selling: a sensemaking perspective", *Journal of Business Research*, Vol. 118, pp. 452-462.

MacLean, A., Young, R.M., Bellotti, V.M. and Moran, T.P. (1991), "Questions, options, and criteria: elements of design space analysis", *Human–Computer Interaction*, Vol. 6 No. 3-4, pp. 201-250.

Maitlis, S. (2005), "The social processes of organizational sensemaking", *Academy of Management Journal*, Vol. 48 No. 1, pp. 21-49.

Maitlis, S., and Christianson, M. (2014), "Sensemaking in organizations: Taking stock and moving forward", *Academy of Management Annals*, Vol. 8 No. 1, pp. 57-125.

Maitlis, S. and Sonenshein, S. (2010), "Sensemaking in crisis and change: inspiration and insights from Weick (1988)", *Journal of Management Studies*, Vol. 47 No. 3, pp. 551-580.

March, J.G. (1991), "How decisions happen in organizations", *Human-Computer Interaction*, Vol. 6 No. 2, pp. 95-117.

Means, B., Salas, E., Crandall, B. and Jacobs, T.O. (1993), "Training decision makers for the real world", in: Klein, G.A., Orasanu, J., Calderwood, R. and Zsambok, E. (Eds) (1993), Decision Making in Action: Models and methods. Norwood, NJ: Ablex, pp. 306-326.

Mintzberg, H. (1989), *Mintzberg on Management: Inside our Strange World of Organizations*. Simon and Schuster.

Mintzberg, H., Raisinghani, D., and Theoret, A. (1976), "The structure of "unstructured" decision processes", *Administrative Science Quarterly*, Vol. 21 No. 2, pp. 246-275.

Okada, A., Buckingham Shum, S. and Sherborne, T. (2008), *Knowledge Cartography. Software Tools and Mapping Techniques.* Springer.

Orasanu, J., and Connolly, T. (1993), "The reinvention of decision making", Klein, GA,; Orasanu J.; Calderwood R., and Zsambok C.E. (Eds) *Decision Making in Action: Models and Methods*, Ablex Publishing Corporation, New Jersey, pp. 3-20.

Ostrom, E. (1998), "A behavioral approach to the rational choice theory of collective action: presidential address, American Political Science Association, 1997", *The American Political Science Review,* Vol. 92, No. 1, pp. 1-22.

Pfeffer, J., and Fong, C. T. (2002), "The end of business schools? Less success than meets the eye", *Academy of Management Learning & Education*, Vol. 1 No. 1, pp. 78-95.

Raychaudhuri, S. (2008), "Introduction to Monte Carlo simulation". In 2008 Winter Simulation Conference (pp. 91-100). IEEE.

Rittel, H. W., and Webber, M. M. (1973), "Dilemmas in a general theory of planning", *Policy Sciences*, Vol. 4 No. 2, pp. 155-169.

Rosness, R., Evjemo, T.E., Haavik, T. and Wærø, I. (2016), "Prospective sensemaking in the operating theatre", *Cognition, Technology & Work*, Vol. 18 No. 1, pp. 53-69.

Rudolph, J. W., Morrison, J. B., & Carroll, J. S. (2009), "The dynamics of action-oriented problem solving: Linking interpretation and choice", *Academy of Management Review*, Vol. 34 No. 4, pp. 733-756.

Sadler-Smith, E., and Shefy, E. (2004), "The intuitive executive: understanding and applying 'gut feel'in decision-making", *Academy of Management Perspectives*, Vol. 18 No. 4, pp. 76-91.

Schildt, H., Mantere, S., and Cornelissen, J. (2020), "Power in sensemaking processes", *Organization Studies*, Vol. 41 No. 2, pp. 241-265.

Schrader, S., Riggs, W. M., and Smith, R. P. (1993), "Choice over uncertainty and ambiguity in technical problem solving", *Journal of Engineering and Technology Management*, Vol. 10 No. 1-2, pp. 73-99.

Simon, H. A. (1979), "Rational decision making in business organizations", *The American economic review*, Vol. 69 No. 4, pp. 493-513.

Simon, H.A. (1997), *Administrative Behavior (4th Ed, pp. 118-122)*. Simon and Schuster.

Singh, V. (2018), "Local action, global impact: from domination to partnership by design", *Interdisciplinary Journal of Partnership Studies*, Vol. 5 No. 3, pp. 1-28.

