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What often keeps them awake at night? – A synoptic review from operations managers' perspective

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Abstract: *This study provides a synoptic review of operations management from practitioners' perspective. The challenges facing operations managers are discussed around the practice of handling issues, risks, and uncertainties with brief review of academics and practitioners' insights. The synoptic review reveals that these events whether current (issue), possible (risk) or unpredictable (uncertainty) contribute to factors that often keep operations managers awake at night – mainly because most business decisions are made with incomplete information and in the face of an uncertain future. The graphical deconstruction of operations managers' perspective and the integration of the concept of spectrum of organisational DNA provide an augmented perspective of operations management. By merging different academic approaches, the study proposes a hybrid concept which includes risk and uncertainty. This hybrid concept portrays the uncodified and implicit way with which operations managers handle the dynamic interplay between risk, uncertainty, and management strategies. This study adds a pragmatic perspective to operations management.*

Keywords: operations management, review, issues, risk, uncertainty,

INTRODUCTION

The business realm is driven by a profit motive and is characterized by economic activities involving the production, distribution, or exchange of goods and services. It inherently involves risk and uncertainty in a complex and interconnected environment. Operations managers' duty revolves around costs control, profit maximisation, and suitable resources allocation. This is achieved by utilising resources efficiently to match supply and demand. Even though this appears to be straightforward, the reality is that the duty of operations managers is not for the fainted heart. Often, on the one hand, they must deal with issues that have occurred whether trigger by internal or external events, and on the other hand, risk assess events that could possibly occur, while forming an opinion on events that are unpredictable. Failing to deal decisively with current events and future possible or unpredictable events through renewal/innovation and/or adaptation, could result in the organisation to stutter, wither, and eventually stagnate. Strategizing about these events is at the core of the duty of operations managers. These events, whether current ("issues"), possible ("risks"), or unpredictable ("uncertainties"), dealing with them ends up giving the organisation an always different face as organizations adapt their structures to maintain fit with changing environmental factors (Sousa and Voss, 2008). Nisma et al.

(2024) highlight that "within the contemporary landscape of global business, the dynamic interplay between risk, uncertainty, and management strategies has become increasingly vital for organizational success and survival". In addition, "globalisation and fast technological innovations scenarios have increased the complexity and interrelation of risks and uncertainty" (Carmine, 2022). According to Robinson (2006) "most business decisions are made with incomplete information and in the face of an uncertain future". "Decision making is certainly the most important task of operations managers and often a difficult one - from which derive on the one hand both costs and revenues, and on the other hand both opportunities and risks" (Taghavifard et al., 2009). Hence, operations managers (or decision makers) "must often seek the best course of action despite conditions of the unknown, described by risk and uncertainty" (Goerlandt and Reniers, 2016). "Risk management plays a key role in uncertain times, since it prevents organizations from acting rashly and incorrectly, and allows them to become flexible and resilient" (Settembre-Blundo et al., 2021). "Risk monitoring plays a significant role in the early identification of issues, as it allows operations managers to keep track of all possible adverse events and their likelihood of occurring" (Chen et al., 2022).

According to Bertini (1991), "the significant factor for the generation of risk and uncertainty is the inability of man to know in advance both the occurrence time and entity with which future events occur". This is mainly because human brains are "pattern-recognition machines" (Rock, 2008), the challenge is the impossibility of resorting to past experiences due to the singularity with which the various phenomena present themselves as highlighted by Carmine (2022). Furthermore, "all future events whether predictable or unpredictable are uncertain, and each economic act has elements of uncertainty, depending on the knowledge and forecasts that one is able to make regarding the occurrence of the various facts". Hence, this study is articulated around three points. Firstly, to provide a synoptic review of the multifaceted field of operations management. Secondly, to identify factors that often keep operations managers awake at night. And thirdly, to attempt to scrutinize the uncodified and implicit way with which operations managers handle the dynamic interplay between risk, uncertainty, and management strategies.

Operations management underlying questions.

Operations management is concerned with "converting materials and labor into goods and services as efficiently as possible" (Greasley, 2008) by trying to balance costs with revenue to maximize net operating profit. Organisations attain and maintain high performance by adapting to changing contextual factors. According to Sousa and Voss (2008), typical underlying contextual questions include: "what processes and practices apply in which contexts? what relationships hold or do not hold in which contexts? And lastly, where do methods work and do not work or how do they vary in different contexts?" The lifespan of firms has four stages: startup, maturity, renewal/innovation, and decline. In most cases the renewal/innovation stage is driven by adaptation failing which the organisation could propel its downfall. The renewal/adaptation derives from ever changing business environment which is characterised by risks and uncertainties. Although fundamental questions should be successfully answered during the startup stage, similar questions could arise during the life of the organisation due to required major changes related to renewal/adaptation. These questions include: What goods/services will be produced? How will goods/services be produced? Who will get the output? How will the system accommodate change? How will the system promote progress? In addition, operations managers should review the design of the process failing which the organisation could miss foreseeable opportunities. This review ensures that the process hierarchy that divides core business processes into lower-level processes with detailed tasks/activities and graphically represents them is aligned to major changes (Thakar, 2021). The choice of process design is most dependent on the volume and variety of the

product or service that an organisation offers. The above exercise related to startup or renewal/adaptation stages is carried out keeping in mind the major business risks: "value risk, business viability risk, usability risk, and feasibility risk" (Krajewski et al., 2016).

