

Designing Serious Games for Senior Executive Strategic Decision Making

Kenneth McKay, University of Waterloo, Canada

Tejpavan Gandhok, JGBS, O.P. Jindal Global University, India*

Darshi Shah, O.P. Jindal Global University, India

ABSTRACT

Senior executive strategic decision making is a prized skill. The analysis of available literature yields three key conclusions: i) strategic decision-making skills, especially in high complexity and ambiguity leverage ‘adaptive expertise’ which is very different from the dominant discourse on narrow domain ‘expert performance;’ ii) unlike focused skills which can be developed by concentrated, high repetition practice, adaptive expertise requires higher order meta-cognitive skills in addition to wide domain knowledge and managerial skills. Third, emerging literature suggests serious games can help to improve capabilities in decision making and cognitive skill, but there is a limited range of games or research explicitly focused on strategic decisions, while there is extensive body of knowledge on such simulations and measures for in-the-moment type decisions. The authors propose several frameworks and design requirements incorporating three levels of skills including higher cognition.

KEYWORDS

Adaptive Expertise, Cognitive Skills, Expert Performance, Expertise, Metacognition, Naturalistic Decision Making (NDM), Senior Executive Strategic Decision-Making (SESDM), Serious Game

1. INTRODUCTION

This paper focuses on *senior executive strategic decision making* (SESDM) where the individuals work on strategic decisions, the long-term plans that shape and form the enterprise. The decision making of senior executives (McKay et al., 2015) does not match the typical decision making made at the operational or tactical levels of an organization (McKay et al., 1992). At these lower levels within the decision hierarchy, an individual can have sufficient chances to make ‘similar’ decisions such that the deliberate practice noted by Ericsson et al. (1993) can take effect. Many of the operational, day-to-day decisions might be made in seconds, minutes, or hours, often by a single individual charged with getting the job done, with the authority to make the decision.

At the senior levels of an organization: i) the variety of decisions is greater, ranging from legal, marketing, facility location, organization design, mergers, acquisitions, expansion, contraction, new

DOI: 10.4018/IJGBL.329221

*Corresponding Author

This article published as an Open Access article distributed under the terms of the Creative Commons Attribution License (<http://creativecommons.org/licenses/by/4.0/>) which permits unrestricted use, distribution, and production in any medium, provided the author of the original work and original publication source are properly credited.

product/service offerings, overarching policies, etc., ii) the uncertainty is higher, many elements are out of the control of the executive, company, iii) the risks and impacts are greater and the future of the company can be at stake, iv) there are longer time durations between similar decisions, v) there can be extended time horizons between the time when the decision is made and observable results, vi) the risks and impacts may take place on a longer time horizon, vii) there might actually be many people involved in the decision making over a long period, viii) the people might be transient with possibly one or more roles or interactions, and ix) the decisions are usually subject to Board oversight, multiple layers of approval.

The first three points noted in the above paragraph are about the decision itself. These are commonly discussed. The remaining six points are structural aspects that reflect the nature of strategic decisions and are rarely discussed in the literature. This list of nine characteristics highlights the difference between routine operational and strategic decisions which we define as longitudinal decision making. Figures 1 and 2 illustrate the difference between individual, routine types of operational decisions, and what the senior executive decision process can look like.

In Figure 1, there are four key decision points: 1) the individual may or may not be given the situation to make the decision about, e.g., decides that groceries must be purchased or might be explicitly asked to decide about groceries, 2) decides if any groceries are needed, 3) thinks about the solutions, ranging from no groceries are needed to a full grocery list, 4) and finally if there is enough demand to warrant a trip, or if the decision maker should wait till there is more to buy. A family member might be involved, but many individuals make grocery decisions as the sole decision maker.

In contrast, Figure 2 illustrates the executive's situation. The happy face indicates the position of the senior executive in the process and each of the key decision milestones: 1) identification, 2) decision to proceed with the decision process, 3) analysis, 4) decision to proceed, 5) solution development, evaluation, 6) and the final go/no-go decision.

Figure 1. Individual, operational decision process: Seconds, minutes, hours

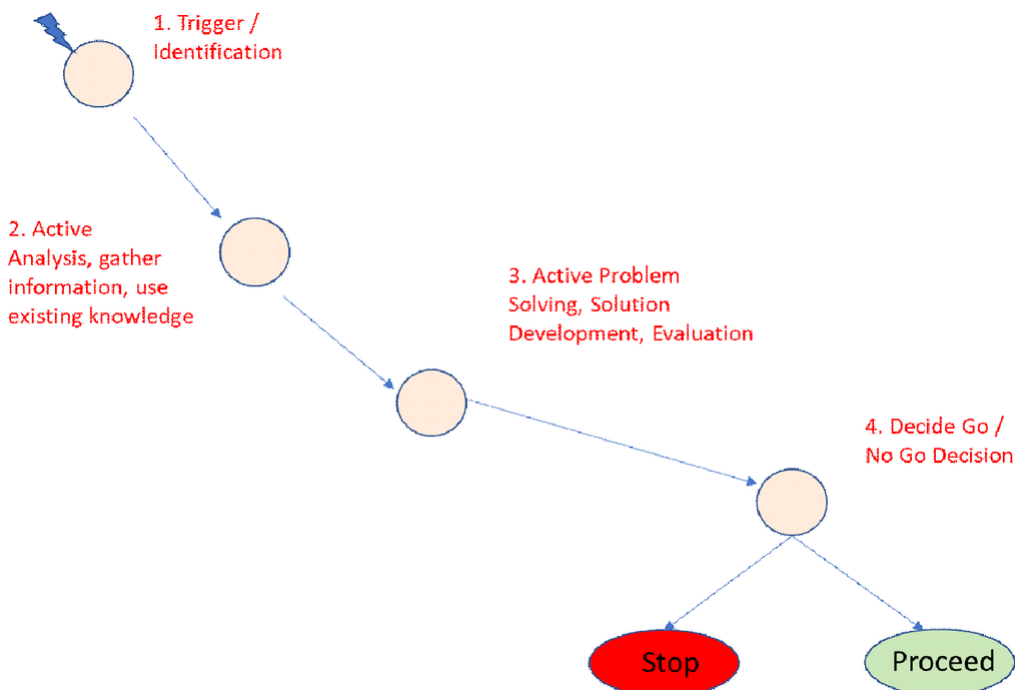
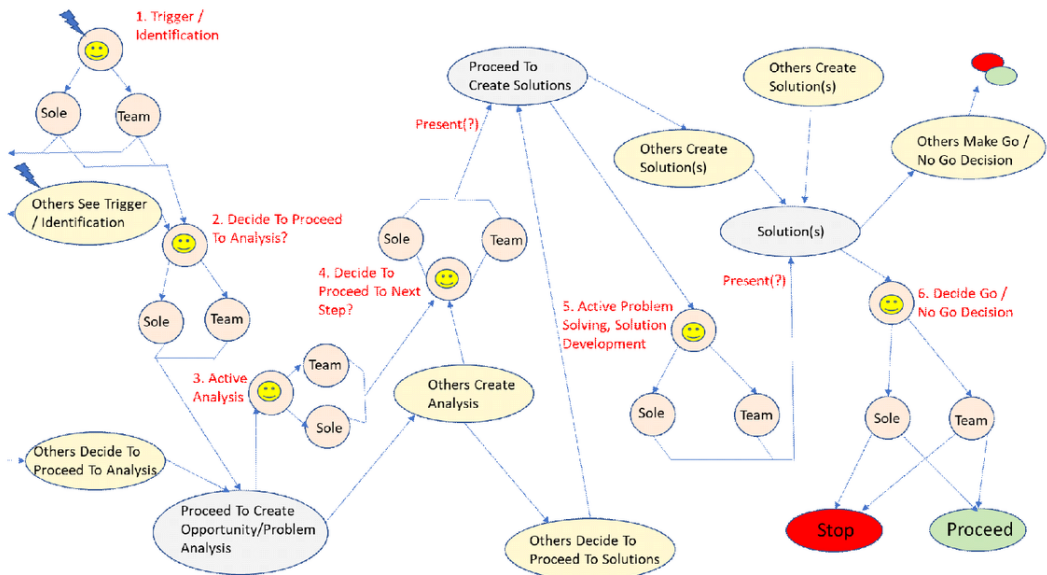


