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RISK MANAGEMENT IN TENDERING: A CASE STUDY OF OY ARBONAUT LTD

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Title
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Abstract

Risk management is essential in tendering and project management. With a reliable risk management method, companies can become more resilient to any level of complexity or unpredictability. A robust process could ensure any potential risks is mitigated.

The thesis investigates how experts handle risks in tendering and develops feasible risk management strategies at Arbonaut Ltd. This study attempts to clarify the advantages of risk management and define analysis techniques in the bidding process. The primary data of the research was collected from interviews with personnel from Arbonaut. At the same time, the secondary data was retrieved from the tendering reports and its proposal feedbacks.

The results determined that risks should be continually assessed throughout different phases. The decision quality of risk analysts can also influence the effectiveness of tender risk governance. Quantitative analysis models are trustworthy instruments in various industries. In comparison, some qualitative tools are criticised for methodological errors and unviable change. Businesses should tailor their risk analysis practices based on the business model, market traits, and core missions.

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Keywords

risk, risk management, tendering, bid, forestry

CONTENTS

ABBREVIATIONS

AHP	Analytic Hierarchy Process
CAC	Customer Acquisition Cost
CPM	Customer Portfolio Management
EOI	Express of Interest
FAR	Fuzzy Attractiveness Rating
FIS	Forest Information System
HDR/KPMG	Hubbard Decision Research and KPMG International Limited
MADM	Multi-Attribute Decision Making
REDD+	REDD-plus stands for reducing emissions from deforestation and forest degradation, and the role of conservation, sustainable management of forests, and enhancement of forest carbon stocks in developing countries (Forest Carbon Partnership 2018).
RFP	Request for Proposal
SBU	Strategic Business Unit
TOR	Terms of Reference

1 INTRODUCTION

Tendering is a process by which governments or financial institutions invite a proposal or bid for a project that must be submitted within a particular deadline (Kenton 2020). The invitation is usually referred to as a Request for Proposal (RFP). Certain cases can require companies to submit a document called Express of Interest (EOI) for the shortlist round before submitting an initial proposal (European Union 2020). For companies or tenderers, making a bid/no-bid decision is often associated with various scenarios; they have to overcome many adversities throughout the bidding. If the company win a tender, it can obtain a profitable project and a great position in the market. Therefore, risk management is an integral part of both tendering and project management; it is used to handle any level of volatility, complexity, and uncertainty that could jeopardise the tender's success. By managing risk strategically, not only can companies ensure a positive outcome in tendering, but they also can maintain a prosperous project value.

1.1 Backgrounds

Arbonaut, the commissioner of this thesis, has long-time pioneer experience in forest information systems (FIS), consultation concerning REDD+ strategies, forest reference emission levels (FREL/REL), and MRV system. The company has been involved in multiple international projects by submitting proposals to private or governmental organisations. Figure 1 illustrates the tender evaluation building blocks from Arbonaut (i.e., tenderer) to the evaluation committee (i.e., buyer). The more proposals Arbonaut is awarded, the more competitive their portfolio and references in future tendering.

From the 2020 tendering data of Arbonaut, the REDD+ unit has shown a low success rate of gaining new projects. Among 29 sent proposals, the department won 8, lost 21 tenders (Arbonaut 2020.) New projects are the livelihood of an organisation, so it is vital to develop a winning proposal in tendering. Submitting many non-winning proposals can be time-consuming and expensive (Kerzner & Thamhain 1986). A team could spend approximately up to 60 hours or more preparing a proposal (Arbonaut 2020). A large amount of time wasted on unsuccessful bids can also hinder an organisation's growth or profitability.

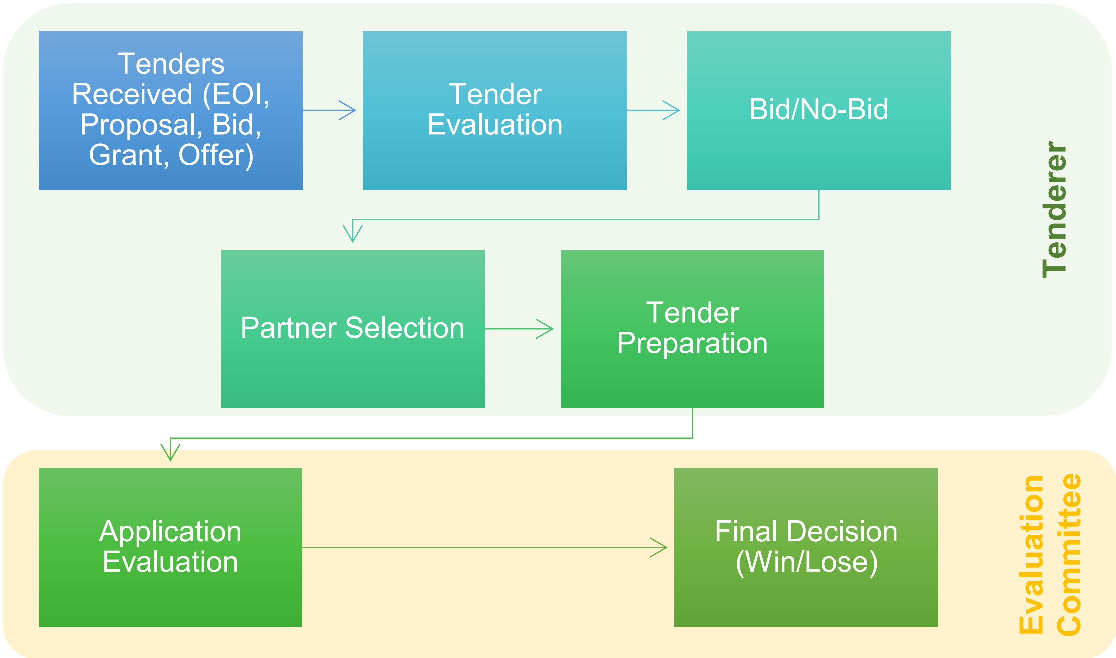

Figure 1. Building blocks of the tendering evaluation process (Arbonaut 2021).

Currently, there is no systematic practice in managing the tendering process in the company operation. Due to limited time and resources, many tender assessment actions are based on expert experience instead of logical guidelines. High levels of uncertainty in various projects can not be addressed with their current risk processing solution. Developing robust bidding strategies is a critical factor in strengthening their success.

The motivation for this thesis originated from a project in Rwanda that Arbonaut had worked on since 2018. Their team created a forest information system (FIS) to integrate the client's forest inventory data into one national database. Specific map-based applications were developed for the customer to view, edit, input new data. Hence, it created silvicultural plans for the coming years based on the existing data. Also, it can show the trends throughout the year (e.g., forest cover, forest fire, deforestation, planting campaign). Overall, the customer could get many REDD+ key indicators from this system.

The project was chosen due to its significant uncertainties in the RFP. Although it was predicted that the proposal might not bring any profit, the tendering team proceeded as an investment for a new product in FIS. Fortunately, Arbonaut had received more projects in Rwanda, establishing a positive relationship with the customers. Nevertheless, structured risk management was neglected, and some identified risks during tendering had occurred, which deterred their project's process. Thus, it emphasised the importance of this thesis in improving Arbonaut's operation and meeting the client demands with minimum risks in the future.

1.2 Research aims, questions, and contents

The thesis examined how experts managed risks and constructed a suitable framework for risk management in tendering at Arbonaut Ltd. As a result, the system can bolster their performance and build organisational resilience toward uncertainties. Furthermore, it can reduce the risks in bidding and during project operation. The study aims to explain the benefits of risk management and defines strategies for risk management in the bidding process. The research questions have been identified and set to guide this study as follows:

- What is a feasible risk management framework for Arbonaut?
- Why should risk management be emphasised in tendering?

The thesis result can contribute to the company's growth and sales plan. The framework will be a part of their guideline to evaluate risks in all FIS projects in developing countries. These projects are at the core of Arbonaut strategies and often have high levels of uncertainty. Because the company only receives two or three proposals in this service per year, the data analysis was combined with projects in REDD+ unit.

The contents of this research are organised logically in the next four chapters. Chapter two presents a literature review and theoretical background of this thesis. It first explained fundamental concepts and risk management factors before narrowing them down to reviewing different risk analysis methods. Afterwards, the thesis's theoretical concepts were clearly defined to test with the research data.

Chapter three provided insights into the chosen research methods in order to reach the final results. Chapter four discussed the research outcomes; it mainly described the optimal risk management framework and strategies for the commission company based on analysed data. Finally, chapter five summed up the main points of this paper and their importance in tendering and building organisational resilience. Suggestions for further research from this thesis were also mentioned in the last chapter.

2 DEVELOPMENT OF RISK MANAGEMENT

2.1 Risk and Risk Management

Risk analysts need to distinguish between *opportunity*, *risk*, and *uncertainties*. There are various definitions for these terms. Browning (2019, 73) believes uncertainties are the event that might or might not happen in project life. It could affect the project's value positively or negatively. In comparison, Vose (2008, 3) defined *risk* and *opportunity* as two types of *uncertainty*. When a *risk* possibly occurs, it will have a *negative* impact on the goals of the project or proposal. Whereas, if an *opportunity* arises, it will have a *positive* outcome on the project or tender. Each event of uncertainty is measured by three elements: the scenario; the probability of occurrence; and its impact's size (Vose 2008, 3.)

Since the building blocks of risk analysis practices was formed, new and more sophisticated frameworks have been created, making risk management more accurate for different working areas, from business to governance (Aven 2016, 2.) Nevertheless, these techniques still serve the ultimate goal of minimising risk in a particular area (Hubbard 2020, 11–12.) In the simplest term, risk management consists of coordinated activities which control and direct a project or an organisation concerning risk (ISO 2018). From an enterprise perspective, Hubbard (2020, 11) defined risk management as a correlated process of recognition, analysis, and prioritisation of risks and economical implementation of resources to mitigate, monitor, and control the risks' probability and impact.

Risk management is a topic of concern in many industries: finance, engineering, cybersecurity, supply chain, and forestry. However, the transfer of risk management knowledge is difficult to synchronise across areas. As the application of specialised risk analysis expanded, different fields tend to produce their concepts, so some ideas are not up-to-date or relative to generic risk management studies (Aven 2016, 2). Thus, a good risk management strategy from one field might not be suitable for others unless remodifications are initiated.

Feasible risk assessment and management requires big data and clarified boundaries. In addition, risk assessment and management constantly concern scenarios with significant volatility and emergence, challenging analysts to improve various models and tools for the new crisis ahead. As a result, substantial research and development are needed to construct innovative analysis methods to handle different specialised activities in various business ventures.

2.2 Risk Management Strategies and Process

To form fundamental risk governance principles and strategies, one should review two foundational pillars of the field study: (a) the primary risk management strategies and (b) the structure of the risk management process. Pillar (a) has three major strategies: risk-informed strategies, cautionary/precautionary and discursive strategies (Aven 2016, 6; Renn 2008; SRA 2018, 5). Risk-informed approaches involve controlling risks through avoidance, reduction, transfer, and retention. In comparison, the cautionary/precautionary strategies focus on containment, substitution, provision of systems with flexible response options, and improvement in emergency management. These strategies are used to solve unfamiliar but damaging crises—pandemics, natural disasters, terrorist attacks, or production breakdown. Discursive strategies are implemented to build confidence and trustworthiness by reducing uncertainties and ambiguities for the organisation (Aven 2016, 6; Renn 2008; SRA 2018, 5.)