The choices of competitive priorities

Writers highlight the importance of applying competitive priorities that include cost, quality, time, and flexibility as the basis for an organisation's operating strategy (Masyhuri, 2023; Krajewski et al., 2013). However, they caution that "there is no guarantee that selecting specific competitive priorities will maintain the organisation's position in the marketplace; because selection requires a critical and continuous process across the organisation's conditions in relation to the external environment which constantly influences the choice of competitive priorities". In today's dynamic business environment, academics recommend organisations to focus on strategic flexibility and innovation capabilities as additional tools to traditional competitive priorities (Awais et al., 2023; D'Aveni, 2018; Hayes and Pisano, 1994). The key questions that preoccupy operations managers include: Which employees need help getting aligned with the organisation's mission? What improvements can be made to achieve and exceed productivity goals? Which processes can be made more efficient? Which resources are being wasted and why?

Academics have developed a range of competitive priorities models (Díaz-Garrido E. 2015; Madi and Munapo, 1016) and theories (Boer et al., 2015) as strategy enablers to aid operations managers, including "(1) 'high-level' theories that are being used across all fields management (such as Transaction cost economics, the Resource-based view, and Institutional theory); (2) 'mid-range' theories that make general predictions within a given context (such as the Sand-Cone model, Swift even flow, or Performance frontiers); and (3) 'focal' theories that make specific predictions within a prescribed context (such as Waiting times in a single-server queue: Little's Law and Kingman's formula)". Nevertheless, it is interesting to note that "all but one of the operations management innovations were developed by organisations, not academics" (Mol and Birkinshaw, 2009). It is worth mentioning that while the academic arena is highly challenging, one could claim that both the academy and industry have their own set of challenges. Lastly, practitioners at the industry hope that "academics identify and validate robust facts to make important tangible contributions and save theoretical discussions for appropriate and impactful platform" (Boer et al., 2015).

The functions of operation management.

"Operations strategy theory mainly deals with alignment between operations choices with factors such as process, volume, variety, and competitive priorities. These theoretical product-process relationships have been articulated" by Hayes and Wheelwright (1984) for manufacturing firms and by Silvestro et al., (1992) for services industry. The design and management of operations strongly influence the efficiency of the organisation regarding the amount of resources utilised to manufacture goods or deliver services to customers. The main functions of operations management have been extensively covered (Wolniak, 2020; Wilson, 2018; Knod and Schronberger, 2000), and they include: "planning, scheduling, organizing, purchasing, controlling, quality control, and inventory control". Supply chains management "makes predictions about how a process performs in light of variation, delays and multiple handoffs, and studies the behaviour of connected processes" (Boer et al., 2015).

Issues faced by operations managers

Operations management covers topics that range from "traditional manufacturing management, via operations strategy and supply chain management, to service management" (Buffa, 1980; Sprague,

2007; Voss, 2007); hence it has become one of the key areas of management. Operations managers view issues from three different aspects: Inevitability, severity, and response (Hansson & Aven, 2014). In a nutshell, an issue is a problem that has already occurred, and operations managers need to act. It is a hindrance and is invariably negative. Dealing with issues is time and effort consuming and revolves around solving the problem to return the operations to its original state. Operational issues could be triggered by internal or external events, arising from day-to-day operations including human errors, system failures, supply chain disruptions, and natural disasters.

The work of academics was outlined by Boer et al. (2015). It seems that operations managers' mind is programmed to deal with issues by following a pattern like academics, however with more practical orientation. The scrutinization of issues revolve around three points: (1) to show that the issue is of practical importance from a business point of view; (2) to highlight what is known about this issue or similar phenomena; and (3) to validate if current knowledge can explain the issue and if not, new facts/theories are needed. To put it bluntly, they test data from both sides of the coin – (what they know and do not know). The crucial attributes of an operations manager when solving issues include prioritising team members' safety before proceeding to meet customer needs and safety, humility and teamwork, constantly developing team members, and lastly, action-oriented problem-solving. Even though risk monitoring is costly and time-consuming, "it plays a significant role in the early identification of issues, as it allows operations managers to keep track of all possible adverse events and their likelihood of occurring" (Chen et al., 2022). The next section covers risks in operations management.