Figure 2. Strategic, senior executive decision making: Weeks, months, years



The executive: i) might or might not be the only player in the process, ii) might or might not actually be active in the process (doing vs listening), and iii) might or might not have the final say on the decision to proceed.

The two figures illustrate the differences in structure and complexity between immediate, individual decision making where the individual does almost all of the tasks, and the senior executive's world of many interconnecting, co-dependent pieces, with many stakeholders involved in any decision, over an extended time horizon. The second figure is merely our illustrative attempt of what might be a typical decision flow and is considered exploratory and preliminary, the subject of future research. While there will be many possible variants, the overall sequence illustrates a process that can be found in many firms, and the role of the senior executive.

A senior decision maker might have some past experience in a similar situation, but it is not likely that any senior executive has made any specific type of decision thousands of times with reflection and feedback about the quality of the decision as implied by the type of deliberate practice usually associated with cognitive skill development. That is, a senior decision maker does not make dozens of merger decisions every day, week, and month for multiple years.

This leads us to several key research questions:

- i) what are the cognitive skills that executives need to make these types of decisions at the different points in the process,
- ii) how does an executive learn to make these rare decisions of great importance, and
- iii) **can these skills be developed and enhanced through serious games.**

This paper explores these three questions. The literature review reviews three aspects of relevant research: i) cognitive skills related to longitudinal, extended decision making at the strategic level, ii) how executive learn these executive skills, and iii) how serious games have been used to introduce and develop these skills. The review suggests that there are different cognitive skills used in longitudinal decision making, that the learning of these skills has not been extensively studied, and that traditional serious game strategies have not been successful in this context. We present a discussion on the

characteristics underlying the cognitive skills necessary by the senior executives, with a preliminary taxonomy for decomposing the decision space. A discussion about how serious games for SESDM can be designed to support the development of senior executive skills concludes the paper.

2. LITERATURE REVIEW

2.1 Adaptive Expertise

The majority of research literature on expertise focuses either on realms that require in-the-moment thinking (Naturalistic Decision Making, e.g., Klein 2008) or very narrow domains that are relatively stable with well-defined rules and well-established knowledge bases (Cognitive Psychology view of skill and expertise, e.g., Feltovich et al. 2018).

The research literature is relatively sparse on complex, strategic thinking fields, where there is multiplicity and changeability of domains as the decision makers progress through the ranks, change careers (Grenier and Kehrhahn 2008). In the Bohle Carbonell et al. (2014) meta survey on adaptive expertise, out of twenty-one studies, there are only three that investigated managerial level factors – they noted Barnett and Koslowski (2002) looking at restaurant managers, Griffin and Hesketh (2003) where management support was researched, and Charbonnier-Voirin et al. (2010) that investigated transformational leadership.

According to a retrospective by Inagaki and Miyake (2007), Hatano first introduced the notion of expert flexibility and adaptability in 1982 and then expanded the concept of adaptive expertise with Inagaki in 1986 (Hatano and Inagaki 1986). In this publication, the authors described routine and adaptive expertise. Inagaki and Miyake noted that at the time of their 2007 review, “we do not know well about the concrete and detailed process of cultivating adaptive experts”, although there were some ideas about motivation in different contexts. Specifically, they noted Hatano and Inagaki’s 1992 publication describing the motivational conditions for adaptive expertise as: i) encountering novel problems continuously, ii) engaging in dialogical interaction, iii) being freed from urgent eternal need, and iv) being surrounded by a group that value understanding (Hatano & Inagaki 1992).

While it is important for an expert to know their domain, there is also a possible danger associated with too much knowledge and fixation, creating challenges with creative problem-solving (Wiley, 1998). Unfortunately, Wiley’s experiments were limited in the range of expertise (e.g., largely undergraduate students) and it is not clear if the effects noted, apply across all of the expertise spectrum. This fixation or entrenchment as it relates to domain expertise has been the subject of other research. For example, in Dane (2010), the author posits that inflexibility is not necessarily based on entrenchment, but is related to the breadth of expertise and knowledge, gained via outside-domain tasks. This suggests that a broader knowledge base across multiple domains might be as important as the single domain expertise in which the decision is being made.

Pulakos et al. (2000) analysed over 1,000 critical incidences and isolated eight dimensions: i) handling emergencies ii) handling work stress, iii) solving problems creatively, iv) dealing with uncertain situations, v) learning new tasks, tech, procedures, vi) interpersonal adaptability, vii) cultural adaptability, and viii) physically oriented adaptability. They then conducted an experiment where the dimensions were used to describe current job tasks – to identify what kinds of tasks required adaptive performance and the magnitude. One of their main findings was that adaptive performance was multi-dimensional. This research suggests that any SESDM serious game design should also view adaptive situations as having multi-dimensions and not rely on single factors.

2.2 Understanding Expertise

Ericsson et al. (2018) is considered the seminal reference for understanding expertise and how expertise has been studied. Observation has been a dominating method and this has limitations when it comes to senior executives and long term decision making. In difficult situations like those faced by senior

executives, descriptions and reflections generated post-event by the decision maker can be analysed (e.g., Kestra 2017). The reflections can be used to partially explain the mental representations and meta-cognition used by the subject.