For pillar (b), it can be broken down into six core stages in line with common standards from most risk analysis researches: (i) planning risk management; (ii) identifying uncertainties; (iii) risk classification; (iv) risk evaluation; (v) executing risk treatments; (vi) revising and monitoring risks (Aven 2016, 6; Keränen 2018, 17).

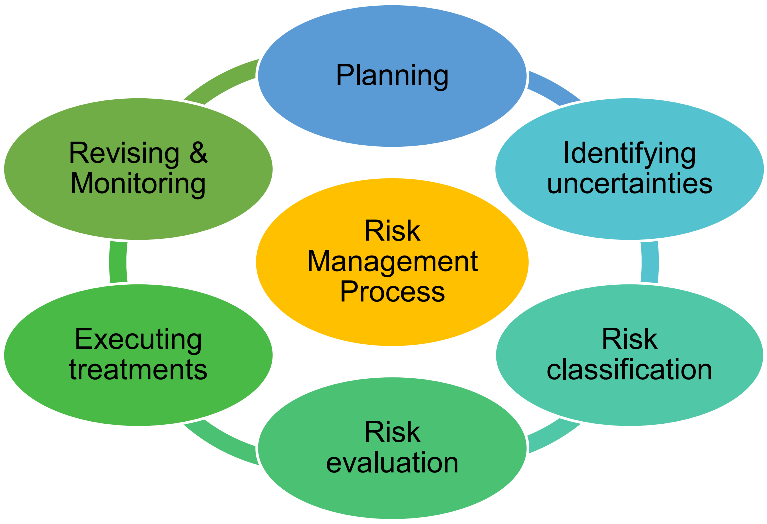

Figure 2. Risk Management Process

Planning risk management (i) means defining straightforward objectives and criteria of risk analysis in tendering activities and project for all team members. Then, the team identifies uncertainties (ii)—risks and opportunities—so every possibility is listed comprehensively. In stage (iii), different organisations might categorise risks based on project types, business goals, and the industry's traits. For tendering and procurement, they can lie in the following areas: Technology, Competition, Schedule, Pricing, Subcontractor, and Resources. After classifying their causes and consequences, the team could evaluate each risk (iv); hence, they can prioritise severe and plausible risks to determine suitable control methods or alternatives. The traditional formula is concluded as follows:

$$R = P \times I, \qquad (1)$$

where *R* denotes the rating of one risk, *P* means the probability of its occurrence, and *I* is its estimated impact. Conversely, advanced methods will have or add different equations to cope with relative errors or biases, which will be addressed further.

Stage (v) of risk management is meant to execute suitable treatments to avoid, mitigate, transfer, or accept the significance of particular risks. Avoiding risks means that the tendering team decide not to take action or a task that might expose them to undesirable scenarios. Risk mitigation is a common alternative. It often prevents or lessens the impact of risks (e.g., a risk/return analysis of new technology investment, operational risk reduction, and internal management initiatives to reduce problems in customer training, security procedures, or schedule delay). Risks can also be transferred to customers, suppliers, or stakeholders via contractual clauses. Furthermore, certain risks will have to be accepted with additional cost in the proposal (Hubbard 2020, 286–288.)

The final stage (vi) is essential as risk analysis should not be a one-time phase. The risk management process should be continuously monitored if some uncertainties occur (Kerzner 2006, 401; Hubbard 2020, 271; Kahneman 2012, 241–242.) Robust risk management is about always being informed. Thus, it requires monitoring and reviewing risk analysis from the tendering process to project management. When risk was omitted, the team will incapably react to abrupt changes, consequently affecting the result of their work (Kerzner 2006, 401; Hubbard 2020, 55–56.)

The critical thing is to create a risk indicator system so the firm will be informed when new risks arise during the project development. Hence, it could enhance the team's response rate to emerging risks. Documentation is also essential in this process (Keränen 2018, 45). It allows the future tendering team to recognise possible threats, learn how to adapt to them, and see potential results in advance. Its database should also be transferable to future tenders or project to calibrate the expert's decision quality or intuition in risk analysis. Plus, comparing that data with the buyer's feedback on their proposals shows how accurate their risk assessment was and which factors should be improved.

2.3 Different Risk Analysis and Assessment Methods

Many institutions have created risk governance guidelines that suit their business models. However, what decides the effectiveness of a risk management framework is its analysis and assessment methods. According to the HDR/KPMG survey, 73 per cent of responded companies used qualitative ranking methods. In comparison, 20 per cent used quantitative methods and 7 per cent used only expert intuition or various auditing methods (Hubbard 2020, 29). Some practices still hold up to the reputation while others have been reformed to meet new emerging risks in some business ventures (e.g., cybersecurity, supply chain management, health care). There are also risk analysis practices that have been debunked or received criticisms from academic researchers due to their highly systematic errors and violation of decision bias. This section will discuss the benefits and drawbacks of some of these standard practices.

Methods	Percentage of Users
Risk matrix based on a standard (ISO, NIST, etc.)	14
Internally developed risk matrix	27
Other qualitative scoring or ranking method	32
Probabilistic method (e.g., math-based models including simulations, statistically empirical methods, etc.)	20
Others (including expert intuition and various auditing methods)	7

Table 1. Summary of the HDR/KPMG survey on risk assessment methods (Hubbard 2020, 29).

Monte Carlo Simulation

One widely-mentioned risk management techniques is the Monte Carlo analysis created by Stanislaw Ulam in 1940. The Monte Carlo analysis is considered a multivariable model that provides a superior illustration of 'what if?' scenarios. This quantitative risk analysis runs a number of variables to determine the outcomes of some uncertainties. The Monte Carlo simulation achieves this by accounting for each volatile impact value of that risk within a probability distribution model (Vose 2008, 4.) That probability distribution of the outcomes allows decision-makers to evaluate the level of risks of a particular event quantitatively, choosing the option with the best balance of benefits against risk (Vose Software 2017).

Scientists and decision analysts have used Monte Carlo to predict uncertainties and disasters in finance, engineering, and supply chain throughout the decades. Nowadays, many risk analysis programs are produced for risk management based on this form of quantitative analysis (e.g., SAS, Crystal Ball, SIPMath, Analytica, and Excel).

To conduct the simulation, the risk analysts must first have a mathematical model such as a spreadsheet. Numerous quantitative estimations (inputs) will be added with suitable parameters based on their datasets (e.g., market size, financial factors, production capacity, etc.) Then, the analysts choose the best algorithm to generate random numbers based on a *seed value* (the initial number from inputs to start a particular sequence) within the parameters. All subsequent generated value will rely on that *seed value*. Afterwards, the Monte Carlo simulation recalculates the scenario multiple times, each time using different random numbers for all uncertain variables; thus, the consequent values are individual outputs of the model. At the end of the simulation, these output values can be displayed in a histogram (Figure 3). Figure 3 demonstrates the simulated outcomes of a firm's possible profit and the likelihoods of those values. It shows that the payoff will be most likely under zero, but there are slight potential gains (Vose Software 2017.)

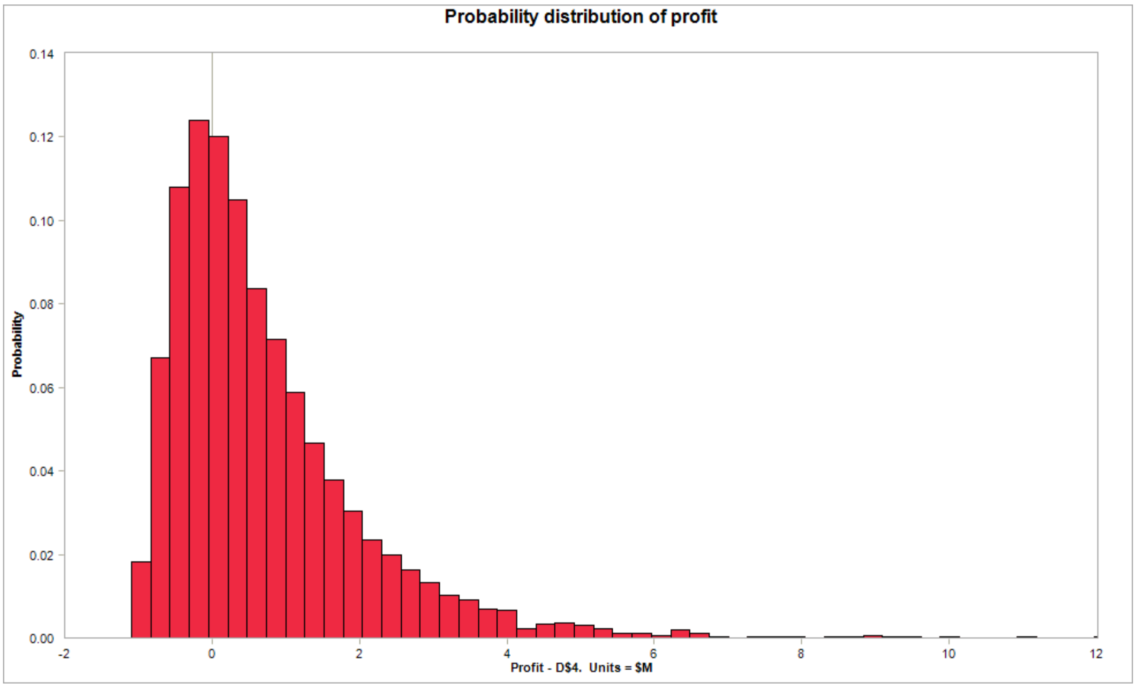

Figure 3. An example of Monte Carlo simulation about the probability distribution of profit (Vose Software 2017).

The more sample (or generated variables) run in the simulation, the smoother the probability distribution becomes, and the more precise and realistic the result is. With a high-quality simulation model, it can run 10,000 variables in a matter of second to get satisfactory but accurate results. The mod

el has also been combined with other mathematical methods such as multi-attribute decision making (MADM), Bayesian network, analytic hierarchy process (AHP), or fuzzy logic to increase the accuracy of the assessment. For a precise and practical simulation, the model requires calibration of probabilities when decision-makers provide many subjective estimates. If the analytic team input historical data in the simulation, empirical research needs to be conducted to reduce experts' biases. Besides, validating the expert's forecast is essential to ensure that the model does not underestimate risks due to experts' subjective judgments (Hubbard 2020, 226).

Multi-Attribute Decision Making

Multi-attribute decision making (MADM) means making preference decisions by assessing and prioritising a finite number of alternatives based on multiple contradicting or independent attributes (Springer 2007, 27). It has been commonly applied in different areas, e.g., individual capability evaluation, quality of life assessment, ecological risk assessment, and competitive bidding. Using MADM, companies can perform a strategic risk assessment of different bids.

This technique includes scoring methods and the standard analytic hierarchy process (AHP). It can also be combined with other risk analysis methods to provide more variable results, indicating the complexity and uncertainty of various risks. First, the team creates a decision hierarchy by breaking down criteria and decision alternatives or risks into an order of decision elements (Figure 4). Figure 4 illustrates the hierarchy of each standard and risk as well as their interdependent influence on each other.