Risks in operations management.

Academics state that "the risk assessment and risk management as a scientific field aims to study and treat the risk of specific activities and to perform generic risk research and development related to managing/governing risk" (Aven, 2016 Aven and Zio, 2014; SRA, 2015b). On the other hand, operations management practitioners contend that risk is an inherent aspect of business operations, arising from factors such as market fluctuations, economic downturns, technological disruptions, and unforeseen events (including human errors, system failures, supply chain disruptions, and natural disasters). Similar to "issues", operations managers view risks from three different aspects: inevitability, severity. and response. In a nutshell, "risks concern events that could possibly occur in the future and could be either positive or negative for the organisation even though the perception is invariably negative" (Aven, 2016). The goal of risk management is to proactively prevent risks from occurring (if possible). It is important to highlight that according to operations mangers' perspective, issues at hand and risks reside within the business realm and no organisation is immune. This is mainly because while dealing with issues, compliance to control measures of organisation's listed risks is unconditional. In addition, issues at hand could generate newer risks.

"Effective risk management strategies enable to identify, assess, mitigate, and navigate risks" (Guo, 2023). By proactively addressing potential challenges, it is possible to safeguard assets, maintain stability, and seize opportunities even in the face of volatility. An important aspect here is the ability to adequately read signals and the precursors of serious events. Operations managers attempt to reduce risks through the linear process of risk identification, assessment, measurement and mitigation, monitoring, and reporting. Burstein and Inon (2024) highlight that "during the risk identification stage, the possible causes of disruptions and the magnitude of events are examined for external and internal factors. Next, the risk analysis process quantifies each event's risk level based on likelihood, severity, and control mechanisms for reducing the risk and their effectiveness. Finally, a comprehensive risk assessment can be considered, and decisions can be made concerning addressing each risk". The types

of risk management strategies include: "risk avoidance, risk reduction, risk transfer, risk acceptance, and risk mitigation" (Guo, 2023). Writers provide guidance on risk acceptance and tolerability criteria (Rodrigues et al., 2014). Risk matrices and risk diagrams are extensively used for safety risks (Thomas et al., 2014; Ale et al., 2015).

Operations managers' fundamental risks related questions include: "How could organisation better identify gaps between the decisions made and their execution? How can systemic, embedded, and networked risk exposure be identified and whose role is it to manage these risks? How might new technologies be used to enhance risk decision making? How might decision makers adequately communicate risks, both internally and externally?" Hansson and Aven (2014) emphasise that "the risk evaluation considers the scientific burden of proof and the practical burden of proof in a particular decision. In addition, the operations managers' (or decision maker's) review and judgement go beyond the scientific field to include a combination of factual and value-based considerations".

Riabacke (2006) advocates for statistical data driven decision rather than decisions that are based on intuition and gut feeling. Lund et al., (2011) highlight the challenge of "risk analysis of changing and evolving systems. They caution that the resulting risk picture is valid only at that point in time and under the assumptions made". Hence, specialised techniques and guidelines are required for changing risks. Guo (2023) concludes that the benefits of effective risk management encompass "enhanced resilience, optimal resource allocation, sustainable growth, stakeholder confidence, and regulatory compliance". Chen et al., (2022) assert that "risks stem from a variety of sources whether internal or external, and their impact on operations can vary in severity on the profitability and capital of a business". Following is a non-exhaustive list of types of business risk: financial risk, legal and compliance risk, strategic risk, operational risk, health and safety risk, and reputational risk. Operations managers always pay careful attention to positive risks since the organisation could use them as leverage e.g. the emergence of a new technology that could increase efficiency and unlock faster sound decision-making.

Aven (2016) acknowledges that risks could bring in uncertainty. Flage et al. (2014) deal extensively with uncertainty in risk assessments. They argue that "probabilistic analysis is the predominant method used to handle the uncertainties involved in risk analysis, both aleatory (representing variation) and epistemic (due to lack of knowledge)". A central area of uncertainty in risk assessment is "uncertainty importance analysis" where considerable work has been conducted (Borgonovo, 2015; Aven & Nøkland, 2010). Goerlandt and Reniers (2016) highlight the momentum gained by "the need to include uncertainty in safety risk perspectives". Several academics believe that graphical consideration of uncertainty in risk diagrams provides strong risk communication (Fischhoff, 1995; Spiegelhalter et al., 2011). "Scientists have a responsibility to consider the consequences of error if evidence is poor and if this may lead to foreseeable changes to the conclusions of an inquiry; these uncertainties need to be made explicit" (Douglas, 2009; Shrader-Frechette, 1993; Aven, 2011; and Goerlandt & Montewka, 2015). Numerous authors have argued for perspectives where uncertainty is given a more prominent role than in traditional probability-based perspectives (Aven and Zio, 2011; Flage et al., 2014; Haugen and Vinnem, 2015; Montewka et al., 2014).

