Decision Making: Applications in Management and Engineering
Vol. 6, Issue 1, 2023, pp. 34-56.
ISSN: 2560-6018
eISSN: 2620-0104
DOI: https://doi.org/10.31181/dmame0601051229022s

NEW MODEL FOR MAKING RESILIENT DECISIONS IN AN UNCERTAIN CONTEXT: THE RATIONAL RESILIENCE-BASED DECISION-MAKING MODEL (R^2DM)

Saloua Said[1*], Hafida Bouloiz[1] and Maryam Gallab [2]

[1] Systems engineering and decision support laboratory, Ibn Zohr University, ENSA Agadir, Morocco
[2] MIS-LISTD Laboratory, Computer Science Department, Mines-Rabat School (ENSMR), Rabat, Morocco

Received: 22 October 2021;
Accepted: 12 November 2022;
Available online: 6 December 2022.

Original scientific paper

Abstract: *The present paper came into existence with the specific purpose of providing an optimized process that enables making resilient decisions in an uncertain context, and here our interest is particularly focused on the activity of new venture creation and on the entrepreneurial decision-making logic, in particular, effectuation theory. Within this framework, the rational resilience-based decision-making model (R^2DM) is introduced. The relevant steps of this model are: (1) The identification of the problem and the available options. In this instance, the studied situation is the effectual customer co-creation case, and the available alternatives are planning, visionary, adaptative and transforming approaches, (2) The definition of the selection criteria that should be used to evaluate the available alternatives. In our case, these criteria are the six principles of entrepreneurial resilience, which are set out in detail, (3) The choice of the methodology to be followed in assessing the available options. To that end, three interconnected methods, based mainly on logical thinking and reasoning, are proposed. They are respectively devoted to Entrepreneurial resilience (ER) calculation, options classification using logistic regression algorithm, and the determination of the most resilient route to reach objectives employing graph theory. The obtained results are compared to what is advocated in the literature and conclusions are made.*

Key words: *Resilience, Decision-making, Uncertainty, Entrepreneurship, Effectuation.*

* Corresponding author.
E-mail addresses: Saloua.said.5@gmail.com (S. Said), h.bouloiz@uiz.ac.ma (H. Bouloiz), meryam09@gmail.com (M. Gallab)

1. Introduction

To make a profit, entrepreneurs must secure capital investment, implement highly specialized competencies, mobilize outside resources, identify opportunities, and take numerous risks (De Winnaar and Scholtz, 2018). In the face of this complexity of the entrepreneurship process, traditional management decision theory has shown its limitations (Long et al., 2021). Companies have developed the habit of being aware of their environment and adopting serial decision-making, where current decisions are influenced by previous ones (Abzug, 2017), in contrast to new ventures that operate in a highly uncertain context with a genuine shortage of information. Therefore, effectuation theory has emerged to resolve this issue. It is a decision-making process designed for expert entrepreneurs to help them create ventures in an environment marked by high uncertainty and resource scarcity (Ghorbel et al., 2021). This theory provides benefits ranging from Knightian Uncertainty management to supporting control logic and sustainability approaches (Sarasvathy and Kotha, 2001). This theory is founded on five principles: (1) Bird in Hand, which alludes to the broad notion of the adage "A bird in the hand is worth two in the bush." In practice, an entrepreneur should begin by implementing the resources at hand rather than waiting for the perfect opportunity (Sarasvathy et al., 2014), (2) Affordable Loss, which can be used as a substitute for the NPV (Net Present Value) traditional approach. According to this principle, it is necessary to make decisions within an acceptable level of risk rather than depending on uncontrollable predictions (Silberzahn, 2016), (3) Crazy-Quilt, a principle inspired by patchwork. Its key feature is that entrepreneurship is a social process that grows through the commitment of stakeholders (Masango & Lassalle, 2020), (4) Lemonade, a term derived from the phrase "when life throws you lemons, make lemonade." It displays the capacity to turn adversity into an opportunity (Pacho & Mushi, 2021), (5) Pilot in the Plane. This concept incorporates the deep philosophy of effectuation theory. It argues the shifting from a prediction to a control logic since, as Abraham Lincoln once said, the only way to forecast the future is to mold it (Sarasvathy et al., 2014). These principles highlight key personality traits and personal qualities that entrepreneurs should possess to overcome the numerous difficulties related to entrepreneurship. Proactivity, stress tolerance, self-efficacy, a need for autonomy, innovation, and creativity are examples of this (Branicki et al., 2017). It is important to note that these personality traits should associate with a system's ability to perform well under challenging circumstances. We are referring here to entrepreneurial resilience. This ability to sustain business in the face of toughness is denoted by access to material resources, development of an attractive personal identity, the experience of power and control, adherence to cultural traditions, the experience of social justice, and cohesion with others (Hedner et al., 2011). The present paper proposes a decision-making process that guarantees to reinforce the entrepreneurial resilience in new businesses while making decisions in uncertain situations. The rational resilience-based decision-making model (R^2DM) represents an attempt to establish a link between resilience and effectuation. In scientific literature, the studies with the same purpose remain small in number. Examples include a qualitative study that links emotional resilience and effectual logic, on the one hand, and cognitive resilience and causal logic, on the other, and highlights the role played by these two resilience dimensions in supporting entrepreneurs in uncertain environment (d'Andria et al., 2018), an analysis that demonstrates two types of coping strategies as a result of juxtaposing effectuation theory and resilience: effectual coping and causal coping (Liu, 2019), a discussion of the