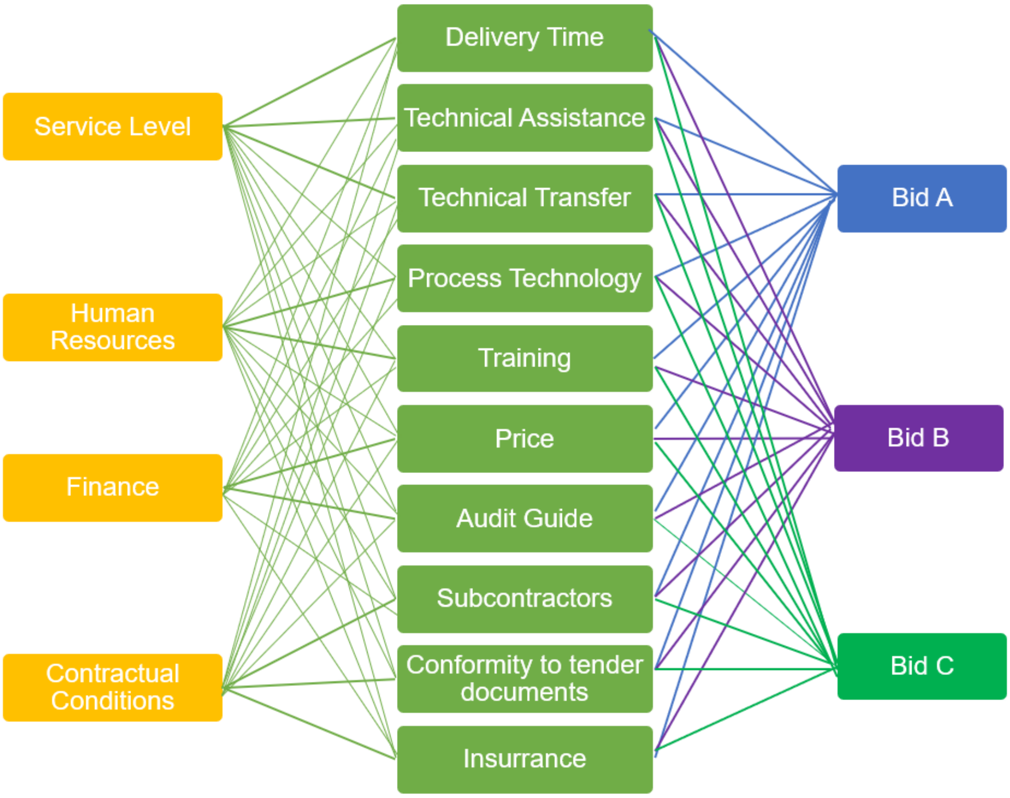

Figure 4. Hierarchy of the competitive criteria and risks in various bids (Cagno, Caron & Perego 2001; Arikan, Dagdeviren & Kurt 2013).

Each relative importance and weight of criteria are evaluated by comparing pairs by pairs using a linguistic scale in Table 2. After assessing all factors, the team can calculate the priority of decision alternatives (P) by multiplying their importance weight (W) with the corresponding rating (R) as follows: $P = W \times R$

Linguistic Scale	Degree of importance
Equally important	1
Moderately more important	3
Strongly more important	5
Very strongly more important	7
Extremely more important	9

Table 2. Linguistic scale for weight and importance rating (Cagno, Caron & Perego 2001, 315).

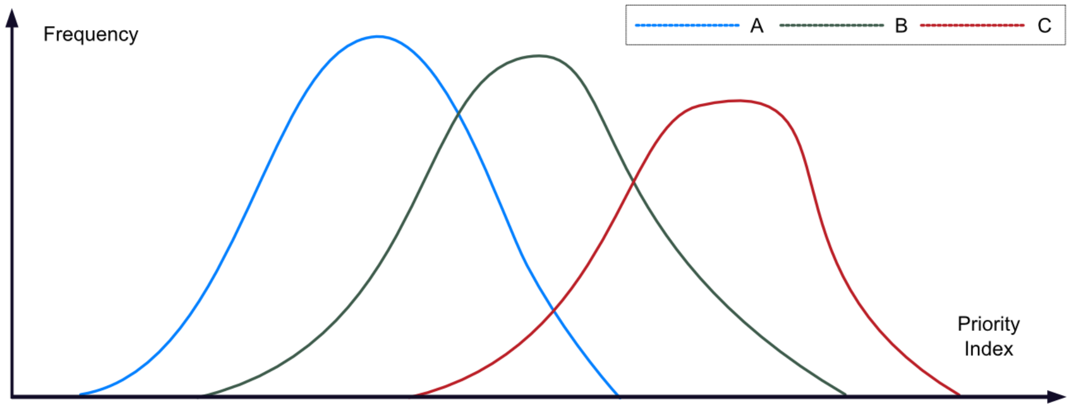

Figure 5. Example of the distribution of the bids' priority (Cagno et al. 2001).

The result is a list of priority indices representing each bid's relative competitive value and certain project risks. This quantitative risk assessment provides standard deviations of absolute priorities and the company's likelihood of winning the project (Cagno et al. 2001, 320.) However, the approach does not take into account certain subjective errors. Hubbard (2020, 190) and Tony Cox mentioned the drawbacks in AHP; although it is a quantitative analysis, it is vulnerable to bias when risk managers evaluate different criteria based on their importance compared to similar ones. Hubbard (2020, 190) suggested that a risk management model should accurately represent risk values and obtain sufficient standard to assess the reliability and validity of experts' judgment.

Fuzzy Linguistic Logic Theory

The fuzzy logic theory is a research approach that accounts for different variables in a volatile environment. It can quantify the linguistic value or facet of available data and decision-making variables (Shan, Chan, Le, Xia & Hu 2015). Fuzzy logic, in general, enables risk analysts to effectively and efficiently quantify uncorrelated information and make decisions based on preliminary and incomplete data, which is often the case in competitive bidding (Baloi, Daniel & Price 2003; Lin & Chen 2004, 586).

In risk management, the fuzzy logic method can be used for selecting suppliers and proposals (e.g., Halabi & Shaout 2019; Karuturi 2013; Lin & Chen 2004) or assessing potential risks in a tender and a project (e.g., Karuturi 2013; Djuric, Todorović, Djordjevic & Borota-Tisma 2019). Therefore, they can have a different formula to assess risks with fuzzy ratings.

The assessment framework includes two main parts: the first part defines criteria, algorithms, and fuzzy quantitative risk analysis; the second part calculates different risks and matches that rating with an appropriate linguistic scale such as Extremely (EH), Very High (VH), High (H), Fair (F), or Low (L) illustrated in Figure 7. As a result, this methodology gives experts more flexible and convincing results. The scales are expressed in a range of values (i.e., a membership degree) represented by a curve called a *fuzzy number* correlated with one linguistic term (Figure 6).

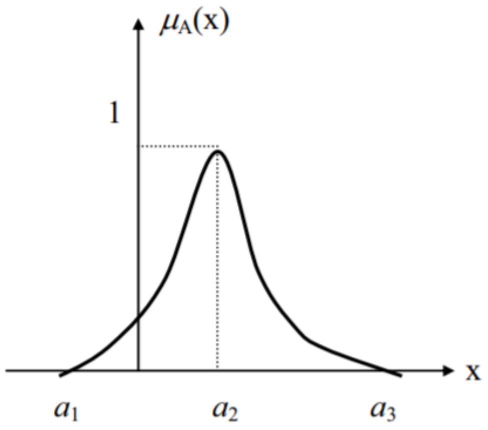

Figure 6. Fuzzy number A = [a_1, a_2, a_3] (Springer 2005, 130.)

A *fuzzy number* is a connected set of possible values rather than an exact number. Its interval is presented by two endpoints (a_1 and a_3) and a peak point (a_2), where a_1 and a_3 show the most negligible probability, whereas a_2 denotes the most feasible one. The fuzzy number A is defined as A = [a_1, a_2, a_3], which illustrates a volatile value of risk in Figure 6 (Springer 2005, 130.) Figure 7 provides a risk evaluation for a bid/no-bid decision an aeroplane proposal.

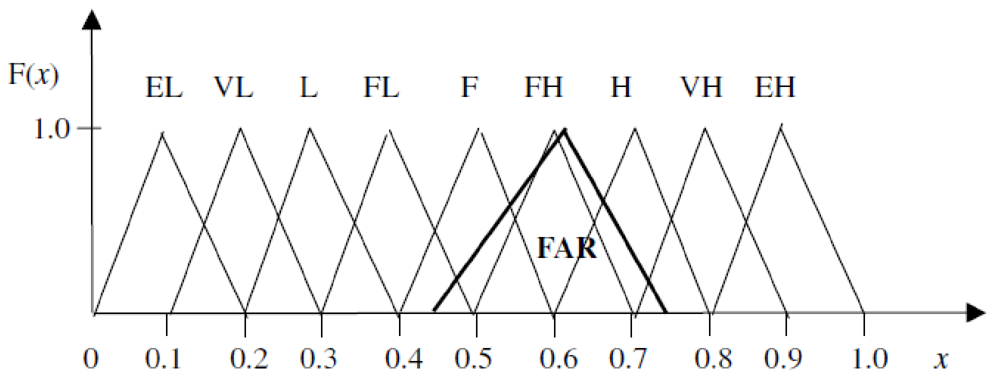

Figure 7. Tender evaluation index (FAR) of an aeroplane project illustrated by a fuzzy number (Lin & Chen 2004).

This mathematical form of risk analysis provides varied suggestions in the bidding process (Lin & Chen 2004, 586). Decision-makers can combine their expert intuition with the market's development to choose a valid option instead of relying heavily on complex mathematical equations. Furthermore, the fuzzy linguistic method considers the interdependence of certain risks and opportunities in a bid. Various factors can affect each other; the weighting principles of fuzzy logic divide them into main and sub-criteria to clarify the correlation among individual risk exposures on their probability of occurrence and impacts on the tender. Figure 8 illustrates a typical fuzzy linguistic risk assessment process in tendering.

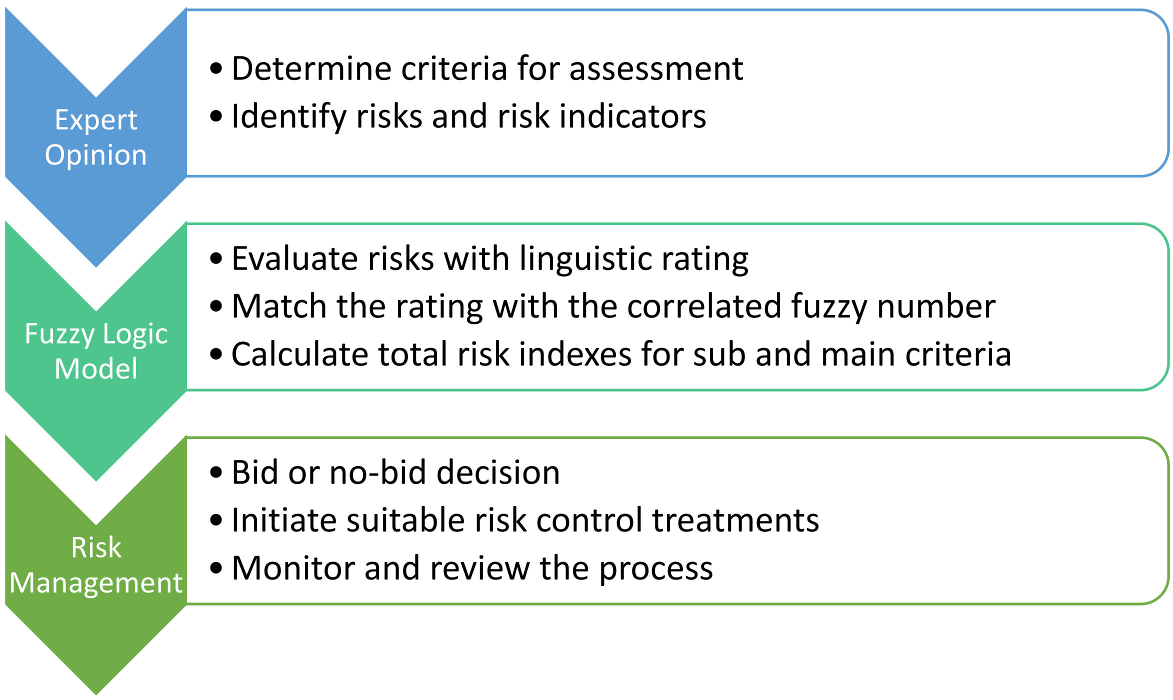

Figure 8. Risk assessment hierarchy structure using a fuzzy logic model

Risk Matrix

Risk matrix is an additive scoring method. It is one of the most popular methods promoted by management consultants and international institutions to analyse probabilities. The technique uses two ordinal scales (likelihood and impact), or three (threat, vulnerability, and consequences) multiplied together using the equation (1) to get an aggerated score (Hubbard 2020, 165). Each score will then be presented in the risk map in linguistic terms as low (minimal project impact), medium (some project impact), and high (substantial project impact).