Alternatives perspectives of uncertainty-based risk were developed in relation to safety risks (Levin, 2005; Flage and Aven, 2009; Montewka et al., 2014 and Goerlandt et al. 2014). They distinguish two broad classes of uncertainty: (1) outcome uncertainty which "as a cognitive attitude of an assessor, who, at a given time, simultaneously holds mutually exclusive beliefs about the occurrence or non-occurrence of an event" (Singpurwalla, 2006; Watson, 1994; Aven & Reniers, 2013; Lindley, 2006); and (2) evidence uncertainty which "focuses on the poor or unreliable evidence base (here assumptions may be poor, models may be crude, and data may be inaccurate or unreliable)" (Shrader-Frechette, 1993; Aven,

2011; Goerlandt & Montewka, 2015a). In general, "many organisations which believe they manage risk effectively find themselves unprepared for 'black swans'" (Hansson & Aven, 2014). Operations managers must often seek the best course of action despite conditions of the unknown described by risk and residual risk. It is literally a balancing act of different concerns, including profits, safety, reputation – this burden weighs down on them and often results in keeping them awake at night.

Uncertainty in operations management

While operations managers are overwhelmed with issues and risks, there is a third entity that is inviting itself on their menu – "uncertainty". Uncertainty refers to "unpredictable events and changes that can either pose challenges or offer opportunities to businesses" (Courtney et al., 1997). For instance, a sudden technological breakthrough opening new markets, or an unexpected surge in raw material prices due to geopolitical tensions. Often, uncertainty is driven by a range of elements ranging from "economic fluctuations and market volatility to technological advancements and regulatory shifts" (Chen et al., 2022). In addition, numerous sources contribute to business uncertainty such as "changes in consumer preferences, competitive pressures, and supply-demand imbalances, political instabilities, or environmental factors which can result in unpredictable revenue streams or profit margins".

Flynn et al., (2016) elaborate on the types of business uncertainty that can occur despite their unpredictability and variety: "Extreme uncertainty, Generated uncertainty, Political uncertainty, Financial uncertainty". Merton (1936) and Kaye et al., (2020) offer a slightly different categorisation of types of uncertainty: "Limited knowledge due to the unpredictability of fortuitous outcomes, Limited knowledge due to ignorance, Modelling limitations and ambiguity, Errors and other operational uncertainty, People uncertainty (arising from a lack of awareness of possible hidden agenda or unintentional biases), and Social and ethical uncertainty".

Kaye et al., (2020) suggest that effective management of uncertainty can lead to informed decisions and outline six principles to manage uncertainty: "Face up to uncertainty, Deconstruct the problem (by considering the way the question itself has been framed, the dynamics and motivations at play), Don't be fooled (un/intentional biases in the absence of certainty, or facts and data), Models can be helpful, but also dangerous (where true uncertainty exists, rules of thumb in the hands of an experienced practitioner can be a better approach), Think about adaptability and resilience, and lastly, Bring people with you". They argue that "face up to uncertainty and take people with you" are the most important. They believe that "face up to uncertainty" encourages to tune in to uncertainty, regardless of its messiness and unpredictability, and despite of deeper human instincts to turn away. They support this based on Rock (2008) research that presumes that human beings are "biologically programmed to seek certainty. To solve problems, human being natural instinct tries to apply memories or experience to predict what will happen next. This is driven by the notion that human beings' brains are "pattern-recognition machines". However, uncertainty automatically takes attention away from one's goals, forcing attention onto the error.

Courtney et al., (1997) models comprise four levels of uncertainty: "a Clear-Enough Future (where operations managers can develop a single sufficiently narrow forecast of the future that is precise enough for strategy development), Alternate futures (where the future can be described as one of a few alternate outcomes, or discrete scenarios), a Range of futures, and lastly a True ambiguity". Kaye et al., (2020) model focuses on two aspects: "Clarity of scope (Clear context, objectives and scope or inherently vague or poorly explained/understood) and Scope of quantification (a modelling challenge, or an uncertainty challenge). They basically advocate two steps (1) analysis and decision making (understanding the uncertainty in terms of risk, opportunity, threat, to make decisions) and (2) renewal, innovation, and adaptability".