Ackerman (2018) discussed two key approaches to study and understand the development of expertise, one of which is the use of reflections and retrospective analysis. The first idea is a prospective approach which has been used more for children and adolescents; watching them learn, develop the skills. The second approach is the retrospective approach where one can retrospectively study the early traits and experiences of those that attained the position of an expert in comparison to a novice. However, this approach also has shortcomings, such as sparse availability of archival data to find expert individuals, faulty recollections, and biases, etc. It appears to be very hard to study the development of expertise in senior executives. Individuals are also unlikely to remember when and how specific cognitive skills are developed over decades of career progression.

Unlike the sparse literature on objective measurement for adaptive expertise contexts, there is extensive literature on objective measurement of experts in NDM contexts. For example Brams et al's systematic literature review examined gaze features, i.e., eye movement tracking to detect features to assess competency in various sports activities (Brams, 2019). Two underlying theories for this are also relevant for our context, because naturalistic decision-making experts also follow a holistic model of processing, i.e., 'they are able to retrieve significant information of a given scene with a quick and brief glimpse' (Brams et al., 2019). Another key reason for studying gaze is a theory called 'information-reduction', per which NDM experts are skilled at optimizing their processing of the vast amount of available information by selective allocation of their attention to 'task relevant stimuli while simultaneously ignoring irrelevant stimuli' (Brams et al., 2019). With the help of these two theories Brams et al summarise that researchers are able to draw conclusions regarding the presence of NDM type expertise in sports contexts using objective measurements based on eye gaze tracking such as: "efficient visual search rate, enhanced selective attention allocation, an extended visual span, and scan pattern systematicity". There is an opportunity to build a similar body of knowledge in our focus area of interest and suitably designed serious games for SESDM can play an important role for such research.

2.3 Leveraging Serious Games to Develop Cognitive Skills

A literature review by Larson (2020) looked at 90 (filtered from 8,800 initial matches) research publications on serious games and gamification in the workplace. While there were many positive findings in the research, such as improved engagement and motivation in learning, and performance, there is no mention in the Larson review about serious games being used at the senior executive level to develop the skills needed to be better decision makers. All of the examples were about improvements in the training itself, or skills at the operational or tactical levels of the organization. While this is a notable absence, Larson's review does point out that use of serious games in business settings is common and has been widely accepted as a training method. This suggests that there is potential for serious game mechanisms to be included at the higher levels of the organization.

2.4 Four Key Implications From the Literature Review

First, the majority of research has focused on contexts that require naturalistic, in-the-moment decisions, or where the training and skill development can be observed. In our literature review efforts, we found sparsity of research in the context of slower, longitudinal, strategic decision making.

Second, there appears to be an implicit or explicit assumption that one can improve these skills through simulated activities without any underlying connection to the higher level cognitive skills, such as meta-cognition, complex pattern matching, contextual cue-sensing, etc. (as opposed to lower level cognitive skills such as perception, attention control etc. which are indeed measured by serious games researchers).

Third, to date there is limited evidence that the above type of cognitive training activities have had long term, sustained impacts once the decision leaves the context of the specific training. A meta-analysis on brain-training programs to examine the overall effectiveness in improving cognitive functioning by Simons et al. (2016) summarized their findings on transfer: “As a general observation, empirical examples of near transfer, in terms of both content and context, are more prevalent than those of far transfer.” Another meta-analysis by Sala et al. (2019) also investigated the claims of near and far transfer in cognitive training. They summarized their meta-study: “near transfer frequently occurs and, interestingly, seems to be moderated by the type of population; by contrast, far transfer is very modest at best. Moreover, once publication bias and placebo effects are ruled out, far transfer effects are null regardless of the type of far transfer measure, type of cognitive training program, and population”. These observations suggest that perhaps a different approach is needed in the serious game design for SESDM. The reviewed studies in both Simons et al. (2016) and Sala et al. (2019) failed to develop the situations for far transfer to be achieved.

Fourth, we also infer that some of the reasons why research on senior executive decision making has been limited, can potentially be explained by the limitations of the longitudinal and retrospective approaches for studying expertise and by the challenge of enrolling as research participants given the likely hesitance of senior executives to have their decision making studied. There is also the confidentiality of strategic business negotiations and decisions, time pressures on the executives, and the very nature of the longitudinal decisions which are problematic to observe and track over time. Each of these reasons can make research difficult. The frequency of decisions in these decision making situations and the sporadic activity on the decisions adds complications; such decisions are not made according to a fixed plan or schedule. The relevant time period can be many months or years if a thorough analysis is to be done, requiring many observations. For comparison, McKay (1992) found that extensive six-month case studies were needed to capture sufficient data points when looking at decisions made daily, weekly, and monthly at the planner and scheduler level with weekly observation periods at the study site. In the six months, approximately 250 decision making episodes were captured. To do this level of robust research in the senior executive context is problematic. However, it might be possible for researchers to do longitudinal research designs over a one-to-two-year horizon with monthly contact points and discussions with the executives, tracking decisions and the decision making process over time. At the strategic level, the studies will not be short and will not involve a few hours of interviews. They will be long and require many data points. The use of effectively designed serious games that are built on exercising the underlying higher level skills needed for such strategic decisions, can be an effective solution to many of these constraints.

3. SENIOR EXECUTIVE STRATEGIC DECISION MAKING: THREE CHALLENGES

The senior executives of a corporation are charged with the strategic decisions that will define the future of the enterprise and the current state. These types of decisions can be quite varied and as noted in the introduction can include deciding a new corporate structure, mergers, and acquisitions, entering, or leaving a market, capital investments, marketing strategies, branding, locations of facilities, and corporate finance issues (e.g., leverage policy, fund raising quanta, source and timing, buy-backs, debt retirement etc). They also must worry about personnel matters at a broad level and specific issues within the top levels of management. They might have to worry about new threats from competitors, changes in government regulations, and so forth. There are many issues that arrive on the senior executives’ desks. Furthermore, the senior executives should be spending half of the time focused on planning and simulating the future and half on today’s realities (Drucker, 2004). The farther out on the time horizon a decision must be made for, the more uncertainty there will be. While some senior executives also make operational and tactical decisions, these decisions are not strategic and are not the focus of this paper. We are focused on the decisions that will possibly affect the existence of the enterprise. By their very nature, these decisions make it hard to learn adaptive

decision-making skills – the specific episodes are rare, the decisions can be formulated over a very long-time horizon, and the rewards or results of the decision might not be materialized for many years later. It is hard to develop the necessary learning cycles for the specific decisions.