Smith, G. F. (2003), "Beyond critical thinking and decision making: Teaching business students how to think", *Journal of Management Education*, Vol. 27 No. 1, pp. 24-51.

Snowden, D. (2005), "Strategy in the context of uncertainty". *Handbook of Business Strategy*, Vol. 6 No. 1, pp. 47-54, https://doi.org/10.1108/08944310510556955.

Snowden, D. J. and Boone, M.E. (2007), "A leader's framework for decision making", *Harvard Business Review*, Vol. 85 No. 11, p. 68-76.

Sonenshein, S. (2007), "The role of construction, intuition, and justification in responding to ethical issues at work: the sensemaking-intuition model", *Academy of Management Review*, Vol. 32 No. 4, pp. 1022-1040.

Spinosa, C., Flores, F., and Dreyfus, H. (1995), "Disclosing new worlds: Entrepreneurship, democratic action, and the cultivation of solidarity", *Inquiry*, Vol. 38 No. 1-2, pp. 3-63.

Stanovich, K.E. (2016), "The comprehensive assessment of rational thinking", *Educational Psychologist*, Vol. 51 No. 1, pp. 23-34.

Strike, V.M. and Rerup, C. (2016), "Mediated sensemaking", *Academy of Management Journal*, Vol. 59 No. 3, pp. 880-905.

Triantaphyllou E. (2000), "Multi-criteria decision making methods", In: *Multi-criteria Decision Making Methods: A Comparative Study. Applied Optimization*, Vol 44. Springer, Boston, MA. https://doi.org/10.1007/978-1-4757-3157-6_2.

Tsoukas, H. (2017), "Don't simplify, complexify: from disjunctive to conjunctive theorizing in organization and management studies", *Journal of Management Studies*, Vol. 54 No. 2, pp. 132-153.

Tversky, A. and Kahneman, D. (1974), "Judgment under uncertainty: heuristics and biases", *Science*, Vol. 185 No. 4157, pp. 1124-1131.

van Gelder T. (2003), "Enhancing deliberation through computer supported argument visualization", Kirschner P.A., Buckingham Shum S.J., Carr C.S. (Eds), *Visualizing Argumentation. Computer Supported Cooperative Work*, Springer, London, pp. 97-115. https://doi.org/10.1007/978-1-4471-0037-9_5.

van Gelder, T. (2010), "The wise delinquency of decision-makers", *Quadrant*, Vol. 54 No. 3, pp. 40-43.

Vroom, V. H. (2003), "Educating managers for decision making and leadership". *Management Decision*, Vol. 41 No. 10, pp. 968-978.

Watzlawick, P., Bavelas, J.B. and Jackson, D.D. (2011), *Pragmatics of Human Communication: A Study of Interactional Patterns, Pathologies and Paradoxes*. WW Norton & Company.

Weick, K. E. (1995), *Sensemaking in Organizations*, Thousand Oaks, CA: Sage.

Weick, K. E., Sutcliffe, K. M., and Obstfeld, D. (2005), "Organizing and the process of sensemaking", *Organization Science*, Vol. 16 No. 4, pp. 409-421.

Winnicott, D. W. (1960). "The theory of the parent-infant relationship", *International Journal of Psycho-Analysis*, Vol. 41, pp. 585-595.

Wright, A. (2005), "The role of scenarios as prospective sensemaking devices", *Management Decision*, Vol. 43 No. 1, pp. 86-101.

Wu, C., and Barnes, D. (2011), "A literature review of decision-making models and approaches for partner selection in agile supply chains", *Journal of Purchasing and Supply Management*, Vol. 17 No. 4, pp. 256-274.

Table 1: Key characteristics of wicked problems

Key characteristic	Example implication
Wicked problems do not have a definitive formulation.	A strategy can be formulated in many different ways depending on the interests of the formulators.
They do not have a "stopping rule".	A strategy is never truly done.
Their solutions are not true or false, only better or worse.	A strategy cannot be labelled right or wrong.
There is no definitive test of the solution to a wicked problem.	It is not possible to unambiguously test a strategy.
Every solution is a one-shot operation.	It is not possible to make multiple attempts at formulating a strategy at the same time.
Potential solutions cannot be enumerated fully, neither can the operations required to solve them.	There are an infinite number of possible strategies.
Every wicked problem is unique.	A company's strategy cannot be that of another company.
A wicked problem can be considered to be a symptom of another problem.	The need to formulate a strategy is symptomatic of other issues that your organization faces.
The way a wicked problem is described determines its possible solutions.	The statement of the problems a strategy must address will play a big role in determining its content.
Those who solve a wicked problem will be held responsible for the consequences.	The shareholders will hold the executives who formulated the strategy responsible for its consequences.