Taghavifard et al. (2009) argue that "for any given problem, the degree of certainty varies among operations managers depending upon how much knowledge each one has about the same problem. Therefore, the domain of decision analysis models falls between two extreme cases: the degree of knowledge we have about the outcome of our actions, and the opposite which is pure uncertainty". Various models of uncertainty have been developed for fields such as inventory management and production planning, pricing and revenue management, scheduling and project management, transportation and vehicle routing. Lu and Shen (2020) highlight that nontraditional methods are required for solving uncertainty in operations management, they "discuss the representation of uncertainty and the decision-making criteria according to various sources of 'model uncertainty' such as demand, supply, and preference".

In summary, few strategy questions are still relevant and contribute to factors that often keep operations managers awake at night: How will the future look like? Which resources to unlock to reposition the business? How is the business going to do this? And when or how the business is going to exit, adapt, or change course? In addition, "due to the accelerated globalization, the 'butterfly effect' that occurs elsewhere can also affect operations and future decisions" (Kaye et al. (2020). This implies that, the risk and return on investment are closely related to global uncertainty.

Modelling operations managers' perspective

Operations managers use several tools, methodologies, and frameworks to anticipate, assess, and navigate risks and uncertainties, including scenario planning, risk assessments, financial hedging strategies, or diversifying product lines and geographical markets. Flynn at al. (2016) explain that "while we can't always predict what the future might bring, operations managers should take steps to be better prepared for when uncertainty does undoubtedly arrive". Sharing ideas can trigger innovation with which stems greater ways of combating uncertainty; nonetheless, many organisations are still apprehensive to share their failures and successes.

The deconstruction of operations managers' perspective could be carried out using graphical representation as depicted in Figure 1 - where Y axis represents "possible" events (encompassing everything that is conceivable, regardless of its likelihood) and X axis represents "predictable" events (encompassing the degree to which future events could be anticipated based on past data, patterns, or established models). This is substantiated by the fat that Chessa (1927) and Douglas (2009) observe that where there is a risk, the predictions can never be carried out systematically without incurring the possibility of error (or uncertainty about the outcome); inversely uncertainties bring risks. The intersection of "possible" and "predictable" represents the area where events are both entirely conceivable and have the highest degree of certainty. The location of "Issues" on the graph points to the fact that issues are problems that have already occurred hence they are beyond the notion of occurrence possibility and predictability (in purely spatiotemporal terms). As we integrate possible and predictable events and move from "close to" to "far from" {possible; predictable}, a spectrum of various risks and uncertain events is covered. This spectrum spans from areas where events are both conceivable to some extent and have a degree of certainty ("blue area"), to events that are conceivable to some extent but uncertain at various degree ("yellow area"). The weather system could be used to provide an illustration: short-term weather is relatively predictable (e.g., tomorrow's extent of rainfall, wind speed, and temperature), and risks to the business are conceivable. Long-term climate change predictability ranges from less predictable to unpredictable due to complex interactions of multiple factors, and risks to the business are conceivably high and could trigger insolvency or opening unchartered business opportunities. Finally, the area coloured in red cautions that on one hand, risks are not inherently impossible to conceive, and on the other hand, uncertainty is not inconceivable as it refers to a lack of knowledge or certainty about something. It is worth mentioning that due to the changing and evolving

nature of the business realm and technology, an event that is currently impossible could become possible in future.