resilience of family businesses by mentioning the significance of effectuation logic to these kinds of organizations (Chrisman et al., 2011), as well as a contribution to fostering a better understanding of the role that effectuation and causation logics play in post-disaster entrepreneurial decision-making (Akinboye & Morrish, 2022). R²DM constitutes a qualitative and quantitative study, which proposes six pillars of entrepreneurial resilience (ER) by taking into consideration psychological resilience related to the entrepreneur, and organizational resilience associated with the new venture. Furthermore, it introduces two new methods allowing to calculate the value of entrepreneurial resilience for each available option, and then classify alternatives according to their ER values into two main categories: resilient and non-resilient decisions. The next step is to identify the most resilient route to achieve objectives, a method to be used especially when dealing with interdependent choices (options and sub-options), and this is the ultimate result of our model. To achieve this, we made use of machine learning and operations research. It is also worth mentioning that the R²DM model is rational with clearly defined steps and logical reasoning applied at some point. This style has been selected because it has proven to be the most relevant and advanced compared with other decision-making types (intuitive, dependent, and avoidant) (Uzonwanne, 2018). In order to give an exhaustive presentation of our model, the remainder of this article is organized in three parts. In the section 2, the R²DM model will be described in detail. First and foremost, the problem is identified. As an example of application, we opt for the effectual customer co-creation case. The objective is to compare the solution recommended by effectual logic in this situation, based on resources acquisition, stakeholders engagement and so on, with the result obtained through the use of the R²DM model, and then, if the same result is produced by the two approaches, discuss the reliability of our model and how it can make effectual logic more effective since it can provide the same results by taking into account a more global criterion, which is resilience. Secondly, the six principles of entrepreneurial resilience, considered as selection criteria, are described in greater detail. Thereafter, the three quantitative methods serving to determine the optimal decision from a resilience point of view are presented. Section 3 is dedicated to the presentation of results and discussion. Finally, conclusions are drawn and opportunities for future research are discussed.