Table 2: Pedagogy integrating practical sensemaking with decision making

Sequential outline of course	Task	Uncertain or Ambiguous problem	Techniques/ concepts used and key works	Further details/explanatory notes
Block session 1: Discussion of the nature of uncertain tasks and application of estimation techniques. The course begins at the "uncertain end" of the ambiguity spectrum (Fig. 2) Starting with simple estimation problems relating to everyday decisions we then progress to more complex scenarios that require probabilistic approaches.	Time estimation of a common task (e.g., cleaning your house) and a more formal organizational scenario (such as executing a project).	Uncertain	Naïve estimation based on knowledge, and formal estimation using Monte Carlo simulation.	Students are asked to estimate how long it takes them to perform a familiar task. When students share their estimates, almost invariably we get a response like X hours or minutes. Next they are asked to think about how accurate that estimate is – that is, what is the chance that they will come in at exactly that number. After confirming that the odds of this happening are low, we ask them to think about a better way of presenting their estimates. This leads to the realization that estimates should be presented as ranges rather than single numbers, which motivates the concepts of probability distributions and Monte Carlo simulation. Project estimation is a good example for demonstrating how Monte Carlo simulation works. The principle behind Monte Carlo for project estimation is to build estimates by "running" the project a large number of times. Each "run" is built by drawing randomly from (cost or time) probability distributions that describe the components tasks and then summing these appropriately to give a total cost or time for a particular "run". Each "run" will have a different total time or cost, so one can build up a distribution for the entire project by cumulating the "runs". The cumulative distribution then enables one to answer questions such as, "what is the probability that the project will finish within a month?" In order to make the technique accessible to managers, we use Microsoft Excel to implement the simulation and walk students through the detailed steps. A complete, classroom-ready implementation with step-by-step details is available online (Author 1, 2018).

Assignment one: *Monte Carlo simulation of a project* (Weight: 50%) Students are asked to develop cost/time estimates for a project consisting of a small number of tasks using Monte Carlo simulation with specified probability distributions. A link to a tutorial for such a simulation is available online (Author 1, 2018).	Cost or time estimation of a project	Uncertain	Monte Carlo simulation based on known probability distributions (Kwak and Ingwall, 2007; Raychaudhari, 2008)	**Assignment details** You are about to lead a project in your organization and have been asked to estimate how long it would take to complete it. Fortunately, your company has done similar projects in the past and has historical data on the minimum, maximum and most likely completion times for a number of tasks that constitute the project. Your task is to: • develop a quantitative estimate for the overall completion time for the project based on the Monte Carlo method. • write a short report describing the method you used on the simulation (500 words max, excluding appendices). The report should explain the following in non-technical terms: o The rationale behind the method. o The assumptions made o The estimated completion time, framed in probabilistic terms (e.g., there is a 90% chance that the project will finish within X days). o Reflection: Are your assumptions reasonable? What can you do if they aren't?
Block session 2: Discussion of how distributions are built and the difference between frequency-based and experience-based probabilities, and the subjectivity inherent in the latter.	Understanding the difference between objective and subjective probabilities Understanding the role of judgement in decision making.	Uncertain to ambiguous	Conditional probabilities, reference classes, probability calibration (Lichtenstein and Fischoff, 1980; Hubbard, 2020), cognitive biases (Tversky and Kahneman, 1974), rationality tests (Stanovich, 2016)	To highlight the subjective nature of experience-based probabilities, we run a number of cognitive/behavioral exercises illustrating differences in how individuals perceive and process information, and how this leads to differences in judgement. Students are given a trivia quiz with a twist. For each answer, they are also asked to rate their confidence in their response. At the end of the exercise, students are awarded points based on correctness of their responses and their confidence in them. For example, getting an answer right with high confidence gets the same mark as getting an answer wrong with low confidence. This exercise helps students understand their individual propensities for overconfidence/under-confidence. The cognitive bias and rationality tests show how easy it is to jump to incorrect conclusions even when all the information required to make a