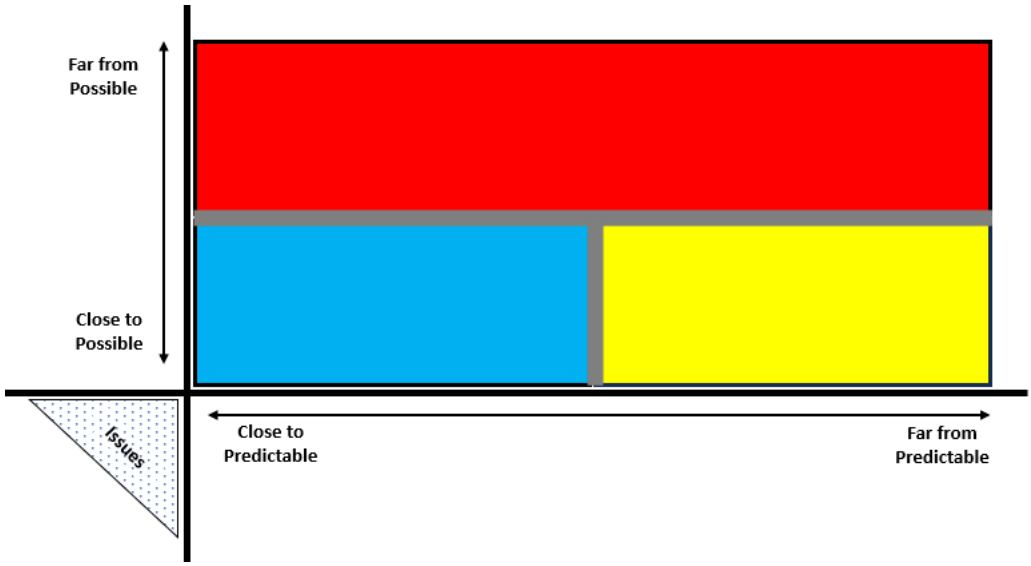

Figure 1. A glance of what often keeps operations managers awake at night

As depicted in figure 1 the perspective of operations mangers is articulated around three specific aspects within the business realm and no organisation is immune. These include: (1) to deal with issues or events that have occurred and have inherently negative impact; (2) to assess events that may or may not occur with potential positive or negative impact and set operations such that the impact on profitability of capital business is minimised if negative or maximised if positive; and lastly, (3) to form an opinion on events that cannot be predicted which could have positive or negative impact, and strategize to navigate through to ensure sustainability.

Lessons from the past have reveal that organisations that swiftly adapt to change, harness new opportunities, and mitigate potential downsides survive in uncertain environments but also thrive and outpace their competitors. At an organisation level, the internal and external environments dynamics require to manage with insight and lead with foresight. "Managing with insight and leading with foresight influence organizational alignment with the environment and firm resources and processes, and on the establishment of an organization's course of action, deriving from renewal and innovative ideas" (Madi, 2025). Overall, preparation is vital to guarantee success regarding sensible course of action. The ever-changing and unpredictable facets of the business environment, necessitates agility, and adaptability and above all to manage with insight and lead with foresight to achieve sustained success amidst issues, risks, and uncertainties. Borrowing from the concept of "spectrum of organisational DNA model" (Madi, 2025) and integrating "what often keeps operations managers awake at night", the complexity of operations management is revealed and stems from dealing with issues, eliminating/mitigating risks, and uncertainty preparedness. In this instance, operational layers consisting of shopfloor employees up to CEO interact with business realm layers (of issues, risks, and

uncertainties). Figure 2 depicts this complexity. For example – an action by a worker could generates an issue, a near miss or trigger a risk. While a risk could bring in uncertainty, and inversely.