2. Rational Resilience-based Decision-making model (R²DM)

2.1. Problem identification: the effectual customer co-creation case

The effectuation process states that a stakeholder's commitment serves as the lifeblood of any new company. Early customer acquisition opens up new avenues and inspires new objectives; otherwise, the small business is put on hold (Sarasvathy et al., 2014). There are more interactions with clients, but there are also more constraints. For instance, the entrepreneur might learn after meeting a client that the factors governing market demand have considerably changed and that interest in the product in question is conditional upon making specific alterations. Effectuation theory offers the entrepreneur four alternatives to deal with this predicament (Silberzahn & Enrico, 2016). The first among them is planning. This consists of making consistent attempts to position the business as accurately as possible. Entrepreneurs who do not want to change their products look for other suitable customers using the market segmentation strategy. The second paradigm is visionary. It describes the attitude of entrepreneurs who cling to their optimistic

vision of the future. In our context, this refers to passionately believing in the product and considering it avant-garde. In this case, the entrepreneur promotes his vision through various communication channels. A high level of prediction characterizes these two approaches. As for planning, the process can take a lot of time without any assurance that the entrepreneur can find his market niche. By adhering to the second approach, visionary, financial resources may be consumed over a long period without prospering in convincing customers of the importance of the product. The third alternative is adaptative. The entrepreneur concurs in making the requested changes by mobilizing adequate resources and time to satisfy the customer and win his commitment. Lastly, the fourth possibility is transforming. This revolves around setting co-created goals by obtaining customers' commitment. Adaptative and transforming approaches agree that the entrepreneur should adjust the product. The transforming strategy ensures that an actual profit will be generated in exchange for devoting time and resources. However, in the adaptative approach, resources and time are at risk because there is no guarantee that the customer will acquire the transformed product without a prior commitment. The effectuation theory supports the transforming approach because it favors control with minimal prediction. The entrepreneur needs to make a final decision by selecting one of the options previously mentioned.

2.2. Selection criteria identification: Entrepreneurial Resilience principles

2.2.1. First ER Principle: Adapt or pivot where required

One of the main causes of startups and new small businesses failing is the inability to pivot (McCarthy, 2017). The entrepreneur has a problem over whether to stick with the previously chosen strategy or alter it and even adopt a new strategy, if required, in the case of any unexpected change (Khurana et al., 2020). Adaptation involves a level of flexibility, which can be defined as the ability to change easily according to the situation (George-Weinstein, 2020). This ability can be measured by the workload that has to be managed within an acceptable amount of time, the response time that designates the time needed to interact, the generated costs, and the quality achieved (Gong & Janssen, 2010).

2.2.2. Second ER Principle: Weigh the options

Despite their extensive knowledge of the subject, decision-makers may still find it difficult to weigh the possibilities. This can be far more challenging for someone starting a small business since, in addition to their lack of expertise, many other factors are at play and must be carefully considered before taking any action. The impact on internal stakeholders or on the development of human resources (Cardon & Stevens, 2004), communication quality (Khoshnodifar et al., 2016), customer satisfaction (Russell-Bennett et al., 2007), defined objectives, financial and investment issues, possession of the necessary knowledge and expertise, application of the work plan, dynamism, and enthusiasm are a few examples (Kiritz, 2015). There are arguments that this method might slow down the business because a lot of time is spent examining the many options. However, making thoughtful decisions results from carefully balancing the available alternatives and minimizing the risk through reducing costs, implementation time, workload, and enhancing quality.

2.2.3. Third ER Principle: Turn adversity into opportunity

The ability to recognize hidden opportunities in unfavorable circumstances is a tremendous advantage. Every negative experience is perceived as an engaging task rather than a challenge to overcome. For instance, reaching consumers who are not pleased with the competitors' services, or hiring skilled but demanding employees. Key lessons can be identified in corporate history, e.g., Ryanair's recession survival in 2008/2009 (Curran, 2010). The ability to recognize opportunities in times of crisis can be called opportunity agility (Stephan et al., 2022), and is based on four metrics, which are costs, time, robustness, and scope (Yauch, 2011).

2.2.4. Fourth ER Principle: Do more than is required

The extra mile and customer satisfaction are closely related concepts in entrepreneurial jargon. Consumer demands and expectations should get constant special attention. Additional efforts have to be made to demonstrate a sincere interest in the customer. This may also present a chance to raise the inherent quality of the finished good or service (Yi & Gong, 2008). Customer satisfaction can be measured by quality that refers to the ability of businesses to constantly improve their products and services to meet the customer expectations, loyalty that can be built via flexibility and agility, and trust that can lead to customer retention, and therefore, to a minimization of risks (Saad et al., 2022).