To better understand the situation, we have split the decision making into two dimensions, knowledge and skill. The knowledge is a combination of what the executive brings to the situation, and what is gained during the longitudinal decision making – either what they learn, or what others learn and share. There are six potential knowledge domains that the executive has when making a decision and which a serious game developer should reflect upon. These are shown in Figure 3.

Specifically, we suggest that senior executives need six key knowledge domains to make sustained, repeated ‘good decisions’ at the senior level. They need to understand the basics for each type of decision that might be encountered, what factors are involved, e.g., mergers and acquisitions (1), the basics of defensible decision making, evidence based reasoning, cost/benefit analysis, etc. (2), the general knowledge domain for the industry (3), the knowledge domain for the specific sector within the industry, the competitive landscape, key processes, best practices (4), the knowledge domain about the firm, company itself, its history, present, plans in motion (5), and they need to know what the capability of the human element is, what can be done, what can be pushed (6).

Most of these types of knowledge domains cannot be learned via the normal degree programs or short courses. Even the first two categories which are often found in courses, basic decision and decision making knowledge, need to be moderated by the domain and the specific situation for the knowledge to be relevant and applicable.

The knowledge is acquired throughout the journey and experiences. The knowledge is used to know what cues to look for, what the implications might be, where to find the cues. The knowledge domains used in actual decision making are one of the challenges faced by any learning or teaching paradigm. Decision making is contextual and a learner should have the relevant domains in play if the exercises are to have high fidelity, make sense, provide value, and have impact on the decision making process; that is, in whatever learning vehicle is used, it is important that the context and actions asked of the executive must be relatable.

Knowledge by itself is not sufficient. There are many skills involved. The high-level, generic skills are shown in Figure 4.

The senior executive must be skilled at intelligence, information gathering, picking up clues (1), their interpretation (2). There is then the analysis and evaluation of what the information implies (3). There are various levels of communication needed one-on-one, group settings, teams, attendee

Figure 3. Knowledge domains of senior executives

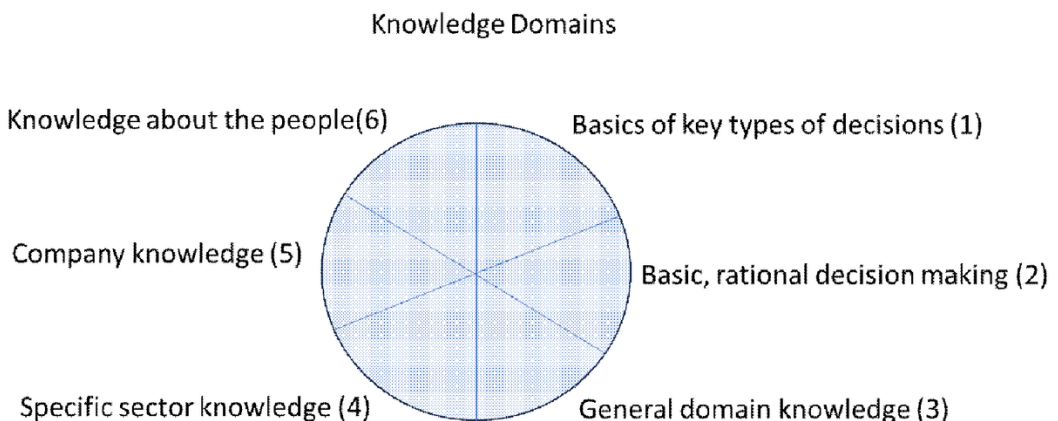
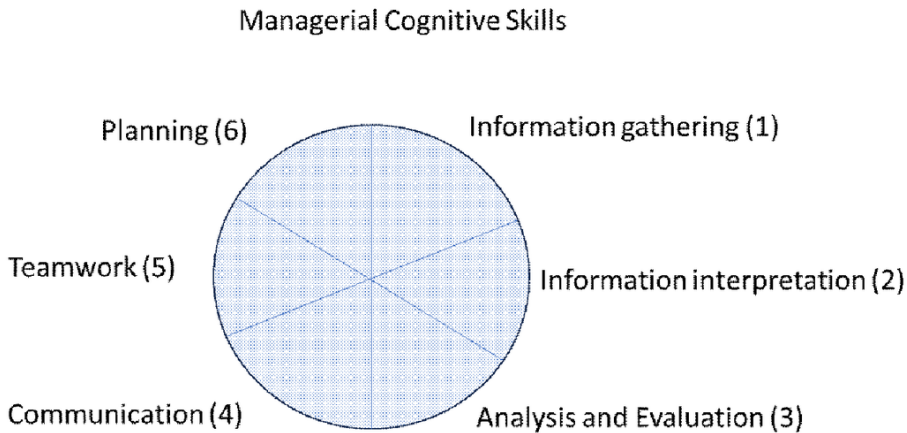


Figure 4. Higher level skills: Managerial



and presenter (4). The executive must be able to work with others (5), and have the ability to either create plans or skillfully evaluate plans made by others (6).

These skills at the novice level can be introduced in degree programs and short courses. To further develop these skills, will require deliberate practice (Ericsson et al. 1993) and many relevant experiences with feedback and reflection. While all of these skills are usually introduced in programs like the MBA, they need to be further developed beyond the novice level and the developing will partially depend on the domain and situation. This is the second major challenge for enhancing and developing the executive skill; the generic managerial skill categories will exist across industries and situations, but the details will vary. Any training or development process must take this into account – the generic skills and the specific nuances. In a learning vehicle, the mechanisms must be calibrated to the executive’s entry skill level and structured that the executive’s mastery can increase.

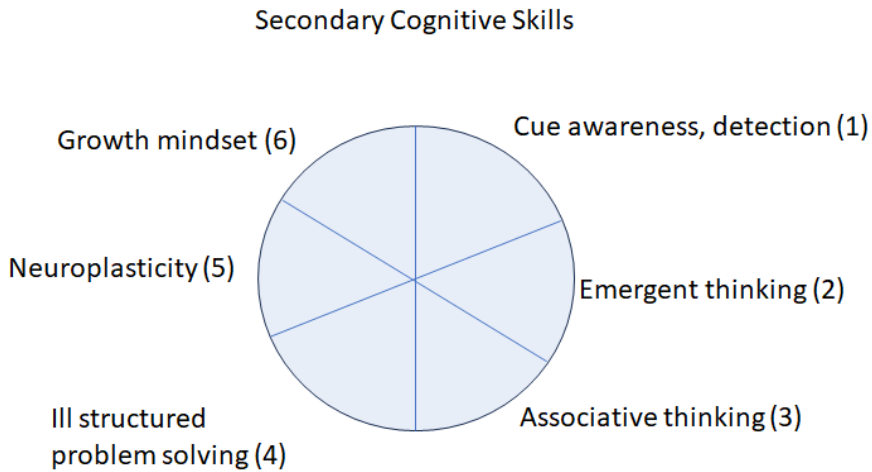
However, the knowledge domains and six generic skillsets are necessary but not sufficient to support what an executive does when dealing with the longitudinal situations.