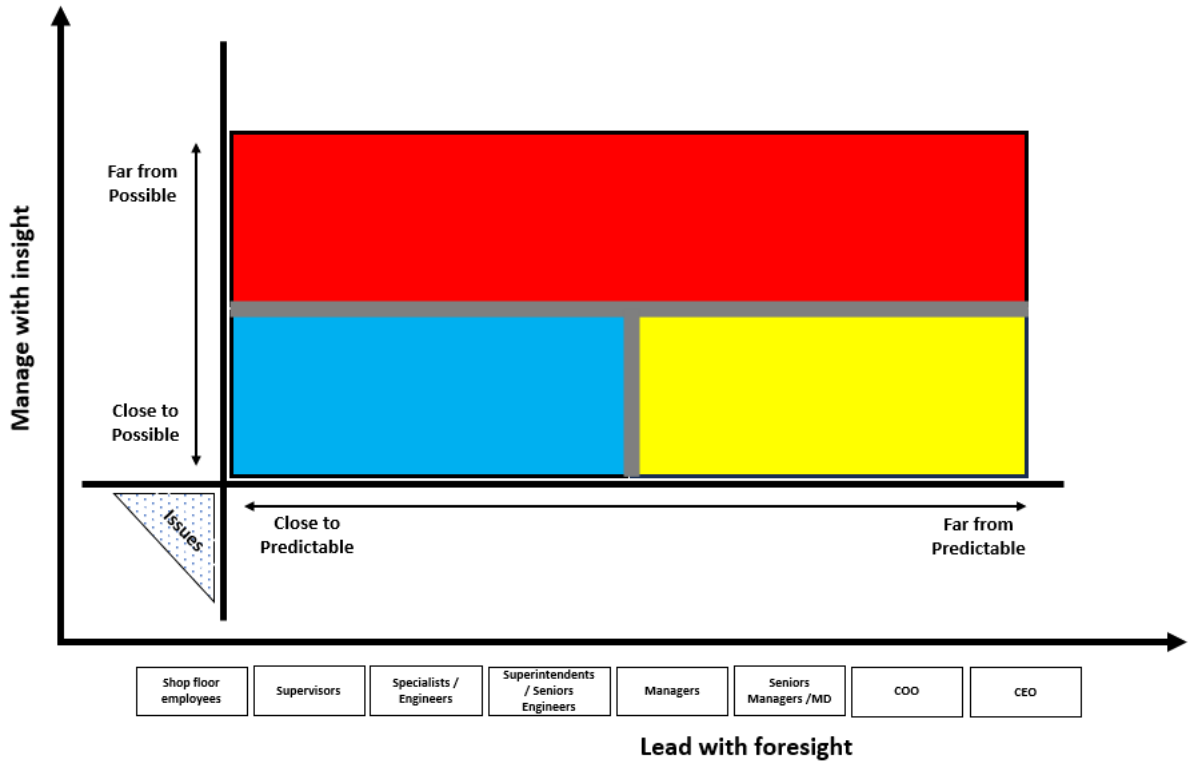

Figure 2. Depiction of interaction between operational and business realm layers

When issues arise, operations managers provide direction and steer the organisation; however, the bulk of work related to dealing with issues is executed by the shop floor employees, supervisors, specialist/engineers, and superintendents/Senior engineers. Dealing with issues consists of solving the problem to return the operations to its original state. While risk can be difficult to navigate, Superintendents/Senior engineers and Managers are often the risk owners within the organisation. It is their duty to ensure that the risk management processes are embedded. At least risks afford the option to decide whether to act upon them or not. Navigating through business uncertainties is even more challenging, this lies under the responsibility of senior managers/Directors, COO, and CEO to ensure that the organisation is prepared for unforeseen events since there is literally no control over whether or not to face the many challenges uncertainty poses.

Although risks can be managed and uncertainty is uncontrollable by nature, daily, operations managers make a set of decisions which in turn translate into actions from which derive both opportunities and risks and in some cases uncertainty. Carmine (2022) contends that “risk is a component of the uncertainty that arises in relation to the appearance of costs, losses or the realization of damage. Therefore, risk is closely related to the degree of uncertainty that a fact will occur at a future moment, however, only if analysed in relation to the forecasts made. Hence, the transition between the observed uncertainty and the risk perceived by a person or by an organisation takes place through the reference to the forecasting process”. Bertini (1991) defines the risk in relation to "the uncertainty that the organisation is forced to undergo at the possible occurrence of events that fall within its orbit". Several variations of uncertainty-based risk perspectives were developed in relation to safety risks (Levin, 2005;

Flage and Aven, 2009; Montewka et al., 2014; Goerlandt et al. 2014; Goerlandt and Reniers, 2016). Furthermore, uncertainty aspects of clarity of scope and scope of quantification carry unforeseeable risks (Courtney et al., 1997; Flynn et al., 2016; Kaye et al., 2020; Chen et al., 2022). Based on the above perspectives on risk and uncertainty which are influenced by changing and evolving business environment (Lund et al., 2011), the different academic approaches can be merged into a new understanding which has enabled to propose a hybrid concept which includes risk and uncertainty - respectively for events that could possibly occur and events that are unpredictable. Bringing together these different traditions opens a new perspective of research. This is mainly because, according to the operations mangers' perspective, issues at hand, risks and uncertainties reside within the business realm and no organisation is immune. Figure 3 models' operations managers' perspective on risk and uncertainty. Most importantly, it displays a curve for an acceptable mitigation level that cannot be mitigated further without efforts and costs being disproportionate to benefit gained or where the solution is impractical to implement. This hybrid concept depicts the uncodified and implicit way with which operations managers handle the dynamic interplay between risk, uncertainty, and management strategies. While this concept of acceptable mitigation level is applied to every risk and uncertainty, an illustration at industry level could be provided, e.g. the stock market is inherently volatile and prone to risks and unpredictable events, its acceptable mitigation level, would be different in nature from other sectors which have inherent risks and more predictable performance based on established trends and financial data.