2.2.5. Fifth ER Principle: Feel self-confident

Entrepreneurship may expose, by its very nature, the new business founders to reiterated failures. Displaying a confident attitude would empower them to embrace and surmount these defeats straightforwardly. Over and above that, others can feel the entrepreneur's confidence, trust him, and be prepared to conduct business with him (Gelaidan & Abdullateef, 2017). Entrepreneurs' self-confidence is denoted by believing in their own abilities, acting independently in making decisions, having a positive self-concept, and daring to express opinions (Febrianto et al., 2022).

2.2.6. Sixth ER Principle: Bounce back

One of the best ways to build resilience is to bounce back (Hoegl & Hartmann, 2020). Unwanted occurrences may devastate a person's life or business. After that, one can suffer significant losses and feel forced to start again. Da capo, a musical word that denotes starting a piece of music from the beginning, can be used to figuratively refer to this situation. Giving up is not an option for an entrepreneur who wants to be successful (Aldianto et al., 2021). The bouncebackability can be characterized by adaptive capacity and recovery potential (Rector et al., 2019).

The question now being asked is whether a quantitative measure can be ascribed to entrepreneurial resilience. In the interest of shedding some light on this issue, the following paragraphs will illustrate our principal findings of the present research.

2.3. Optimal decision identification: Methodology

2.3.1. Method N° 1: ER calculation using logical thinking and reasoning

We start by evaluating how much each ER principle is involved in the given alternatives. The options are divided into two categories: resisting the change by

declining to make the requested modifications and keeping the product in its original state or complying with the demand by deciding to make the necessary modifications. If a change is refused, planning or visionary techniques are envisaged, and if it is accepted, adaptative or transforming strategies can be used. According to the formulated judgement, a mastery level is assigned to the relevant principle as described in the following Table 1:

Table 1. Levels of mastery of ER principles

Principle's value	Level of mastery
Pi ∈ [0.8, 1]	The principle is very well mastered
Pi ∈ [0.6, 0.8[	The principle is well mastered
Pi ∈ [0.4, 0.6[	The principle is moderately mastered
Pi ∈ [0.2, 0.4[	The principle is weakly mastered
Pi ∈ [0, 0.2[	The principle is unmastered

The value of entrepreneurial resilience is the sum of the length of each interval (0.2 for all of them) divided by 2 and weighted as follows: unmastered principle: 10% (multiplied with 0.1), weakly mastered principle: 15% (multiplied with 0.15), moderately mastered: 20% (multiplied with 0.2), well mastered principle: 25% (multiplied with 0.25), very well mastered principle: 30% (multiplied with 0.3).

Table 2. Calculation of the ER value for the option: Opposing the changes

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur does not adjust to the situation since he decides to keep intact his initial product. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	0.1
Weigh the options	The entrepreneur's approach does not take into consideration the minimization of risks. On the contrary, he chooses a situation that is far from being free of ambiguity and uncertainty. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	
Turn adversity into opportunity	Resistance to this change has ruins opportunities that might be arising from working with the customer who asked for the product modification. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	
Do more than is required	The entrepreneur is unable to understand and accept the customer's needs. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	

Feel self-confident	The insistence on maintaining the product in its original state shows the entrepreneur's great confidence in himself and in his product. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]
Bounce back	The entrepreneur does not find it difficult to start from scratch and to look for new customers. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]