		Impact				
		Negligible	Minor	Moderate	Significant	Severe
Likelihood	Very Likely	Low Med	Medium	Med Hi	High	High
	Likely	Low	Low Med	Medium	Med Hi	High
	Possible	Low	Low Med	Medium	Med Hi	Med Hi
	Unlikely	Low	Low Med	Low Med	Medium	Med Hi
	Very Unlikely	Low	Low	Low Med	Medium	Medium

Table 3. An example of a universal two-scale risk matrix (Boers 2017).

Most companies chose the risk matrix as their first approach in developing risk management because of its convenience and simplicity. Without much calculation, experts could define individual risks' values based on their experience and the project's information. However, many risks and decision analysts have deprecated the method for being susceptible to subjective errors such as overconfidence or miscommunication. The qualitative description of likelihood can be understood and used differently based on an individual's perception of the risk's probability and severity (Hubbard 2020, 169). Using such a method has significant unintended consequences when the expert underestimated risk or misinterpreted it during evaluation (Hubbard 2020, 174).

Dr Tony Cox (2008, 499), the editor-in-chief from the society of Risk Analysis, stated in his most cited publication that the model could incorrectly rank a more severe linguistic term to quantitatively more minor risks. Decision-makers would have a lower expected profit value for the project. As a result, those risks with negative frequencies and severities can be "worse than useless", causing more complex decisions (Cox 2008, 500). The risk map can also create imprecision by compressing a wide range of risk value under one category on the scale.

Overall, for risk matrix and other qualitative analysis approaches, Douglas W. Hubbard (2020, 169) and other respected academic researchers (Tony Cox, David Vose, and Daniel Kahneman) voiced their criticism of pure qualitative methods. It not only creates the illusion of rational analysis but also magnifies the inaccurate probability when assumption errors occur. In a portfolio, the risk matrix helps the customers see the overall picture of risk analysis. Conversely, for internal operation, companies should combine it with other scientifically proven techniques to handle uncertainties. It is also necessary to improving the risk matrix and quantitative risk analysis methods to address high complexity different fields. Historical data from various project risk analysis can be stored and transferred to the quantitative model as variable information, increasing its accuracy.

2.4 Influences of Decision Quality in Risk Management

The risk assessment supports organisations to choose between decision alternatives for puzzling scenarios. Thus, the cycle of risk management is often aided by decision analysis principles. Such analysis calibre is determined by our willingness to use reason and logical thinking rather than in any enterprise imperfection (Howard 2007, 32.) A person with profound experience in one industry can still make arbitrary choices if they are influenced by unfounded information and cognitive biases.

Kahneman (2012, 86) discovered that most decision-makers tend to underestimate the extent of inference from a given amount of information. When the news was first received, their mind has already jumped to the conclusion. As a result, even when another fact disproved it, their bias has already favoured the first information (Kahneman 2012, 85–86.) Since the 1970s, much research has shown that people's decisions based only on their intuition were subject to many errors which could be identified by reflecting on their actions. Whenever decision-makers assess different probabilities and preferences, they must be aware of many pitfalls represented in human thought (Howard 2007, 36.) Tversky and Kahneman (1974) defined them as heuristics – ways of thinking that is generally helpful but can misinterpret things with biases.

One example is the illusion of validity when the person is overconfident in prediction based on highly consistent patterns. For example, people are more positive in predicting a company's future profit whose first-year sales were constantly high than predicting the one with unstable sales growth. However, an estimation based on several inputs can be more precise when they are independent of each other instead of being unvaried or redundant (Tversky & Kahneman 1974; Kahneman 2012, 424). Hence, even though decision-makers express more confidence due to the correlated sale growth in the first year, their estimation could be less accurate.

In addition, a heuristic called availability of scenarios is used when an individual evaluates a specific event's frequency based on the events that come to his mind. The ability to visualise any possible uncertainty is essential in assessing risks and opportunities. Nevertheless, it could become a mistake due to the instances' retrievability (Tversky & Kahneman 1974; Kahneman 2012, 425-426.) The likelihood of a scenario could be inflated if it is easier to remember or it occurred more recently than other less notable ones.

Another systematic error is the framing of outcomes. Risk analysts evaluate the option to control each threat characterised by its effect and likelihood. However, if the decision was changed when its information had been described in other manners, the experts would have violated the principle of rational choices. The invariance requirement demands that the preference order between probabilities should not depend on how they are mentioned (Tversky & Kahneman 1984; Kahneman 2012, 425–426.)

In risk assessment, decision quality provides plausible predictions from the experts. However, the experts' confidence in their intuition is not a trustworthy guide to their validity. Expert intuition is considered to be skilled only when two conditions are satisfied: (1) they have an environment that is sustainably consistent and predictable; (2) there is an opportunity to learn these uncertainties through practices and feedbacks (Kahneman 2012, 241–242.) Therefore, in risk assessment, it is important to calibrate experts' probability estimates by providing training, tracking their performance, analysing the decision pros and cons, and being critical about each other prediction (Hubbard 2020, 271). In return, these actions can fine-tune both the firm's risk management method and expert intuition's validity (Hubbard 2020, 313; Kahneman 2012, 242–243.)

2.5 Theoretical concepts

A number of studies have sought to determine that risk analysis helps businesses control uncertainties strategically. However, the scientific foundation of risk management is, in some aspects, not dependable as research gaps still exist in both theoretical results and practice (Aven 2016, 10).

Firstly, the effectiveness of risk management models has hardly ever been measured. When the business uses a method, there is usually little experimentally verifiable evidence that it successfully improves the assessment and mitigation of risks. Part of any risk analysis model's triumph is the quantifiable evidence of its result and not solely based on a risk manager's subjective perception. Second, since many risk management methods use expert's judgements, it should be accounted that human can misperceive and underestimate risks systematically. Unless their errors are identified and fixed, any risk management method, even the most quantitatively concrete one, can become invalid and ineffective (Hubbard 2020, 16–17.) Thus, there is always a requirement for a managerial review that sees beyond the analysis results. Adversities that were not identified by the analysis should be observed as well as the expert's knowledge on which that risk evaluation is based (Aven 2016, 6.)

In summary, the recent development in the field has increased the demands for guidelines of risk management that match a company's strategies. Companies need to tailor their risk analysis concepts to suit their business model instead of applying conventional management methods. Successful management of risk or uncertainty might also help companies reduce their time spent evaluating tenders and invest more resources in decision quality and proposal preparation. Hubbard (2020, 281) suggested that risk analysis should include the entire organisation, which means that people with different expertise should participate in the process. Hence, the identification of risk will be more comprehensive, and certain risks will not be ignored. In this study, the requirements of the suggested risk management framework are:

- Systematic risk management can improve expert's knowledge and provide quantitative data to measure its analysis attribute in Arbonaut's tendering.

- The analysis method is understandable for various expertise in Arbonaut.

- The framework can use historical data to strengthen Arbonaut's future proposals and project values through monitoring and review.

Methods	**Monte Carlo Simulation**	**MADM**	**Fuzzy Linguistic**	**Risk Matrix**
Type	Quantitative	Quantitative	Quantitative	Qualitative
Advantages	- Easy to compute on Excel with 'What if' function - Highly accurate and practical - Strengthen from every historical data - Convenient in data management and calibrated training - Visual-friendly - Little influence of heuristics and bias	- Suitable for competitive bidding or highly uncertain project - Fairly practical - Strengthen from every historical data - Requires few trials	- Easy to compute on Excel - Suitable for competitive bidding or highly uncertain project - A more comprehensive range of variable for decision-making - Requires few trials - Fairly accurate and practical - Convenient in data management and calibrated training - Visual-friendly	- Easy to compute on Excel - Convenient in data management - Visual-friendly - Requires few trials - Faster analysis - Small database
Disadvantages	- Requires many trials (minimum 10,000 times) - Large database - Requires new simulation for every change	- Vulnerable to analysis placebo due to arbitrary score - Large database - Not visual-friendly - Easily affected by heuristics and bias - Requires new simulation for every change - Inconvenient in data management and calibrated training	- Somewhat vulnerable to arbitrary score - Moderately affected by heuristic and bias	- Significantly influenced by heuristic and bias - Positively affected by analysis placebo - Inconvenient in data management and calibrated training

Table 4. Comparison table of different risk analysis and assessment methods

3 METHODOLOGY

3.1 Methodology Approaches

The thesis is a qualitative study to develop a risk management portfolio for the company; the author will analyse the cause and effect of different risks and the risk management process for tender evaluation. The research will be based on academic research, international business development reports in forestry technology, and information from Arbonaut Ltd. Data analysis methods comprise descriptive statistical analysis, hermeneutic analysis, and discipline-specific methods.

The primary data of the research is collected from semi-structured interviews with personnel from the organisation. By conducting interviews, a broader perspective on the subject is reached with open and closed questions. Interviews allow more detailed questions, if necessary, to be asked during a conversation in order to gain a deeper understanding of the interviewee's opinion and knowledge. Four respondents were interviewed: two managers involved in tendering evaluation, one project manager and one technical expert who participated in project planning and tender assessment. Some of the interviewees have a longer career in Arbonaut, and some have just started. Each participant works in a different business unit, and all have worked with varying projects of forestry. As a result, the chosen participants will give variety and a wide range of insight into the matter and combine the company expertise and various perspective (Keränen 2018, 25). The semi-structured approach was selected because it encourages accessible communication and allows interviewees to respond to questions more naturally and honestly.

Although it was an in-depth interview in which the interviewer had topics and questions to ask, questions were open-ended and flowed according to how the participant responds to each (Esterberg 2002). Some questions might not be asked based on their answers and expertise. A filter question is needed to determine whether the respondent is qualified or knowledgeable about the researcher's questions of interest (Trochim, Donnelly & Arora, 2016). The questions were chosen to supports the research themes: (1) Importance of systematic risk management, (2) Arbonaut's experience-driven opinions and expectation for the model, (3) Managerial reviews of risk analysis in project development, (4) Client cooperation and contribution to risk management (Appendix 1). Before the interview, the participant was informed about being recorded. The majority of the discussion was done via online meeting, which reduced bias issues and increased this study's reliability.