There are additional, perhaps subtle, secondary level cognitive skillsets that the senior executive should have mastery over if the decision making is going to be well done, using the necessary knowledge domains and leveraging the generic skills. While the topics in Figures 3 and 4 are often found in the literature, deeper discussions about higher level cognitive skills are not. An initial, non-exhaustive, set of secondary cognitive skillsets as they relate to senior executive decision making are illustrated in Figure 5:

- 1) awareness of out-of-the-ordinary cues (Greitzer et al. 2009),
- 2) awareness of emergent opportunities (Mintzberg & Waters 1984),
- 3) associative thinking (Glöckner & Witteman 2010),
- 4) ill-structured problem solving (McMillan & Overall 2016),
- 5) neuroplasticity with respect to adaptive and resilient heuristic generation (Herrman et al. 2011), and
- 6) growth mindset (Miller 2016, Johnston 2017).

There are additional, underlying characteristics and traits associated with the six skills noted in Figure 5. There is intellectual curiosity and the intrinsic motivation and inclination to seek knowledge and explore ideas. Kashdan et al. (2020) points out how workplace curiosity is strongly linked to stress tolerance and being open to other people’s ideas and they suggest that workplace curiosity

Figure 5. Secondary level cognitive skillsets



is more related to outcomes than mindfulness. Another possible characteristic is the tolerance for cognitive dissonance. In their review, Hinojosa et al. (2017) note that most of the work has been at the microlevels of organizations, and that opportunity exists in the entrepreneurial context (one of several opportunities noted by the researchers). Metacognition, the ability to think-about-thinking is potentially important because decision makers should be aware of their own cognitive abilities and limitations (Ackerman 2017). The concept of sense-making, the ability to construct semantic mappings of ambiguous and confusing situations, which are then used in decision making appears to be another key skill needed by managers as they deal with a highly uncertain future (e.g., Weick et al. 2005).

4. SKILL AND CAPABILITY TAXONOMY FOR THE FOUNDATIONAL LEVEL OF EXECUTIVE DECISION MAKING

The three challenges and the work leading to them have led us to the belief that it is not reasonable to think that senior executive decision-making skill is developed by the repetition of specific decisions; it is not at the level of skill development that Ericsson et al (1993) has researched. We believe that the knowledge and skillsets are developed through the way executives see the problem and situation. Others have noted the complexity and contextual dependencies which further emphasizes the unlikelihood of replicated situations. For example, Nutt (1998) looked at the framing of strategic decisions, the role of external parties, the processes, and the difficulty of defining success. Nutt's work did not have a precise definition of strategic decision making and included many examples of what one firm might consider as strategic, but another might not. This lack of definitional clarity limits the power of Nutt's work, but the complications and issues discussed by Nutt are applicable for consideration in a serious game design.

Strategic decision making is basically how individuals 'see' the problem and bring past knowledge and experiences to bear. What moving parts do they 'see'? What are the interdependencies and co-dependencies? What are the constraints, degrees of freedom? Assumptions? Decisions that will need to be made. It is at this level of problem solving that we speculate cognitive expertise in decision making arises for senior executives and is responsible for repeated successes.

We can perhaps speculate that most senior executives will be well educated in the general knowledge domain and skillsets presented in Figures 3 and 4. Most executives will understand the basics of their industry and situation (Figure 3). Most will also have reasonably well-developed

skillsets for business decision making recipes and processes (Figure 4). They would have observed, participated in various activities as they progressed up the ranks. Perhaps some have seen others make similar decisions. They might have seen how things worked out, during the decision journey and afterward. They could have taken courses and workshops on various topics (e.g., topics typical of an MBA program). The skills and knowledge suggested by Figures 3 and 4 are necessary to support a taxonomy but not sufficient on their own. We suggest some key concepts of the taxonomy in Figure 5.

How are these subtle, secondary level cognitive skillsets acquired and developed? There has to be effective reflection and feedback during the journey. Over time, a body of additional knowledge and observed patterns will be created; cause and effects, cues to pay attention to, and strategies for resolving the unknowns and reducing risk. During this journey, they might also assist, be a member of the ‘team’ and have the possibility to consciously, deliberately practice what they have been reflecting upon and learning. These are all self-aware and mindful activities as well, being aware and seeing things normally taken for granted and ‘just done’. There is thinking about why things are happening and how the decisions are being made, not just a focus on the final decision. Some decisions will be well done, others satisfied, perhaps a few done sub-optimally. What are the traits and characteristics of the good, bad, and the ugly decisions? Some individuals will be self-aware, mindful of the situation, and consciously think about how things are done and how the decision making can be more efficient and effective, others will not. One group will develop cognitive expertise and the other will not. One group will have repeated success and the other will be hit and miss, relying on luck and the misfortune of others.

We propose the following skill and capability taxonomy for this foundational level of executive decision making, supported by Figures 3 and 4, but focused on Figure 5. The taxonomy addresses our proposed third challenge for serious game design; the ability to support the learning mode necessary for the higher level cognitive skill development.

The proposed taxonomy can be viewed as a systematic (a priori or in hindsight) framework that is needed for repetitive, successful ‘rare’ decision making. Meta-knowledge is the foundation, and the adaptive and anticipation skills are the key elements for the decision journey; allowing different types of infrequent decisions to be handled at a level of skill and expertise. Being able to support emergent and associative thinking, cue-awareness, neuroplasticity, the development of a growth mindset, and the ability to do ill-structured problem solving.

4.1 Meta-Knowledge

Meta-knowledge includes: i) long term memory storage and retrieval and the ability to create and use knowledge about past ‘similar’ situations, solutions, and strategies; ii) the ability to see complex, patterns of similarity and patterns of dissimilarity, as well as re-form complex patterns matching from several partial match patterns in long term memory; and iii) having meta-knowledge about the types of skills, knowledge, and expertise which are needed to investigate, analyze, and deal with each type of decision along the likely path.

4.2 Adaptive Control

This incorporates: i) the ability to know what clues should be actively scanned, listened, looked for and the ability to recognize such clues in developing ambiguous situations; ii) the ability to know and recognize what might be constraints, hard and soft, and understand the degrees of freedom or elasticity present in each; constraints which are restraining and confining, and constraints which are restraining and confining, and constraints which allow or force expansiveness and free-ranging thinking; iii) the ability to estimate and project what level of effort/risk & reward and gestation time is needed for the different, potential legs of the projected journey; and iv) prioritize cognitive resources effectively, to have the ability to know what decisions might be relevant versus irrelevant, and the ability to decide which of these decisions to consider and put resources on.