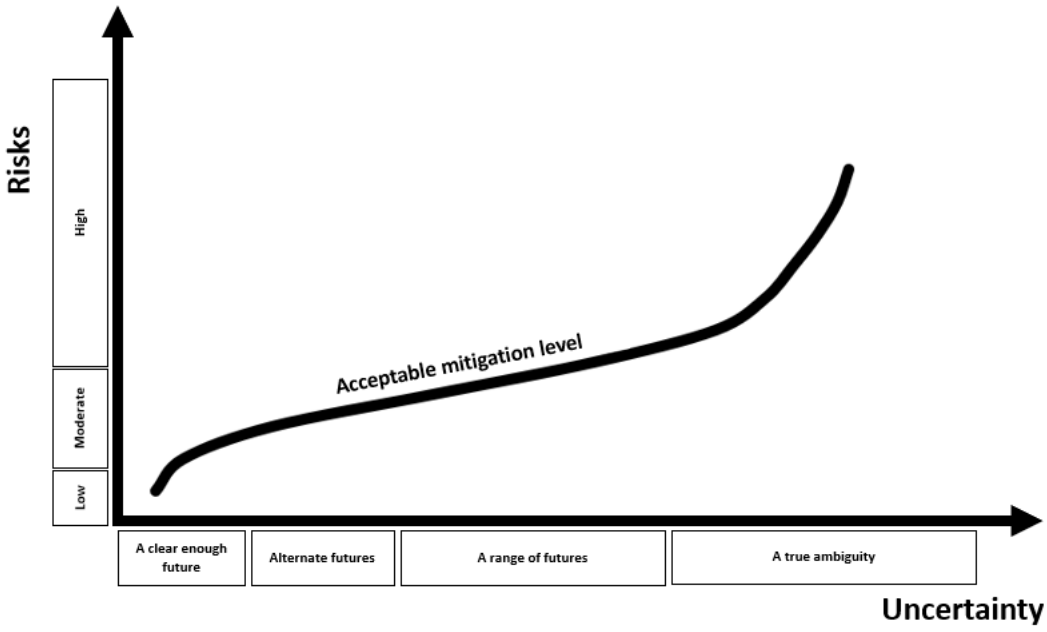

Figure 3. Acceptable mitigation level

When there is a possibility that an event may occur in the future, this event will generate a certain degree of uncertainty; and inversely when there is an event that is unpredictable that event will have a certain level of risks. The common foresight method summarized in three steps by Barrett et al. (2021) - trend and megatrend analysis, scenario planning, and visioning and backcasting could be used to establish the levels of uncertainty proposed by Courtney et al., (1997). It can be argued that when there is low

level of uncertainty or "A clear-enough future", operations managers can develop a single forecast of the future through modelling since the scope is somehow clear. However, this will be inexact and carrying moderate risks after control measures are instituted because all business environments are inherently uncertain. The forecast will be sufficiently narrow to point to a single strategic direction. For instance, one of the major risks for the artificial intelligence development is cybersecurity, while organisations have a clear enough picture of the future, one cannot predict how it will pan out, even though implemented control measures reduce the risk to "moderate". A true ambiguity "translates into multiple dimensions of uncertainty interacting to create an environment that is virtually impossible to predict" (Courtney et al., 1997). Hence, Taghavifard et al. (2009) state that when probability is used to express uncertainty, the deterministic side has a probability of one (or zero), while the other end has a flat (all equally probable) probability and associated risks; One could argue that these probabilistic outcomes are respectively equivalent to "A clear enough future" and "A true ambiguity".

Alternate Futures - here "the future can be described as one of the few alternate outcomes, or discrete scenarios. Analysis cannot pinpoint which outcome will occur, even though it may help establish probabilities" (Courtney et al., 1997). The risks are moderate to high after control measures are instituted. For instance, pandemics - while no one can predict whether the next pandemic could be caused by a bacterium or a virus or where the epicentre could be located, this however will have high risks and possibly alternate futures or even worst a range of futures. A range of future – "the actual outcome may lie anywhere along a continuum bounded by the range" (Courtney et al., 1997). Developing a meaningful set of scenarios, however, is less straightforward here compared to the case of alternate futures. Here, models' limitation due to unquantifiability and vagueness of scope is becoming apparent. This is a typical case where rules of thumb in the hands of an experienced practitioner can be a better approach. Writers confirm that at least half of all strategy problems in operations management fall into "alternate futures" or a "range of future" with associated risks, while most of the problems are categorised as a "clear-enough future" (Courtney et al., 1997).

The significant factor for the generation of risk and uncertainty is the inability of man to know in advance both the occurrence time and entity with which future events occur (Bertini, 1991). This is mainly because human brains are "pattern-recognition machines" (Rock, 2008), the impossibility of resorting to past experiences to unlock forward-looking could be the bottle neck regarding risks and uncertainties. This is typically due to the singularity with which the various phenomena present themselves (Carmine, 2022). Tackling this challenge, revolves around finding new pathways possibly anchored on artificial intelligence. Relatedly, and more recently, Scholes (2025) advocates for the integration of human expertise with artificial intelligence.

CONCLUSION

This synoptic review reveals that the business realm inherently involves issues, risks and uncertainties and no organisation is immune, according to operations mangers' perspective. Strategizing about these is at the core of the duty of operations managers due to changing and evolving environment. These events whether current, possible or unpredictable contribute to factors that often keep operations managers awake at night – mainly because most business decisions are made with incomplete information and in the face of an uncertain future. The graphical deconstruction of operations managers' perspective and the integration of the concept of spectrum of organisational DNA provide an augmented perspective of operations management. In addition, by merging different academic approaches for events that could possibly occur and events that are unpredictable, the study proposes a hybrid concept which includes risk and uncertainty. This hybrid concept portrays the uncodified and implicit way with which operations managers handle the dynamic interplay between risk, uncertainty, and management

strategies. Bringing together these different traditions opens a new perspective of research where new pathways, possibly anchored on artificial intelligence, could emerge.

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