The secondary data is collected from tendering reports retrieved from Arbonaut's project management platform (Jira) and the proposal evaluations. Data from the Jira platform provide project information such as business value, the time spent on preparing the proposal, and the results of tenders. RFPs were also processed to show lists of invited competitors. As for proposal evaluations, preferably, when a bidding decision is announced among tenderers, the customer will provide comprehensive information about their assessment provided in the Notification of Intention to Award. This Notification often includes the following information:

- The name and address of the winning bidder/proposer
- The contract price of the winning bidder
- The names of all bidders/proposers that submitted bids/proposals and their prices and evaluations
- A statement of reason(s) why the recipient's bid/proposal was unsuccessful
- Instructions on how to request a debriefing and/or submit a formal complaint during a certain period (World Bank 2017, 6).

Therefore, documenting data from tendering and customer feedback shows how much resources Arbonaut has used for individual tenders and their effects. The data can indicate their proposal's shared strengths and weaknesses. Plus, it can show the frequency of risk occurrences and their consequences compared with the primary data.

Several respective literature materials and their research reviews were used to substantiate the reliability of the thesis theoretical framework. Verification strategies back both validity and reliability of qualitative research: methodological coherence, sufficient sampling, collecting and analysing data concurrently, and theory development (Morse, Barrett, Mayan, Olson & Spiers 2002). Confidentiality and data protection are considered in the research process and interview.

3.2 Analysing Data

After the interviews, the data was analysed and compared with the theory. The coding method was used in this research when analysing the collected data. It is a form of organising data by transferring the raw data into a theoretical narration, putting the data back together in a new way after breaking it down and conceptualising it. Each question was chosen based on the themes of this study; every participant's response was carefully transcribed and compared with other interviewees' answers. The interview results will support theoretical concepts by presenting various experts' opinions on quantitative risk management methods. It will also show their expectation of a risk management framework and its effect on the tender evaluation. The interview results will contribute to the development of this thesis's risk management framework

For the secondary data, the author also analysed and categorised tendering records and customer feedback from 2020. Thus, it could provide conclusive data for the quantitative risk analysis model. The content is managed within an Excel file to be easily exported as various diagrams. Both analysed primary and secondary data can support the hypotheses that systematic risk management in tendering and continuous review of risk analysis can improve the company's resilience to uncertainty.

4 RESULTS

Based on the collected data, the findings were concluded and arranged based on the theme of the thesis. This chapter first presented the situation of Arbonaut and risk-averse perspectives from different expertise. This information can prove the importance of systematic risk management in the company and its relationship between tendering and project management. Thus, the result will provide optimal risk management strategies.

4.1 Risk management at Arbonaut Ltd

4.1.1 Missions and strategies

Arbonaut is among the world's leading companies that provide a full-service forest information collection and data management system. Through procurement, they have succeeded in many prominent projects in over thirty countries. That is why risk governance in tendering is essential for their business development. Since starting this thesis, Arbonaut has not had any official instruction on risk analysis in neither tendering nor projects. Their approaches are based on managers' and experts' intuition. In the tendering process, the Arbonaut team set the following criteria to evaluate each proposal:

- Arbonaut's role and added value
    a. Service/product need
    b. Available and needed partners
- Financial
    a. Potential service value
    b. Expected profit margin
    c. Sub-contracting value
- Acquisition process
    a. Time required to achieve (sales cycle length)
    b. Costs involved
    c. Likelihood for success
- Future potential
    a. Market share prospect (volume)
    b. Continuation

Depending on the market and services, each factor is prioritised differently. The interviews showed that the coordinated experts in Arbonaut assess each criterion. After reviewing RFP and TOR, technical professionals will look at key expert, FIS system, and database requirements. Respectively, others will look at the financial aspect, market, partner's strengths, and competition. Critical questions are often raised in tendering meeting:

- Does the project fit Arbonaut's strategic development objectives? Will it lead the company in the right direction?
- In the technical plan, is it viable? Can it be done in a reasonable amount of time and resources?
- In the financial plan, is it profitable? Based on the customer's stated budget, working days, key expert, what is the maximum project values? Should Arbonaut take risks?
- For partnership, how is the partner reputation and experiences? What is their relationship with other partners?
- Is there any competitor which should be aware of?

Technical and financial aspects are equally measured in the tendering meeting. If financial scopes are not realistic, it will be immediately a no-bid decision without considering the technical part. An exception is negotiable if the tender involves new research and development. Thus, Arbonaut can eventually accept financial risks if the opportunity of new technology is attractive. In special cases, Arbonaut submitted proposals to learn about specific markets, pricing, and main competitors. Therefore, Arbonaut is capable of designating suitable experts and analysing risks in proposals. All forest database expert acknowledged that risk management has a major influence and importance on project value. However, in their opinions, the work is still ineffective.

4.1.2 Challenges

The main issue is the company's incomplete digital asset filing. For instance, the firm did not document tendering information (e.g., cost, result, time spent on a proposal) until mid-2019, limiting historical data for proposal improvement or risk management. According to the tendering results, most of Arbonaut's losing bids had the weakest points in implementation or technical values (Table 5). Several weak points were also mentioned together and reoccurred in many proposals. In 2020, Arbonaut lost 46% of total tenders and won 17% only of them (Figure 9)

Main weak points from proposals	No. of Tender	Percentage
Implementation	4	13%
Technical	3	9%
Financial	3	9%
Key Expert	2	6%
Methodology	1	3%
No comment	16	50%
Other	3	9%
Total	**32**	**100%**

Table 5. Main weak points in REDD+ tenders received from customer's feedbacks (Arbonaut 2021).

In the interviews, all participants responded that data management is needed to decrease proposal making time by reusing or modifying relevant information. Furthermore, key experts could use such data to enhance their decision quality and awareness of current development, objectives, and resources. New employees in Arbonaut can learn from experienced people in various projects, so it is helpful to collect not only risk reports but also proposal documents. Even when unanticipated events occurred, the team will recognise signs of such uncertainties in the future by documenting tendering cases thoroughly.

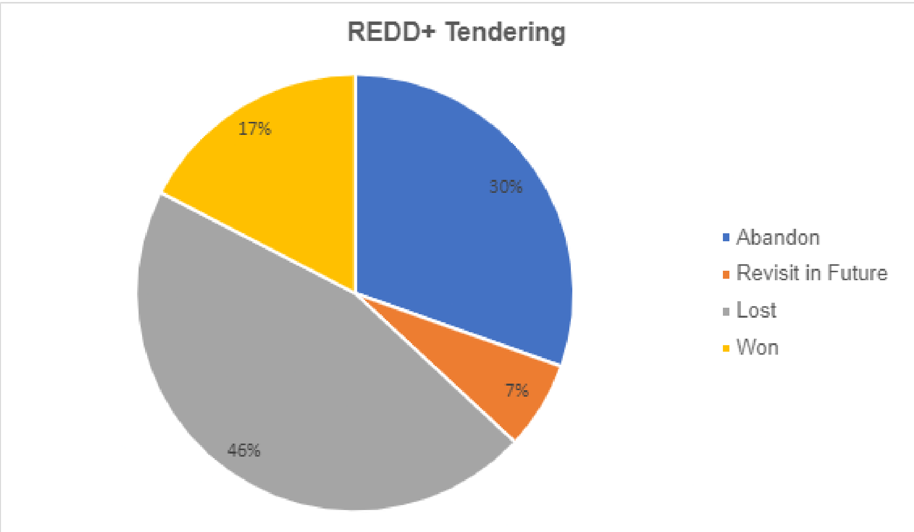

Figure 9. Percentage of REDD+ Tenders in 2020 (Arbonaut 2021).

The firm created a value analysis on Excel based on estimated turnover and data to calculate profit margin, staff cost, and profit percentage for recent REDD+ projects. Nevertheless, the research is no longer relevant. It has never been updated consistently due to insufficient personnel work, support, and data.

A systematic risk management framework can provide an informative environment for experts to calibrate their estimation of risk and tenders' probability of winning. The majority of technical experts stated they would like to improve their ability to analyse RFPs, make better estimation when answering critical questions: What is their probability of winning? What are the resources? Is it worth making a bid? One manager also proposed that the team be more selective on the proposals to increase their percentage rate of success. Without straightforward instruction for risk management, many risks could occur in the project, and no suitable mitigation measures are applied.

In summary, these results from primary and secondary data provide crucial insights into the benefits of robust risk management for Arbonaut. Suppose a framework is appropriately implemented in tendering. In that case, it will have a significant impact on expert's decision quality, managing their sale capacity, risk mitigation, and tender evaluation.

4.2 Risk awareness among different expertises

All respondents mutually valued a proposal's chance of winning. However, technical experts will choose the most profitable or technology-driven proposals when there is a limited capability and resource capacity. On the other hand, sales personnel prioritises the ones with the highest chance of winning and the least competitive candidates.

Arbonaut experts' dissimilar perceptions in risk analysis also influence how they see the consequences of failures. Besides wasting time and sales capacity pipeline, one manager added that the company's future is not dependent on one non-winning tender but rather the quantity of the accepted project. However, the chief technology officer (CTO) believed their resources should have been used wisely to keep the company profitable with a favourable growth rate. Suppose the team is pessimistic about their capability, not proceeding to improve a proposal. In that case, it could let a newcomer into the business. In addition, technical experts raised more concerns about many risk analysis models that might not include social factors such as customer behaviours, international relations, and buyers' biases. In some instances, such prejudices can affect how one applicant get the contract.

Overall, this evidence supports the theoretical concept that risk analysis should have diverse expectations in the risk analysis process. It is best to have many opinions in the process to ensure different levels of uncertainty are included and worst-case scenarios are accounted for (Hubbard 2020, 282). At a minimum, every risk analyst could think about the possibility of these threats: What would cause a complete change of tender management? What factors would make them lose most of their market share?

4.3 The connection between tendering and project management

Besides maintaining systematic risk management, risks still need to be closely observed throughout stages. For tendering, using collected data for benchmarking could support the team's learning experience. In the REDD+ unit, there has not been any benchmarking conducted to monitor the risks and competition. However, the CTO said that it had been done in other services. In public tendering, Arbonaut could see the competitors' proposals and compare them. By being in the customer's position, Arbonaut can understand which proposal is better and why. Sometimes, the team also perform benchmarking with partners. Suppose someone has built a valuable system or technology. In that case, Arbonaut can learn from it or provide a more advanced solution in that gaps. By utilising winning bids, the company can observe the competitor and customer's perspectives, using them as leverages to improving Arbonaut's technology and proposal strengths.

Hence, it shows that monitoring risk management in tendering continually can bring many benefits. It is crucial to look through customer's proposal feedback.

For instance, reporting their time on writing proposals or mitigating risks indicates how much resources they needed for certain tenders. That way, they can estimate financial value, cost and resources more precisely based on types of services or clients. In 2020, Arbonaut spent more than 753 hours on non-winning proposals. A major project could take the team more than 270 hours to prepare the documents (Arbonaut 2021.) Some REDD+ proposals could cost Arbonaut thousands of euros as it could take a month to write them. Therefore it is important to have an accurate pricing level for certain bids to compensates for the loss.

Supervised risk analysis can increase the team's alert and reaction time when an identified threat arises in projects. In many instances, some technical risks could have been avoided if the team had had a thorough discussion. Although there were risk indicators of inefficient performance, they were omitted, causing intense damage for Arbonaut that year.

Another risk that can be diminished or eliminated by supervising is data quality. In various projects, especially in developing countries, uncorrelated or disorganised data has happened frequently, not only in REDD+ but also in other FIS projects. In the interview, the project manager of the Rwanda project explained that the team found many mistakes when the data was integrated into the system. After several modifications, the data still had issues. Hence, the team had to endure it in the end. According to the manager, it is essential to agree on the principles beforehand and follow up with the project risk management. Also, it requires a skilful team and a standardised information system to avoid similar problems.