With regard to the option 'Opposing the change', and by reference to Table 2, two ER principles represent the strength of this action. In fact, this choice reflects a strong confidence about the capacity of the product to reach the consumer in its present state, and about the aptitude of the entrepreneur for identifying potential clients in the best possible way. For this reason, the level of self-confidence in this situation is thought to be between 0.8 and 1. Moreover, by taking this approach, the commercialization process does not advance with the target client, and the entrepreneur must undergo the whole process from the beginning by seeking for new customers. Consequently, the capacity of bouncing back is also estimated at between 0.8 and 1. However, four ER principles are identified as unmastered principles. The first one is adaptation. By declining the client's request, the entrepreneur refuses to accept this situation that forces him to change his initial strategy and vision. Therefore, this principle is estimated to be between 0 and 0.2. Concerning the principle related to minimizing risks (Weigh the options), it is not fulfilled since the entrepreneur runs, in this situation, a substantial risk with respect to finding a suitable client within a short time frame while mobilizing the minimum possible resources. In consequence, this principle is also between 0 and 0.2. The third unmastered principle is turning adversity into opportunity. Indeed, the entrepreneur misses the opportunity that could possibly be hidden behind the modification demand, which might seem, at first glance, complicated and time-consuming. The value of this principle is thereupon between 0 and 0.2. The last principle described as unmastered is associated with the acceptation and comprehension of the consumer's needs, which are completely absent in this situation. As a result, the value attributed to this principle is between 0 and 0.2. The ER value is:

$$ER_1 = (((0.2-0)/2) \times 0.1) + (((0.2-0)/2) \times 0.1) + (((0.2-0)/2) \times 0.1) + (((0.2-0)/2) \times 0.1) + (((1-0.8)/2) \times 0.3) + (((1-0.8)/2) \times 0.3) = 0.1. \quad (1)$$

That means that the option 'Opposing the change' is 10% resilient. For proper interpretation of this result, we propose an application of the resilience scale introduced by (Said et al., 2019), and devoted to classifying processes according to their resilience level (called echelon) (Figure 1).

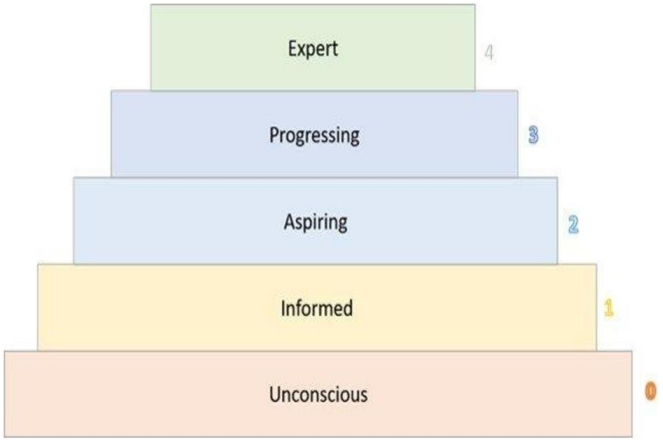


Figure 1. Resilience scale (Said et al., 2019)

This scale will be used, in this context, to define an available option as per its resilience (Table 3). In this case, the option 'Opposing the change' is unconscious.

Table 3. Classification of available options on resilience scale using ER values

ER value	Option's echelon
ER ϵ]0.25, 0.3]	The option is expert
ER ϵ]0.2, 0.25]	The option is progressing
ER ϵ]0.15, 0.2]	The option is aspiring
ER ϵ]0.1, 0.15]	The option is informed
ER ϵ]0, 0.1]	The option is unconscious

Regarding the option 'Planning approach', which is a sub-option of the alternative 'Opposing the change', it is considered as an informed option since the corresponding ER value is 0.125 (12.5%).

$$ER_2 = (((0.6-0.4)/2) \times 0.2) + (((0.2-0)/2) \times 0.1) + (((0.6-0.4)/2) \times 0.2) + (((0.8-0.6)/2) \times 0.25) + (((0.8-0.6)/2) \times 0.25) + (((0.8-0.6)/2) \times 0.25) = 0.125. \quad (2)$$

By referring to Table 4, it can be noticed that three ER principles are well mastered. This indicates that, by adopting this option, the self-confidence of the entrepreneur is between 0.6 and 0.8 since it is admitted that the product may only be suitable for a specific category of consumers. On a different note, it is true that the entrepreneur has not been able to respond to the needs of the client by modifying the product. Nonetheless, he seems keen to reach and retain his target customers through segmentation, even though this strategy is accompanied with risks. Hence, the values of the two principles 'Do more than is required' and 'Bounce back' are between 0.4 and 0.6. In addition, adaptation and turning adversity into opportunity are moderately mastered with a value between 0.4 and 0.6. Lastly, weighing the options is unmastered because there is no limitation of risks in this case. Consequently, the associated principle's value is 0 and 0.2.