				good decision is available. The aim of these exercises is to highlight the difficulties of making reliable subjective judgements.
Block session 2: Discussion of decision scenarios of increasing complexity (moving towards the right on the ambiguity spectrum (Fig. 2)).	Introducing social complexity, e.g., establishing a development center for a multinational organization.	Uncertain to ambiguous	Wicked problems (Rittel and Webber, 1973), complicated vs complex problems (Snowden, 2005)	Discussion of the problem of developing a business case for setting up a development center for a large company. The options available have pros and cons that cannot be reliably rated without additional context – i.e., the company culture, risk tolerance, cost vs quality, etc. Each of these are hard to assess because perceptions of them can vary considerably across an organization. Students thus realize that the key difference between uncertain and ambiguous problems is that for the former there is rarely disagreement between stakeholders about the "facts of the matter" whereas for the latter it is likely that there will be disagreements about substantive issues.
Block session 2: Discussion of the conditions required for effective deliberation in group settings. A common theme running through all these techniques is the importance of building and fostering trust within the group (see also Wright, 2005).	Holding environments and conditions required for open dialogue	Ambiguous	Behavioral approaches to collective choice (Ostrom, 1998), communicative rationality (Habermas, as described in Flyvbjerg, 1998), relational approaches to communication (Watzlawick *et al*., 2011)	Discussion of techniques to explore the conditions for open dialogue (as described by Flyvbjerg, 1998 and elaborated by Culmsee and Awati, 2012). Students are then asked to reflect on what organizational factors, such as, e.g., power structures, impact these conditions.
Block session 3: Students are introduced to a selection of sensemaking techniques, explaining how they can	Practical sensemaking tools and techniques to	Ambiguous	Cynefin (Snowden, 2005), Dialogue Mapping using	Classroom exercises illustrating how Issue Mapping works in practice. We focus on Issue Mapping as it has been found to be extremely helpful in dealing with ambiguous problems in a range

reduce ambiguity by helping move stakeholders towards a shared understanding of the problem. The focus is on Issue Based Information (IBIS) notation invented by Horst Rittel (Kunz and Rittel, 1970).	resolving social complexity		IBIS (Conklin, 2006)	of business domains (see examples in Culmsee and Awati, 2013, 2014). IBIS can be used to map a dialogue as it unfolds in a meeting. This enables the participants to visualize key issues, ideas and arguments for and against them, all in a way that makes the connections between them explicit. The emerging visual can help the group make collective sense of the options along with their pros and cons, thus paving towards a shared understanding of a complex problem. Fig. 4 shows an example of an issue map of a meeting in which a group discussed the implementation of a business information system (see Author 1, 2009 for a detailed explanation of this example). More complex case studies are discussed at length by Culmsee and Awati (2012, 2013, 2014).
Assignment Two: *Decision-making in a socially complex scenario* (Weight: 50%) Students are asked to identify potential decision options in a socially complex scenario. This is an exercise in collective sensemaking. The objective is to surface decision criteria, options canvassed and arguments for and against them as a step towards framing the problem. Once options are identified, these can be rated using quantitative or semi-quantitative approaches.	Strategy discussion which the students structure using a conversational mapping tool.	Ambiguous	Dialogue Mapping using IBIS (Conklin, 2006)	**Assignment details:** You've been provided with the transcript of a board meeting of a mining company and have been asked to identify the key issue(s) discussed, options canvassed, and the arguments offered for and against the options. The aim is to identify which idea(s) is (are) worth pursuing. You've decided to use Issue Mapping to identify issues, options and criteria, followed by paired comparison and weighted matrix approach to select an option. Your task is to develop a set of artefacts that show the process you followed. Specifically, you are required to: • Develop an issue map of the meeting using the IBIS notation. Your map should focus on identifying options discussed, arguments for and against them and the criteria for making the decision. • Write a report, showing how you developed the map. • Using the provided template, do a pairwise comparison to rate the identified options. You need to make the subjective choice as to which option is the preferred one in each

				comparison. Your ratings should be guided by the dialogue, and your sheet must be internally consistent. • Imagine that the top two options are very close in score and the stakeholders cannot agree on a consensus. Based on what you have learnt in this subject, outline a possible way forward by describing an approach you would use to help the group decide between the two options.