The study proved that the probability of forecasted risks could change during the project. It highlights the importance of continual reviews and re-evaluation of risks. Combined with the first concept of systematic risk management, the framework can successfully reduce the effects of many risks; Arbonaut can conveniently monitor the costs of various projects to adjust its financial plan for different customer segments during tendering.

4.4 Nominated guideline of risk management in tendering

Based on the research results and Arbonaut's business environment, a practical risk management model needs to be computable while generating a realistic risk probability. The format should be transferable, flexible to update, and convenient for future reference or data management. Therefore, the fuzzy linguistic analysis can address these requirements.

The model provides a wide variance of risk value that accounts for volatility of risk and competitive bidding. Instead of giving one specific probability of the event, the fuzzy logic theory considered its minimum and maximum possibility. The qualitative scales obtain various numerical extents, reducing subjective and systematic errors without using complicated mathematical equations. The calculation process can be computed on an Excel sheet with formulas and functions, simplifying the risk assessment.

In order to improve the quality of tender and project management in Arbonaut, a risk report will be added to the fuzzy linguistic model (Appendix 2). The report will list the identified risks and other factors affecting the tender or project. Decision quality and expert's intuition require historical data such as previous risk analysis reports to improve their judgment for uncertainties. They can look through the data to understand how accurate their prediction is based on the tendering result and effectiveness of controlling project risks. The result of risk analysis can be generated into a chart or diagram to review efficiently. Graphs are also more convenient for data management when uploaded to the company's database system. Experts can inspect and assess the effectiveness of precision of their evaluation faster. Once the project is in development, the risk report from tendering can be transferred to the project team as references for project risk management (Appendix 2). The unit can be more conscious of possible risks that have been predicted since the bidding phase. Thus, they can respond immediately when the situation changes or certain risks arise.

In this section, a model of tender risk management using fuzzy logic is devised. It is assumed that three experts in Arbonaut would evaluate tender risks and decide whether to proceed to bid. The evaluation criteria and aggregation process account for the volatility and ambiguity of different factors in competitive bidding. Individual steps are listed below:

1. Hold a tendering meeting. Determine the main and sub-criteria for assessment. Identify risks in each criterion and their effects on the proposal and future project

2. Assign the probability and impact of various risk indices using a linguistic scale (e.g., High, Fairly High, Good, etc.)

3. Approximate linguistic rating by fuzzy numbers, which are a connected set of possible value (e.g., Fuzzy number A = [a_1, a_2, a_3])

4. Sum up these fuzzy numbers to calculate an overall risk extent, guiding decision-makers in making a bid/no-bid decision.

5. Assign and execute control methods for individual risks

6. Monitoring and reviewing risk management throughout the tendering process

Determine the main and sub-criteria for assessment

In step (1), the firm will form a committee of decision-makers and hold a briefing session to introduce the acquisition plan, facilitating their holistic understanding of the particular tender. The debriefing can include the following information:

- Brief description of the bid opportunity—a statement of requirements, specifications, scope, customer organisation, and key decision-makers.

- Why should Arbonaut bid? What are the benefits that meet the company's business plan and missions?

- Committees perform a competitive assessment and discuss potential competing firms and their experience in the subject area.

- Can the team prepare a winning proposal? A description of the required resources needed for a competitive bid.

- Discussion of critical win factors and their importance to the tender's success rate.

- Discussion of winning strategies and vital points guiding the team effort to win the bid.

- A detailed action plan that covers critical win factors and winning strategies.

- Creating a summary of essential resources such as key personnel, support services and other services needed for the tendering (Lin & Chen 2004, 589-590.)

Afterwards, the committees identify risk Arbonaut could consider in a proposal, as shown in Figure 10. Depending on the business units and market characteristics, decision-makers can add or remove components to reflect equivalent criteria in specific tenders. The notations can be used for the computational purpose as follows:

- C_i = i^{th} 1^{st} level risk index (Main source of risk); i = 1,2,...,m.
- C_{ij} = j^{th} 2^{nd} level risk index which is under i^{th} 1^{st} level risk index C_i (Risk event); j = 1,2,..., n.

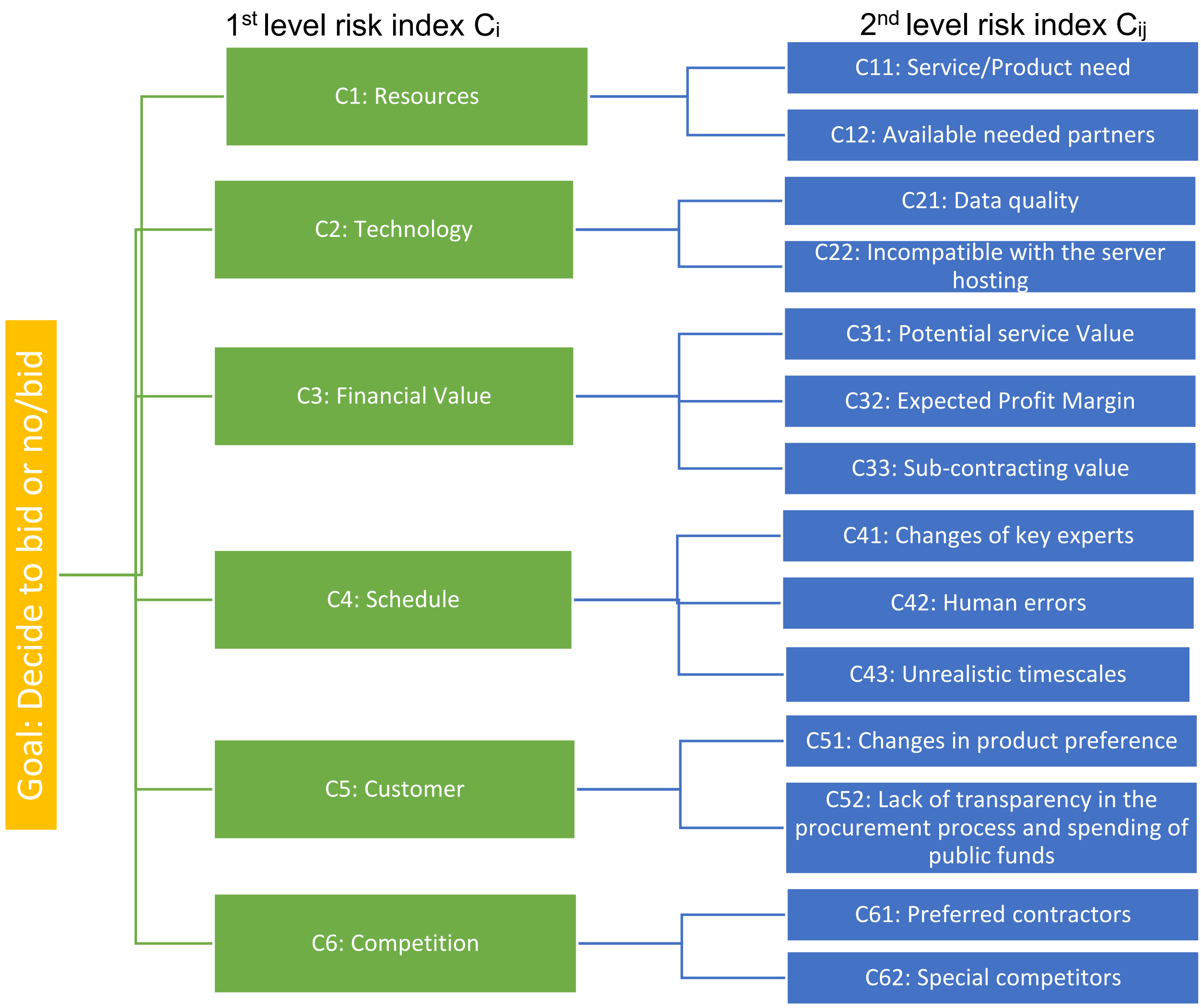

Figure 10. Potential main and sub-criteria for tender evaluation and risk analysis in Arbonaut (Arbonaut 2020).

After determining possible criteria, committees need to analyse each scenario in a risk report (Appendix 2). Each listed factor is a reference that helps manage and monitor risk in proposal preparation and project planning if the proposal succeeds (Table 6). Furthermore, it provides tendering committees with a clear picture of the relationship between risks and other tendering criteria.

Sections	Descriptions
Risk types	Identify risk types based on each strategic objective of the tender or project (e.g., Technology; Competition; Schedule; Pricing; Subcontractor; Resources)
Risk Events	Committees describe possible uncertainties that can happen.
Consequences	Explain the impacts of the risk on different factors in tendering or project development. It is suggested to assume the risk impacts in quantifiable data such as cost, time, or loss in tendering scores to understand the risk's severity better.
Risk Indicator	Identify possible factors that can trigger the risk. It can be specific events or when another identified risk occurs.
Priority	Determine the priority to manage risks based on their severity and probability (e.g., Very High, High, Medium, Low)
Management Control	Decide possible risk control methods (e.g., Accept, Transfer, Mitigate, or Eliminate Risks) and describe how to initiate that method.

Table 6. Possible elements in risk report in tender evaluation

Measure the impact and probability rate using linguistic terms

For step (3), members can use linguistic terms to assess the impact value and probability of the 2nd level risk index C_{ij} and 1st level risk index C_i based on the data in the acquisition plan.

Impact	Fuzzy Numbers	Probability	Fuzzy Numbers
Very Low (VL)	(0, 0, 2)	**Very Rare (VR)**	(0, 0, 0.2)
Low (L)	(0, 2, 4)	**Rare (R)**	(0, 0.2, 0.4)
Fairly Low (FL)	(2, 3.5, 5)	**Seldom (S)**	(0.2, 0.35, 0.5)
Fair (F)	(3, 5, 7)	**Fair (F)**	(0.3, 0.5, 0.7)
Fairly High (FH)	(5, 6.5, 8)	**Often (O)**	(0.5, 0.65, 0.8)
High (H)	(6, 8, 10)	**Usually (U)**	(0.6, 0.8, 1)
Very High (VH)	(8, 10, 10)	**Always (A)**	(0.8, 1, 1)

Table 7. Linguistic terms describe the risk's impact and probability (Lin & Chen 2004, 590; Karuturi 2013, 40).

Approximate linguistic rating with fuzzy numbers

Following step (4), the experts will approximate the qualitative scales with fuzzy numbers. Using the Excel IF function, they can run a logical test and returns one value based on a set of criteria. Hence, the experts, for example, can input an "H" (High) value on the associated index, and the associated fuzzy number sets will be immediately filled in adjacent cells on the Excel sheet (Appendix 3). Therefore, the experts only need to assess all criteria with relevant linguistic terms. The Excel sheet will calculate the results, saving time on tendering process.

Calculate the overall risk extent

Afterwards, the committees can sum up these fuzzy numbers to obtain individual risk extents to make a bid or no-bid decision (5). By dividing the sum of each value by the number of committees (i.e., the received number values of rating in that 2[nd] level risk index), the average fuzzy ratings and the average fuzzy likelihood of occurrences and impacts of 2[nd] level risk index C_{ij} are obtained and listed in Table 10. The fuzzy risk extent of each 2[nd] level risk (RE_{ij}) can be calculated as follows:

$$\mathrm{REij} = (\mathrm{Pij} \times \mathrm{Iij})$$

Here, P_{ij} is the aggregated probability of a 2[nd] level risk, and I_{ij} represents its aggregated impact. As a result, the fuzzy risk extent of each of the 1[st] level evaluation index (RE_i) can be calculated:

$$\mathrm{REi} = \frac{1}{\mathrm{n}}\sum_{\mathrm{j}=1}^{\mathrm{n}}(\mathrm{Pij} \times \mathrm{Iij})$$

Here, n is the amount of sub-criteria in that risk index. Because all mathematical steps are integrated into the Excel sheet, the team can have these results as soon as all sub-criteria receive input from every member.