Table 4. Calculation of the ER value for the planning approach

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur tries to adapt to the situation by changing his strategy (selection of target customers). However, the risk of not finding potential customers is very high. Verdict: In this situation, this principle is moderately mastered.	Pi ∈ [0.4, 0.6[	0.125
Weigh the options	The risk is always there and is not limited in this case. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	
Turn adversity into opportunity	The entrepreneur tries to use the situation to his advantage by reducing his room for manoeuvre, thus saving time and resources. Verdict: In this situation, this principle is moderately mastered.	Pi ∈ [0.4, 0.6[	
Do more than is required	The segmentation paradigm allows for a better understanding of customers and their expectations. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	
Feel self-confident	The entrepreneur is convinced that his product can be interesting for a certain category of customers. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	
Bounce back	The entrepreneur was able to pursue a different strategy than the one originally envisioned. However, this change is associated with several risks. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	

The visionary approach, detailed in Table 5, requires a huge self-confidence that is estimated, in the present instance, between 0.8 and 1. Moreover, this strategy revolves around the communication and promotion of the product until the right customers are found, while calling up important resources. That is why it was deemed that the principles 'Do more than is required' and 'Bounce back' are moderately mastered with values between 0.4 and 0.6. On the other hand, the principles relating to adaptation, weighing the options, and turning adversity into opportunity are unmastered since the visionary approach constitutes a risk-taking experience par excellence. As a result, this approach is 10% resilient (ER Value = 0.10) and, through referring to the resilience scale, this option is unconscious.

ER_3 = (((0.2-0)/2) × 0.1) + (((0.2-0)/2) × 0.1) + (((0.2-0)/2) × 0.1) + (((0.6-0.4)/2) × 0.2) + (((1-0.8)/2) × 0.3) + (((0.6-0.4)/2) × 0.2) = 0.1. (3)

Table 5. Calculation of the ER value for the visionary approach

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur refuses to adapt to current customer needs. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	0.1
Weigh the options	The entrepreneur uses extra resources to persuade customers with his product instead of trying to meet their needs. The risk is high in this situation. Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	
Turn adversity into opportunity	There is no immediate opportunity. The entrepreneur follows a logic of prediction and targets opportunities whose probability of occurrence in the future is unknown Verdict: In this situation, this principle is unmastered.	Pi ∈ [0, 0.2[	
Do more than is required	The entrepreneur tries to better understand the profile of customers who might be interested in and satisfied with his product. Verdict: In this situation, this principle is moderately mastered.	Pi ∈ [0.4, 0.6[	
Feel self-confident	The entrepreneur has full confidence in his product and is willing to use all means to make it a success. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	
Bounce back	The entrepreneur has not given up on the customer, but rather has increased communication around his product in order to be able to convince him in addition to the other customers. Verdict: In this situation, this principle is moderately mastered.	Pi ∈ [0.4, 0.6[	

For the option 'Complying with the change', five principles out of a total of six are very well mastered. In fact, this option is proof of the perfect capacity of adaptation while not fearing to go by a road different to that originally envisaged, capturing the opportunity presenting itself while taking in mind the necessity of minimizing risks, bending towards the specific needs of customers, and restarting the process if necessary. The remaining principle 'Feel self-confident' is well mastered since the entrepreneur has doubts about the completeness of his product in its initial state.

Thus, the option 'Complying with the change' is aspiring (ER Value = 0.175 (17.5%)) (Table 6).