4.3 Anticipation

The concept of anticipation includes: i) The ability to project and simulate likely paths that the decision or situation will lead to, seeing multiple paths and identifying the most likely subset; ii) the ability to ‘read the play’, know where one is at, where one is going, what are likely branches, as well as the likely responses of competitors and cooperators; iii) the ability to see the evolution in the near and far future and timeline of how things might transpire during the decision making and afterward. Klein et al. (2007) describe the pattern matching, trajectory tracking, and conditional types of anticipatory thinking that they consider key for expertise in decision making.

5. IMPLICATIONS FOR SERIOUS GAME DESIGN FOR SENIOR EXECUTIVE DECISION MAKING

Section 4 proposed metacognitive skills required for the framing of decisions typically made by senior executives, beyond the basic decision making skillsets. Serious games, in general, can be quite sophisticated with simulated business situations that one or more players participate in. Often, multiple paths are imbedded in the game and as the players move through the journey of decision making and participating, the paths and future possibilities are opened based on what has transpired.

For serious games design specifically for SESDM, In the context of the secondary skillsets and the metacognition framework, we suggest the following general principles:

The following game characteristics/principles are suggested to be present **before** the exercise is conducted, imbedded in the design of the game:

1. A baseline, individual exercise should be conducted to determine the baseline thinking of each player. The baseline should address the knowledge domains, basic skills, and the secondary cognitive skillsets (Figures 3, 4, and 5).
2. The game should have a mix of individual and team decision making where one player makes a decision that all others then integrate, or the team arrives a decision and the game moves forward. This will support the processes illustrated in Figure 2.
3. The game should have imbedded cues, some obvious, some very subtle that depend on domain knowledge and deep understanding; as implied by situational cue awareness and emergent analysis.
4. The game scenario should be a typical decision that most of the players might have experienced or have seen – e.g., market expansion, new facility, capital expansion, merger / acquisition; or have read about, discussed (e.g., similar to something everyone in the industry would have seen, talked about). This would help satisfy the need to be relatable to the executive’s existing knowledge domains used in the decision making.
5. All the key cognitive skills relating to meta-knowledge, anticipation, and adaptive expertise, should have the opportunity to exist, tried, tested, and reflected upon. This will provide the opportunity to deliberately practice.
6. There should be an element of estimating, planning, projecting future paths in the game and then a comparison made to what happened, how accurate the estimates were, what was missed if the estimate was high or low. This is necessary for the learning of anticipatory skills.
7. There should be ‘personnel’ with different skills and expertise that might be known in the beginning or not, that are chosen to do delegated tasks with various outcomes – delays, mistakes, accuracy, etc. The mix should be realistic of real teams (e.g., not all CEOs), matching the process schema from Figure 2.

The following game characteristics/principles are suggested to be present **during** the game playing activity:

1. The games should progress from few degrees of freedom and open-endedness, and few co-dependencies, interdependencies to higher degrees of difficulty. Progressive learning, going from the certain to uncertain, structured to ill-structured (i.e., allowing for complex pattern matching skills to be observed / practiced).
2. The game can expose constraints and options in advance, or after a decision is made; the old ‘forgot to tell you’, ‘yes, but’ types of realistic situations of how knowledge and information is provided, unfolds, requires intelligent estimation/iterations.
3. The players should not be ‘learning’ two things at the same time. That is, the domain of the game should be within their normal industry or business space, at the domain level of knowledge. There is a need for the game to be relatable and match the individual’s knowledge and skill set.
4. The game should capture, track, and analyze how the decisions are made, not just the final decisions. The decision path(s) taken by the participant players needs to be appropriately captured and reported for the purpose of analysis, discussion, reflection. It is a key part of deliberate practice; the processes should flow somewhat like those found in Figure 2.

The following steps are suggested **post** exercise:

1. Approximately eight to ten games should be played, to start setting up habits and a pattern of thinking.
2. The games should be played over an extended time horizon, not all in one session; allowing time for game analysis, debriefing, and reflections to be conducted. This is also related to deliberate practice and the time implications in Figure 2.

6. DISCUSSION

We are intrigued and challenged by the longitudinal decision making that senior executives are faced by. This type of decision making is structurally different from the classical Cognitive Science expertise tasks and the in-the-moment Natural Decision-Making tasks typical of those represented by Figure 1 presented in the introduction. These structural differences appear to suggest that different approaches are needed to both study and improve the former type of decision making. In longitudinal decisions, there is a very broad and deep history in play, as well as a very broad and complex current ecosystem within which the decisions are being made. There are many factors to consider and usually a team is required to do the necessary deep-dives and analysis. In some cases, the expertise lies in the interpretation of the results and what is implied. In other cases, the expertise lies in the analysis itself, thinking it through and deriving the results. In almost all cases, the specific details will be different, and it is likely that individuals or organizations involved will also be different. The complex nature suggests that meta-skills and knowledge about the ‘how’ and the ‘what’ are in play and must be focused upon. There will likely not be far transference at the detail level.

We have presented three challenges in the paper. The first challenge was the need for knowledge domain relevance to the executive. The second challenge was to make the basic skill sets relevant to the individual, matching their entry level of master. The third challenge was to support the secondary skill sets which we suggest are important for senior executives to develop.

The characteristics in the challenges are based on a cognitive science perspective of the decision making and have been linked to pertinent research results. The themes of meta-knowledge, anticipation, and adaptive expertise appear to capture the salient and pervasive characteristics of infrequent, longitudinal decision making. We recommend that the following points be incorporated into serious games for improving senior executive decision making:

1. The decision scenarios are similar to ones that the executive has made in the past and can expect to be made in the future. For example, entering a new market, increasing production capacity by creating a new factory in a new country.
2. The scenario uses domain/industry specifics which would be known to the participants, using their background knowledge.
3. The clues or decision factors are exposed and shared with the participant in realistic ways – over time, some explicit, some implicit, some hinted at – where the participant has to pick up the significance and potential future use of the information on the fly.
4. The game is multi-player and played over months with each player having a role in the decision making similar to real situations, matching their role in the real world – e.g., legal, financial, marketing expertise.
5. There should be a series of milestones and partial decision making, collaboration leading up to the final go-no go decision.
6. There should be a holistic view of the game taking into account culture, world trends, competitor activity, weather events, etc.