Risk Index							
C1	0,711	1,742	3,467	**C11**	0,000	0,333	1,444
				C12	1,422	3,150	5,489
C2	0,922	2,450	4,250	**C21**	0,978	2,800	4,667
				C22	0,867	2,100	3,833
C3	1,981	3,167	6,511	**C31**	1,700	3,750	6,533
				C32	2,689	3,483	7,333
				C33	1,556	2,267	5,667
C4	1,004	2,292	4,389	**C41**	1,300	3,000	5,367
				C42	0,000	0,300	1,689
				C43	1,711	3,575	6,111
C5	2,933	5,075	7,800	**C51**	3,022	5,250	8,089
				C52	2,844	4,900	7,511
C6	0,622	1,978	4,122	**C61**	1,244	2,800	4,911
				C62	0,000	1,156	3,333

Table 8. An example of aggerated fuzzy risk indices of main and sub-criteria

Once all risk extents of the 1st level index were calculated, the decision-makers can match the scores with appropriate linguistic level terms and make a bid/no-bid decision. Based on the company's strategies, the qualitative rate of risk extents is set in Table 9. As a result, the example shows that customer risk (C5) has the highest rate while resources (C1) has the lowest risk extent (Figure 11).

Risk Level	Fuzzy Numbers
Extremely Low (EL)	(0, 1, 2)
Very Low (VL)	(1, 2, 3)
Low (L)	(2, 3, 4)
Fairly Low (FL)	(3, 4, 5)
Fair (F)	(4, 5, 6)
Fairly High (FH)	(5, 6, 7)
High (H)	(6, 7, 8)
Very High (VH)	(7, 8, 9)
Extremely High (H)	(8, 9, 10)

Table 9. Linguistic levels to match the risk extents (Lin & Chen 2004, 591).

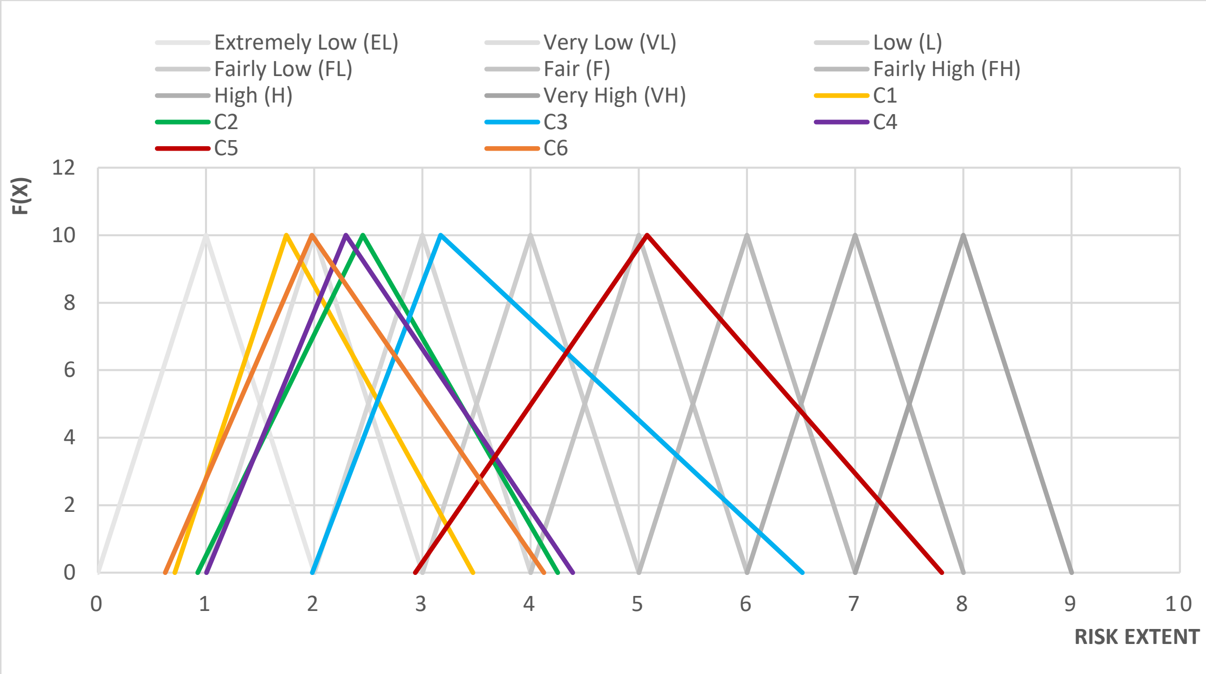

Figure 11. Fuzzy risk rating of 1st risk level C_i.

Furthermore, the fuzzy logic method can be used for risk assessment in project management. Like tender evaluation, the fuzzy rating can indicate the risk score and priority of control based on its linguistic term (e.g., Extreme High, Very High, Fair, or Extremely Low).

Risk controls and monitoring the process

For step (5) and (6), once the bidding proceeds, the team could decide the treatment of identified risks to sustain that proposal's winning rate. Tendering is mainly related to making bid/no-bid decisions, so it is practical to conduct a complete risk management framework for the potential bids only. Abandoned tenders can be documented in tendering reports for reference or reconsidering in the future. Table 10 explains the required factors to conduct systematic risk management in tendering, monitoring and reviewing risks quickly throughout the tender or the project life cycle.

Sections	Descriptions
Cost of Mitigation	The team assume possible cost or required resources, technology to control the identified risks. This section can compare the expert's expected values versus the actual cost after tendering to help them understand the risk change.
Control Effectiveness	This section can be done at step (6). Once the tendering is over, the team can assess how well they have managed the risks to improve future proposals. The control effectiveness can be ranked as very effective, practical, partially effective, or ineffectiveness based on the team's expectation.
Responsibility	Identify the responsible entities that monitor and manage specific risks. The responsibility can be divided strategically between the firm's experts, subcontractors, and partners.
Comments	Once every risk factor has been re-evaluated, experts could discuss or add a remark to express their opinions and suggestion to enhance the success of risk management in the future.

Table 10. Critical factors for risk management report in tendering

More importantly, Arbonaut should practice continuous risk reviews from both financial and marketing perspectives. Therefore, the decision-makers could estimate the criticality of certain risks and their negative impact on project costs. Companies often accept risky projects with an inevitable loss to develop or penetrate a market. What can be learned from the Rwanda project was that specific disadvantages are acceptable if it provides more projects in the long run. However, decision-makers need to be mindful about prioritising different costs and risk mitigation explicitly. Whether the company can recover from such projects could affect its growth. Organisational resilience can be increased by knowing where and how much the firm can tolerate or reduce threats.

Although the suggested risk management framework is a valuable tool for dealing with uncertainties in tendering, limitations should also be addressed. Human is susceptible to consistent types of errors in heuristic judgment about volatile events without certain precautions. Therefore, it is essential to standardise expert estimations frequently. The model might also face recurring mistakes due to a lack of historical data in the organisation. Quality control is often non-existent in users of quantitative modelling tools. Nevertheless, it is vitally important to assess the system's reliability through further research.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The thesis set out to determine that risk management in tendering is significantly vital for Arbonaut's operation. However, it has been neglected due to insufficient resources and a lack of comprehensive planning. A robust method could ensure potential risks are identified and handled, from the bidding process to project implementation.

For centuries, risk management methods have been developed and reformed to minimise risk more accurately. Quantitative analysis methods remain credible tools to use in multiple industries, while certain qualitative tools receive disapprovals for systematic errors and unviable improvement. Even though the risk matrix is most favoured by business, many research articles presented strong evidence that the model is ineffective in analysing risks. However, with sensible modifications, it can be used for uncomplicated issues or portfolio presentation.

The fuzzy logic theory has provided a valuable method of assessing risks in tendering. Its fuzzy linguistic approach gives decision-makers reliable results in a range of values. Its structure allows the analyst to evaluate risk indices directly with little technical knowledge. Thus, a fuzzy linguistic approach to risk analysis can improve the team's communication and maintain consistency in decision-making. Nevertheless, every risk management method contains particular limitations. Comparing the efficiency of this model with different types of tenders is needed to ensure its validity.

Arbonaut Ltd is an international company with long experience in forest information systems, consultation land-use monitoring systems. Beneficial bidding strategies can generate opportunities for Arbonaut's progression. Therefore, this thesis has provided a risk management strategy to recognise potential pitfalls. As a result, the framework can support the firm in further project development stages.

5.2 Discussion

Throughout the researches, the author notices a joint statement of developing specialised risk analysis models. No matter how precise or complex mathematical the techniques are, organisations should customise them to suit the core mission, business models, and objectives. Based on prestigious academic posts, Monte Carlo simulation is still a popular and reliable practice to modify (e.g., Hubbard 2020; Vose 2008; McMurray, Pearson & Casarim 2017). However, the author focused on fuzzy logic theory as it is more feasible to established in the commission company's operation. In addition, similar to the Monte Carlo method, it is supported by reputable studies from different fields (e.g., Halabi & Shaout 2019; Karuturi 2013; Lin & Chen 2004; Djuric et al. 2019; Morauszki, Attila, József & Pokorádi 2019).

One unexpected finding was that social factors could significantly dictate the unpredictability of procurement. There are inevitable adversities that can hinder the improvement of risk management in a company. One challenge is that personal data protection varies in different organisations and financial institutions. In the European Union, it is regulated that applicants are entitled to an explanation of why their tenders were rejected (European Union 2020). In the World Bank Procurement guideline (2018, 31), once the client sends the Notification of Intention to Award the contract to all bidders, the Standstill Period is triggered, allowing unsuccessful bidders to seek a debrief and/or submit a complaint about the decision.

Some clients can refuse to announce the winning candidate's identity and only provide general comments. In some instances, the candidate only receives a notification of the decision, such as win or lose. For example, the UNDP's Instruction to Bidder (2019, 15) stated that unsuccessful proposers might request a debriefing from UNDP to discuss the strengths and weaknesses of their submission; however, the content of other proposals and how it is compared to the unsuccessful proposer's submission shall not be discussed. The UNDP (2019, 12) also stressed that "Information relating to the examination, evaluation, and comparison of Proposals, and the recommendation of contract award, shall not be disclosed to Bidders or any other persons not officially concerned with such process, even after publication of the contract award." Qualitative feedback helps the enterprise identify weak points in their proposal but not their perception of risks and competition. With pressure from international competition and lack of continuity in data collecting from customer feedback, it can be a drawback for Arbonaut to build feasible competitor analysis and performance benchmarking.

Vendors and customers hold a special place in risk analysis as well as financial institutions. Each individual visualises different possibilities when they think of risks. Some institutions also consider risk management an essential part of the project; thus, they could be eager in the tenderer's risk analysis to achieve a successful project. However, FIS and REDD+ projects often run into problems that customers might have indecisive demands or uncooperative with governing risks. One method to test the effectiveness of the risk management method is getting outsiders' views. The central issue is how companies can motivate the customer to collaborate.