ER_4 = (((1-0.8)/2) × 0.3) + (((1-0.8)/2) × 0.3) + (((1-0.8)/2) × 0.3) + (((1-0.8)/2) × 0.3) + (((0.8-0.6)/2) × 0.25) + (((1-0.8)/2) × 0.3) = 0.175. (4)

Table 6. Calculation of the ER value for the option: Complying with the changes

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur adapts perfectly to the situation. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	0.175
Weigh the options	The entrepreneur minimizes the risk of losing a potential customer and not finding a new one. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	
Turn adversity into opportunity	The entrepreneur seizes the opportunity to sell his product and improve its quality at the same time. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	
Do more than is required	The entrepreneur has perfectly understood and accepted the needs of his customer. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	
Feel self-confident	The entrepreneur believes that his product should be improved. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	
Bounce back	The entrepreneur is able to start from scratch if necessary. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	

The option 'Adaptative approach', presented in Table 7, is a sub-option of 'Complying with the changes' alternative. That said, in the absence of a commitment from the client, the principle 'Feel self-confident' is considered as weakly mastered, weighing the options is moderately mastered as the risks are increased in this situation, adaptation and turning adversity into opportunity are well mastered since the results are not guaranteed in the present case, and finally, the principles 'Do more than is required' and 'Bounce back' are very well mastered because the interest expressed to the customer's needs is perfect, in this situation, and the entrepreneur has no objection to relaunch the process of product conception. The ER Value of the adaptative approach is 0.145. This implies that the latter is informed.

ER_5 = (((0.8-0.6)/2) × 0.25) + (((0.6-0.4)/2) × 0.2) + (((0.8-0.6)/2) × 0.25) + (((1-0.8)/2) × 0.3) + (((0.4-0.2)/2) × 0.15) + (((1-0.8)/2) × 0.3) = 0.145. (5)

Table 7. Calculation of the ER value for the adaptive approach

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur adapts to the situation, but he puts himself under pressure if the customer does not make a commitment. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	0.145
Weigh the options	The entrepreneur minimizes the risk of losing a potential customer and not finding a new one. However, without a commitment from the customer, there is a risk that the latter changes his mind. Verdict: In this situation, this principle is moderately mastered.	Pi ∈ [0.4, 0.6[	
Turn adversity into opportunity	The entrepreneur has taken the opportunity to sell his product while improving its quality. In this situation, however, these results are not guaranteed. Verdict: In this situation, this principle is well mastered.	Pi ∈ [0.6, 0.8[	
Do more than is required	The entrepreneur has perfectly understood and accepted the needs of his customer. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	
Feel self-confident	The entrepreneur believes that his product should be improved, and he has not succeeded in obtaining a commitment from his customer. Verdict: In this situation, this principle is weekly mastered.	Pi ∈ [0.2, 0.4[	
Bounce back	The entrepreneur is able to start from scratch if necessary. Verdict: In this situation, this principle is very well mastered.	Pi ∈ [0.8, 1]	

The last option is the 'Transforming approach', which requires a commitment on the part of the client before proceeding with any changes, and this has a very positive impact on ER principles values that fluctuates between very well mastered (five principles) and well mastered (one principle). This option is aspiring (ER Value = 0.175), Table 8.

$$ER_6 = (((1-0.8)/2) \times 0.3) + (((1-0.8)/2) \times 0.3) + (((1-0.8)/2) \times 0.3) + (((1-0.8)/2) \times 0.3) + (((0.8-0.6)/2) \times 0.25) + (((1-0.8)/2) \times 0.3) = 0.175. \quad (6)$$

Table 8. Calculation of the ER value for the transforming approach

ER Principles	Train of thought	Principle Value	ER Value
Adapt or pivot where required	The entrepreneur adapts perfectly to the situation. Verdict: In this situation, this principle is a strength.	Pi ∈ [0.8, 1]	0.175
Weigh the options	The entrepreneur minimizes the risk of losing that customer, but also of wasting resources and time unnecessarily. Verdict: In this situation, this principle is a strength.	Pi ∈ [0.8, 1]	
Turn adversity into opportunity	The entrepreneur seized on the opportunity to sell his product while improving its quality. Verdict: In this situation, this principle is a strength.	Pi ∈ [0.8, 1]	
Do more than is required	The entrepreneur perfectly understands and accepts the needs of his client. Verdict: In this situation, this principle is a strength.	Pi ∈ [0.8, 1]	
Feel self-confident	The entrepreneur admits the fact that his product needs to be improved, but in return he manages to keep his customer through obtaining a commitment from him. Verdict: In this situation, this principle is developing well.	Pi ∈ [0.6, 0.8[	
Bounce back	The entrepreneur is able to restart again from the beginning if necessary. Verdict: In this situation, this principle is a strength.	Pi ∈ [0.8, 1]	

The optimal solution that can be selected is simply the one with the highest value of entrepreneurial resilience, which is, in this case, complying with the change by adopting the transforming approach (ER = 0.175).