Without these points addressed in an SESDM serious game application, there is likely to be short term wins, and near transference within the game or repetitions of the game, but no gain beyond the game, no far transfer. This is the key issue. The game must support the repeated activities and feedback needed to develop meta-knowledge and to deal with the corresponding cognitive complexity: comprehension, application, analysis, synthesis, and evaluation e.g., Bloom's Taxonomy (Anderson & Krathwohl 2001). The games must make the executive aware of the process, of the metacognition, and allow the executive the opportunity to see the value of conscious attention to these elements. The games must also support the skills needed to decipher, recognize, and decode the necessary signals and cues needed in adaptive expertise. These are also requirements for anticipation. All of these relate to the third challenge, the support for the secondary level cognitive skills used in decision making.

The preliminary research reported in this publication has only been able to scratch the surface and point to the nature of decision making and the characteristics to consider. It is a preliminary taxonomy and framework. It is suggested that a suitable, more complete operational taxonomy needs to be developed for the types of mechanics needed in serious games to support the cognitive taxonomy. Research is also needed to support the longitudinal nature combined with the collaborative, dynamic team situations; the game mechanics needed in this space. We also suggest that recent advances in technology (e.g., gazing analysis, eye tracking, wearable EEG, stealth assessments, AI etc) could be investigated as potential ways to support the understanding, monitoring, tracking, analysis, and development of these specific decision-making skills – to address the issues with observation methods and retrospective analysis. Additional research is also needed on how to create objective measures of skill development which are robust and applicable for real world situations in this specific longitudinal decisions and adaptive expertise context.

7. CONCLUSION

We analyzed senior executive decision making from a cognitive science perspective of skill and expertise, and propose a framework of meta-knowledge, adaptive expertise, and anticipation that could guide the design of serious games for SESDM which would have the express purpose of improving their skills in such decision making. We caution that the framework is preliminary and exploratory. A detailed taxonomy is required to further flesh out the framework and identify specific traits and their characteristics that such a serious game would need to support. It is doubtful that such a serious game that does not explicitly consider and support far transference will have sustained impacts on the decision maker using the game (i.e., the three challenges noted in the paper). There may be improvements within the game, but there will be no impact on the individual's real decision making

in situ. That being said, we believe it is possible to include the necessary concepts in the modern, state-of-the-art tools available and address the traditional shortcomings. The identified key gaps in this paper, also call for more research on adaptive expertise in longitudinal strategic decision making that are more prevalent in business contexts than classic NDM situations, beyond the dominant discourse on expert performance.

Specifically, we suggest that the concepts related to the knowledge domains, managerial decision making skills, and secondary cognitive skills be consciously incorporated into serious game designs for senior executive training. Once incorporated, a further, deeper analysis of the issues can be conducted including topics such as objective measurement.

We believe that appropriately designed serious games based on these principles can help address a number of the issues related to current use. These include the more complex dynamics and relationships illustrated in Figure 2; as well as the longitudinal issues, team decision making, complex cues, anticipatory factors, and ill-structured problems. Each of these will present research, design and implementation challenges. We hope that with better consideration of these factors, can help improve the odds of achieving meaningful, far transference and the desired goals of developing such games.

There is both opportunity and need to build a similar body of knowledge and objective measurements in the focus area of interest of this paper, as exists in the extensive research on NDM expertise. Building suitably designed serious games for SESDM can play an important role for such efforts.

FUNDING STATEMENT

The authors received no financial support for the research, authorship, and publication of this article.

REFERENCES

- Ackerman, P. L. (2018). *Expertise: Individual differences, human abilities, and nonability traits*. APA Handbook of Giftedness and Talent.
- Ackerman, R., & Thomson, V. A. (2017). Meta-Reasoning: Monitoring and Control of Thinking and Reasoning. *Trends in Cognitive Sciences, 21*(8), 607–617. doi:10.1016/j.tics.2017.05.004 PMID:28625355
- Anderson, L., & Krathwohl, D. A. (2001). *Taxonomy for learning, teaching and assessing: A revision of Bloom's Taxonomy of educational objectives*. Addison Wesley Longman.
- Barnett, S., & Koslowski, B. (2002). Adaptive expertise: Effects of type of experience and the level of theoretical understanding it generates. *Thinking & Reasoning, 8*(4), 237–267. doi:10.1080/13546780244000088
- Bohle Carbonell, K., Stalmeijer, R. E., Könings, K. D., Segers, M., & van Merriënboer, J. J. G. (2014). How experts deal with novel situations: A review of adaptive expertise. *Educational Research Review, 12*, 14–29. doi:10.1016/j.edurev.2014.03.001
- Brams, S. Z., Ziv, G., Levin, O., Spitz, J., Wagemans, J., Williams, A. M., & Helsen, W. F. (2019). The relationship between gaze behavior, expertise, and performance: A systematic review. *Psychological Bulletin, 145*(10), 980–1027. doi:10.1037/bul0000207 PMID:31414844
- Charbonnier-Voirin, A., El Akremi, A., & Vandenberghe, C. (2010). A multilevel model of transformational leadership and adaptive performance and the moderating role of climate for innovation. *Group & Organization Management, 35*(6), 699–726. doi:10.1177/1059601110390833
- Dane, E. (2010). Reconsidering the trade-off between expertise and flexibility: A cognitive entrenchment perspective. *Academy of Management Review, 35*(4), 579–603. doi:10.5465/amr.35.4.zok579
- Drucker, P. F. (2004). What makes an effective executive. *Harvard Business Review, 82*(6), 58–63, 136. <https://hbr.org/2004/06/what-makes-an-effective-executive> PMID:15202287
- Ericsson, K. A., Hoffman, R. R., Kozbelt, A., & Williams, A. M. (Eds.). (2018). *The Cambridge Handbook of Expertise and Expert Performance*. doi:10.1017/9781316480748
- Ericsson, K. A., Krampe, R. T., & Tesch-Römer, C. (1993). The role of deliberate practice in the acquisition of expert performance. *Psychological Review, 100*(3), 363–406. doi:10.1037/0033-295X.100.3.363
- Feltovich, P. J., Prietula, M. J., & Ericsson, K. A. (2018). In K. A. Ericsson, R. R. Hoffman, A. Kozbelt, & A. M. Williams (Eds.), *Studies of Expertise from Psychological Perspectives: Historical Foundations and Recurrent Themes* (pp. 59–83). The Cambridge Handbook of Expertise and Expert Performance.
- Glöckner, A., & Witteman, C. (2010). Beyond dual-process models: A categorisation of processes underlying intuitive judgement and decision making. *Thinking & Reasoning, 16*(1), 1–25. doi:10.1080/13546780903395748
- Greitzer, F. L., Podmore, R., Robinson, M., & Ey, P. (2009). Naturalistic Decision Making for Power Operators. *Proceedings of NDM9*, (pp. 37-44).
- Grenier, R. S., & Kehrhahn, M. (2008). Toward an Integrated Model of Expertise Redevelopment and its Implications for HRD. *Human Resource Development Review, 7*(2), 198–217. doi:10.1177/1534484308316653
- Griffin, B., & Hesketh, B. (2003). Adaptable behaviours for successful work and career adjustment. *Australian Journal of Psychology, 55*(2), 65–73. doi:10.1080/00049530412331312914
- Hatano, G., & Inagaki, K. (1992). Desituating cognition through the construction of conceptual knowledge. In P. Light & G. Butterworth (Eds.), *Context and cognition: Ways of learning and knowing* (pp. 115–133). Harvester/Wheatsheaf.
- Herrman, H., Stewart, D. E., Diaz-Granados, N., Berger, E. L., Jackson, B., & Yuen, T. (2011). What Is Resilience? *Canadian Journal of Psychiatry, 56*(5), 258–265. doi:10.1177/070674371105600504 PMID:21586191
- Inagaki, K., & Miyake, N. (2007). Perspectives on the Research History of Giyoo Hatano. *Human Development, 50*(1), 7–15. doi:10.1159/000097679