Table 3: Survey results relating to effectiveness of the pedagogy

Question	Year	Response Rate	Avg Score (max 5)	Std Dev
The subject provided practical learning activities to develop new skills and knowledge I may need in my workplace.	2019	52%	4.6	0.51
The subject has developed my understanding of my intended profession.	2019	52%	4.6	0.63
The subject provided practical learning activities to develop new skills and knowledge I may need in my workplace.	2020	73%	4.41	0.67
The subject has developed my understanding of my intended profession.	2020	73%	4.41	0.73

Table 4: Student comments on the practical relevance of the course

Comment
"[The course] addressed the human/social complexity in managing change and making decisions. One of the most rewarding subjects in the curriculum."
"The assignments and concepts were extremely practical and can be applied directly to work and real life. [The course] is very practical and has a great mix of theory and experience."
"[I liked] looking at uncertainty in a systematic way and realizing that uncertainty is not a number but a shape, great insights…"
"The examples of the material were practically based and easily applicable to my day to day work."
"[the course developed my] ability to accept uncertainty as opportunity, not fear & build the pathways through unknown to known solutions using the tools: the skill to use IBIS to map & archive the ideas & questions asked at meetings to solutions & the pathways not taken…"
"This subject opened my world with practical skills I can start using today. I loved the Monte Carlo simulations and will now never estimate without a min/max. I also loved the IBIS and how it can really capture a conversation in a useful way."
"...I can also see how great IBIS is for having logical discussions and I have already talked to my manager about using it for our next team meeting."

Figure 1: Uncertain and ambiguous decision problems

Figure 2: The ambiguity spectrum

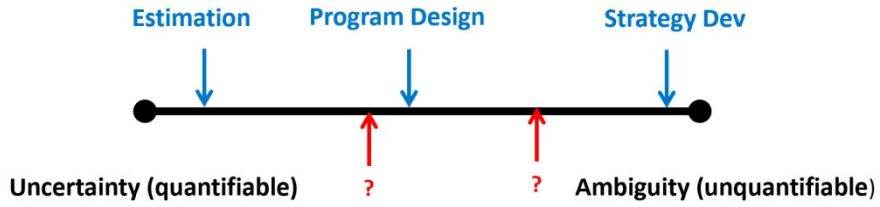

Figure 3: A conceptual model integrating collective sensemaking and rational decision making

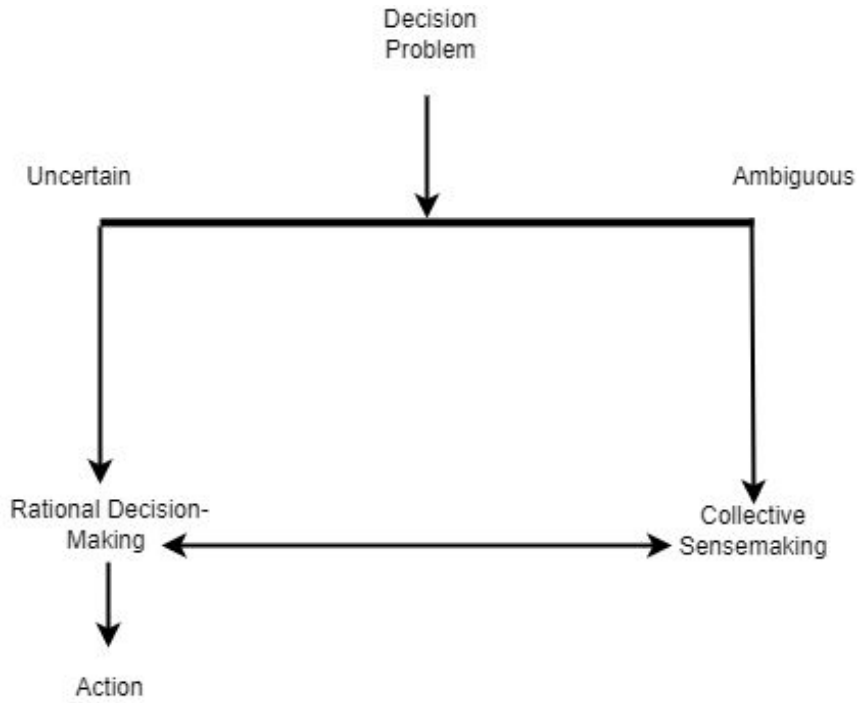

Figure 4: An example issue map