Another challenge is in the company's operation; the company uses an agile project management platform called Jira, which is helpful to monitor operational cost and personnel performance. However, some personnel did not report the time spent on proposals, making it challenging to gather factual data to review the organisation growth from customer acquisition costs or actual project value. Experts' decision quality and risk management might not be accurate without total risk mitigation cost, proposal making time, and resource capacity.

5.3 Recommendations

At present, there is abundant space for further progress in sustaining effective risk management strategies and constructing customer co-development in projects. Risk management has become increasingly crucial in gaining a successful bid with emerging risks. To ensure every uncertainty is effectively managed in the long term, it requires powerful and committed initiatives from the company at strategic, tactical, and operational levels. Cooperation between different work positions also helps Arbonaut manage the customer participation uncertainties, motivate them to work productively with the company in risk management, and successfully reduce the impact of the crisis in tendering or project management.

At the strategic level, senior managers must continually review risk management development to provide suitable strategies to improve proposals and determine their goals in tendering process that yields the best results. Benchmarking with partners and competitors can also help them stay alert to new technologies and information in the fields. Suppose the activity is frequently conducted throughout Arbonaut's services. In that case, managers can learn from benchmarking results and set competitive pricing in their proposals. For customer risks, business developers should sufficiently build conclusive portfolio management strategies to understand and mitigate customer participation risks. In the long run, the enormous data from risk management in tendering and project management can help the firm construct better customer portfolio management (CPM).

To reshape organisational performance at the tactical level, Arbonaut also requires middle managers and technical personnel who participate in tendering and oversee project development. A risk-averse culture should be formed in the firm's working environment. Proper documentation must review and monitor risk management; thus, superiors must train employees about the importance of consistent reporting or observing customer's attitude in project works. Receiving valuable and comprehensive data from the project and tender management can help them monitor the company's growth, CAC and adopt various approaches to pricing based on the company's goals, target market, operation costs, and services.

Risk-averse strategies and management plans cannot be successful without the help of frontline workers at operational levels. Experts and team members working directly in the project need to monitor and initiate risk controls continuously. They will be the first responders and report to the risk manager if any level of volatility arises. The project team needs to conduct open book accounting and risk-sharing meetings to build customer co-development in risk management. By doing customer engagement, co-creation, and co-production research, the Arbonaut team could reduce client-related uncertainties. The client can also become more eager to support the team through training and sharing useful insights during the project. As a result, the field work's performance helps uppers levels understand the quality of their risk management and improve their job effectively.

Issues	Responsible persons	Resources	Timeframe
Employee training	Sales representatives and project managers	Presentation, tracking their performance, analysing the decision pros and cons	Six months
Resourceful risk governance	Project and tendering members, customer	Debriefing of risk analysis in meetings; continually monitoring risk report	One year
Review risk management and benchmarking	Business developers, sales and technology managers	Collecting historical data; calibrating expert estimation and risk assessment; reviewing competitors and partners profiles; conducting external researches.	Two to three years
Adopt different pricing strategies based on customer portfolio	Sales representatives	Documenting tendering and project process; analyse customer data and relationship.	Three years
Establish customer portfolio management	Business developers	Analyse historical data; collect external researches in the fields; R&D collaboration with the customer	Five years

Table 11. Suggested action plan for future development.

Risk management is still a new scientific study and is only one part of tendering. There is always a demand for innovative findings or formal investigations to test the validity of different strategies, methods, or programmes. Risk managers need frequent feedbacks and prolonged practices to have skilled intuition.

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Questionnaire for the interviews

Filter question: Are you involved in tendering and some REDD+ project work?

Theme 1. Risk management process

How should our tender evaluation be improved?
Could you explain the process of risk management in Rwanda and REDD+ projects?

a. What about other REDD+ projects?
b. Are the risks monitored continuously during the project?
c. What is included in the process?
d. Key personnel

What was your prediction of risk at the beginning of the project? How about now?
From the rank of 1 to 5, what is your opinion on the current risk management process?
In your opinion, from 1 to 5, how important is risk management in a project?

Theme 2. Risk awareness among expertises

What is your role in the tendering process?
How do you evaluate a proposal?

a. What goals or outcome do you have when you approach a new opportunity (proposal?
b. What value/opportunity from the proposal do you consider?
c. How do you prioritise them? (e.g., Arbonaut's role and added value; Financial value; Acquisition Process; Future Potential)

Do you feel a hierarchy in the tendering meeting where each expert's opinions are ranked differently?
What has Arbonaut learnt and lost from unsuccessful proposals?

a. What are the consequences?
b. What are the lessons?

Do you agree or disagree with using a risk analysis framework to forecast our chance of winning a proposal?
Could you explain why?
What were your tasks in the Rwanda Project? (In the specification stage and implementation stage)
How should the process be improved?
What is your opinion about having the projects' risk reports reviewed and transferred to a database as a risk bank at the end of every project?
Who do you think are our competitors in the REDD+ service?

Theme 3. Monitoring the risk analysis

Has Arbonaut conducted any benchmarking?

Theme 4. Client cooperation in risk management

How did the client and project provider participate in the risk management process?

a. At what stages did they join in?
b. How did Arbonaut's team conduct risk management without the client presence?

Layout of a risk report

Risk Event Cards

Strategic Objectives	Risk Types	Risk Events	Outcomes	Risk Indicators	Priority	Management Control	Control Effectiveness	Cost of Mitigation	Responsibility	Comments
Guarantee reliable and competitive supplier-client-processes	Schedule	Interruption of development	Overtime Quality problem	System requirements will change from the customer side during the project.	**High**	Requirements and functionalities will be discussed with the customer for each sprint. Possible new ideas will be written down and handled as additional work.	Partially effective	100h	Project Manager from Arbonaut, Product Owner from customer	
	Cost	Synchronisation solution is technically challenging and complex.	Delays in implementation. The project can not be kept in the schedule and budget.	The technical risk occurs	**Very High**	The fieldwork will adopt working processes where a data conflict risk is low.	Effective	50h	Product Owner from the customer (processes), Developers, Arbonaut	
	Technology	Selected technology is not compatible with the server hosting.	Installation of the system environment is delayed	Communication between the service provider and customer is not adequate.	**Medium**	Ensure that the server can host the selected software before purchasing hosting services.	Partially effective	10h	IT experts from Arbonaut, Product Owner from customer	

Guarantee the system is effective and user-friendly	Human resources	Insufficient IT skills to complete user testing from the customer.	Testing the system will be delayed and will not cover all the functionalities.	The customer is not familiar with system technology.	**Low**	Train the testers before the testing period. Select personnel with good IT skills for initial testing.	Ineffective	10h	Product Owner Training Expert	

Risk assessment with fuzzy logic in Excel

Risk Analysis				Committees	
Date	18-May-21	**Country**		#1	#3
Type	Bid	**Reference No.**		#2	
Title					

Main Criteria (Level 1)		Sub Criteria (Level 2)		Committee #1 Impact				Committee #1 Probability			
C1	Resources	C11	Service/Product need	**L**	0	**2**	4	**R**	0	**0.2**	0.4
		C12	Available needed partners	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7
C2	Technology	C21	Data Quality	**L**	0	**2**	4	**A**	0.8	**1**	1
		C22	Incompatible with the server hosting	**FL**	2	**3.5**	5	**O**	0.5	**0.65**	0.8
C3	Financial Value	C31	Potential service Value	**H**	6	**8**	10	**F**	0.3	**0.5**	0.7
		C32	Expected Profit Margin	**VH**	8	**1**	10	**F**	0.3	**0.5**	0.7
		C33	Sub-contracting value	**VH**	8	**1**	10	**S**	0.2	**0.35**	0.5
C4	Schedule	C41	Changes of key experts	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7
		C42	Human Error	**F**	3	**5**	7	**VR**	0	**0**	0.2
		C43	Unrealistic timescales	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7
C5	Customer	C51	Changes in Product Preference	**H**	6	**8**	10	**U**	0.6	**0.8**	1
		C52	Lack of transparency in the procurement process and spending of public funds	**FH**	5	**6.5**	8	**O**	0.5	**0.65**	0.8

C6	Competition	C61	Preferred Contractors	FH	5	**6.5**	8	**S**	0.2	**0.35**	0.5
		C62	Special Competitors	H	6	**8**	10	**R**	0	**0.2**	0.4

Input	Impact	Fuzzy Scores (Min, Med, Max)		
VL	Very Low (VL)	0	0	2
L	Low (L)	0	2	4
FL	Fairly Low (FL)	2	3,5	5
F	Fair (F)	3	5	7
FH	Fairly High (FH)	5	6,5	8
H	High (H)	6	8	10
VH	Very High (VH)	8	10	10
Input	**Probability**	**Fuzzy Scores (Min, Med, Max)**		
VR	Very Rare (VR)	0	0	0.2
R	Rare (R)	0	0.2	0.4
S	Seldom (S)	0.2	0.35	0.5
F	Fair (F)	0.3	0.5	0.7
O	Often (O)	0.5	0.65	0.8
U	Usually (U)	0.6	0.8	1
A	Always (A)	0.8	1	1

Presumption from Committees

Committee #1								Committee #2								Committee #3							
Impact				Probability				Impact				Probability				Impact				Probability			
L	0	**2**	4	**R**	0	**0.2**	0.4	**FL**	2	**3.5**	5	**VR**	0	**0**	0.2	**L**	0	**2**	4	**R**	0	**0.2**	0.4
FH	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**F**	0.3	**0.5**	0.7	**FH**	5	**6.5**	8	**S**	0.2	**0.35**	0.5

L	0	**2**	4	**A**	0.8	**1**	1	**FL**	2	**3.5**	5	**U**	0.6	**0.8**	1	**FL**	2	**3.5**	5	**A**	0.8	**1**	1
FL	2	**3.5**	5	**O**	0.5	**0.65**	0.8	**FL**	2	**3.5**	5	**F**	0.3	**0.5**	0.7	**FL**	2	**3.5**	5	**O**	0.5	**0.65**	0.8
H	6	**8**	10	**F**	0.3	**0.5**	0.7	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**F**	0.3	**0.5**	0.7
VH	8	**1**	10	**F**	0.3	**0.5**	0.7	**VH**	8	**10**	10	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**O**	0.5	**0.65**	0.8
VH	8	**1**	10	**S**	0.2	**0.35**	0.5	**H**	6	**8**	10	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**S**	0.2	**0.35**	0.5
FH	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**F**	3	**5**	7	**F**	0.3	**0.5**	0.7
F	3	**5**	7	**VR**	0	**0**	0.2	**F**	3	**5**	7	**R**	0	**0.2**	0.4	**FL**	2	**3.5**	5	**VR**	0	**0**	0.2
FH	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**F**	0.3	**0.5**	0.7	**F**	3	**5**	7	**O**	0.5	**0.65**	0.8
H	6	**8**	10	**U**	0.6	**0.8**	1	**H**	6	**8**	10	**O**	0.5	**0.65**	0.8	**FH**	5	**6.5**	8	**O**	0.5	**0.65**	0.8
FH	5	**6.5**	8	**O**	0.5	**0.65**	0.8	**FH**	5	**6.5**	8	**U**	0.6	**0.8**	1	**H**	6	**8**	10	**O**	0.5	**0.65**	0.8
FH	5	**6.5**	8	**S**	0.2	**0.35**	0.5	**FH**	5	**6.5**	8	**F**	0.3	**0.5**	0.7	**H**	6	**8**	10	**S**	0.2	**0.35**	0.5
H	6	**8**	10	**R**	0	**0.2**	0.4	**H**	6	**8**	10	**VR**	0	**0**	0.2	**VH**	8	**10**	10	**R**	0	**0.2**	0.4