- Johnston, I. (2017). Creating a growth mindset. *Strategic HR Review*, 16(4), 155–160. doi:10.1108/SHR-04-2017-0022
- Kashdan, T. B., Goodman, F. R., Disabato, D. J., McKnight, P. E., Kelso, K., & Naughton, C. (2019). Curiosity has comprehensive benefits in the workplace: Developing and validating a multidimensional workplace curiosity scale in United States and German employees. *Personality and Individual Differences*, 155, 109717. doi:10.1016/j.paid.2019.109717
- Keestra, M. (2017). Metacognition and Reflection by Interdisciplinary Experts: Insights from Cognitive Science and Philosophy. *Issues in Interdisciplinary Studies*, 35, 121–169.
- Klein, G. (2008). Naturalistic Decision Making. *Human Factors*, 50(3), 456–460. doi:10.1518/001872008X288385 PMID:18689053
- Klein, G., Snowden, D., & Pin, C. L. (2007). Anticipatory Thinking. *Proceedings of the Eighth International NDM Conference*, June 2007, Pacific Grove, Larson, K. (2020). Serious Games and Gamification in the Corporate Training Environment: A Literature Review. *TechTrends*, 64, 319–328.
- McKay, K. N. (1992). *Production planning and scheduling: a model for manufacturing decisions requiring judgement*. [Ph.D. Thesis, University of Waterloo].
- McKay, K. N., Buzacott, J. A., Charness, N., & Safayeni, F. R. (1992). The scheduler's predictive expertise: An interdisciplinary perspective. In *Artificial Intelligence in Operational Research* (pp. 139–150). Macmillan Education UK. doi:10.1007/978-1-349-12362-9_15
- McKay, K. N., Waefler, T., & van Wezel, W. (2015). Expertise in Organizational Planning: Impact on Performance. In M. Frese & M. Mumford (Eds.), *The Psychology of Planning in Organizations: Research and Applications* (pp. 200–228). Taylor and Francis.
- McMillan, C., & Overall, J. (2016). Wicked Problems: Turning strategic management upside down. *The Journal of Business Strategy*, 37(1), 34–43. doi:10.1108/JBS-11-2014-0129
- Miller, C. (2016). *Expectations Create Outcomes: Growth Mindsets in Organizations*. UNC Executive Development.
- Mintzberg, H., & Waters, J. A. (1985). Of strategies, deliberate and emergent. *Strategic Management Journal*, 6(3), 257–272. doi:10.1002/smj.4250060306
- Nutt, P. C. (1998). Framing Strategic Decisions. *Organization Science*, 9(2), 195–216. doi:10.1287/orsc.9.2.195
- Pulakos, E. D., Arad, S., Donovan, M. A., & Plamondon, K. E. (2000). Adaptability in the workplace: Development of a taxonomy of adaptive performance. *The Journal of Applied Psychology*, 85(4), 612–624. doi:10.1037/0021-9010.85.4.612 PMID:10948805
- Sala, G. A., Aksayli, N. D., Tatlidil, K. S., Tatsumi, T., Gondo, Y., & Gobet, F. (2019). Near and Far Transfer in Cognitive Training: A Second-Order Meta-Analysis. *Collabra. Psychology*, 5(1), 18. doi:10.1525/collabra.203
- Simons, D. J., Boot, W. R., Charness, N., Gathercole, S. E., Chabris, C. F., Hambrick, D. Z., & Stine-Morrow, E. A. L. (2016). Do “brain-training” programs work? *Psychological Science in the Public Interest: A Journal of the American Psychological Society*, 17(3), 103–186. <https://doi.org/10.1177/1529100616661983>
- Weick, K. E., Sutcliffe, K. M., & Obstfeld, D. (2005). Organizing and the Process of Sensemaking. *Organization Science*, 16(4), 409–421. doi:10.1287/orsc.1050.0133
- Wiley, J. (1998). Expertise as mental set: The effects of domain knowledge in creative problem solving. *Memory & Cognition*, 26(4), 716–730. doi:10.3758/BF03211392 PMID:9701964

Kenneth McKay is a Management Sciences Professor at the University of Waterloo. His current areas of research involve interdisciplinary research integrating operations management, information systems, and human judgment used in decision making and predictive analytics. He is exploring the use of serious gaming for developing senior management decision making and for tracking cognitive skills as they change over time.

Pavan is appointed as Professor of Practice in Jindal Global Business School. His applied research interests are in learning innovations leveraging immersive engagement and bio-feedback based objective measures for better strategic thinking ; and in better appreciating the role of sub-conscious cognitive processes for Adaptive Strategic decisions under high flux and uncertainty. Pavan is a serial entrepreneur with a strong track-record of investor returns and successful exits including start-ups, high growth and turn-arounds. He also has 20+ years of international Senior Partner level corporate advisory experience in Country & Regional Head roles across Australia, USA, South East Asia and India with Strategy consulting & Private Equity firms such as Halcyon Partners, AT Kearney, Stern Stewart & co. and the Boston Consulting Group. In earlier career roles, he worked in corporate strategy; technology management and incubation, and as an engineer and research scientist. Pavan is an Indian born, US educated, Australian citizen, former permanent resident of Singapore and an Overseas Citizen of India.

Darshi Shah has completed her Bachelor of Arts in Psychology from California State University, Long Beach. She is currently pursuing her postgraduate degree in Applied Psychology from Narsee Monjee Institute of Management Studies. She is also a Research Assistant at the Centre of India Australia Studies (CIAS) of O. P. Jindal Global University.