This first method suggests the calculation of the ER value for each available option based on the values of the six ER principles, and, in the context of our studied case, the best solution can be easily detected since we are dealing with very few options. However, in complex situations, this task will become much more difficult. Considering this, we propose, in the next paragraph, a second method aimed at classifying available alternatives into resilient and non-resilient options. The part of logical reasoning introduced under the umbrella of method N°1 and serving to determine the mastery levels of ER principles for each option, will be used in method N°2 in order to build the dataset. Then, the option class (1: resilient, 0: non-resilient) will be identified through the use of a logistic regression model.

2.3.2. Method N° 2: Options classification using logical thinking and reasoning and logistic regression algorithm

The issue addressed here can be regarded as a binary classification problem since we have two classes, namely resilient options belonging to class 1 and non-resilient options, which are in class 0. In order to bring about a resolution to this problem, we decide to use the logistic regression algorithm, a statistical model, which is widely used in Machine Learning (Rymarczyk et al., 2019) for studying the relationships between a variable Y to be predicted, and a set of explanatory variables X_i. In the present instance, Y stands for Entrepreneurial Resilience (ER) and {X_1, X_2, X_3, X_4, X_5, X_6} represent the six principles of ER. The environment chosen to write and run our model is Google Colaboratory or Colab. We also used PySpark, an interface to Apache Spark in Python. This is considered as one of the most optimized data structures in Machine Learning since it enables high-performance computations (El Bouchefry & de Souza, 2020).

After installing PySpark and creating a SparkSession as an entry point, we import the dataset, which is, for this case, a CSV file named "Entrepreneurial_Resilience.csv". The latter consists of seven columns. The first six columns correspond to the ER principles and the last column to the class to which the option belongs, 1 for resilient options and 0 for non-resilient options). The sheet contains 1200 lines as well. They are populated with ER principles' values for several options available to deal with different situations related to managing cash flow issues, launching new products, hiring suitable candidates, building consumer loyalty, stepping out from the comfort zone, coping with cyber security issues, and so forth. The ER principles' values are calculated while following the same process previously explained within the framework of the rational resilience-based decision-making model. As for deciding on the class to which a given option belongs (resilient or non-resilient), this can be achieved through the application of a few rules. In effect, an option can be deemed as resilient on condition that one of the following scenarios apply: (1) If no principle among the six ER principles is very well mastered, we must have at least four principles that are well mastered, (2) If there is only one principle that is very well mastered, we must have at least three well mastered principles, (3) If two principles are considered as very well mastered, we must have at least two principles that are well mastered, (4) If three principles are considered as very well mastered, only one principle has to be well mastered, (5) If four or more principles are found to be very well mastered, the option is adjudged as resilient. In applying such a method to the options described in Tables (2, 4, 5, 6, 7, and 8), one observes that only the three alternatives: complying to the change, adaptative approach, and transforming approach can be taken into account. As regards with our logistic regression model, Table 9 illustrates the first five lines of the imported dataset.

Table 9. Data sample visualization

	S	P	A	K	J	D	Result
0	0.2 to 0.4	0.6 to 0.8	0.6 to 0.8	0.4 to 0.6	0.4 to 0.6	0.8 to 1	0
1	0.6 to 0.8	0.6 to 0.8	0 to 0.2	0.6 to 0.8	0.6 to 0.8	0.2 to 0.4	1
2	0 to 0.2	0.2 to 0.4	0.8 to 1	0 to 0.2	0 to 0.2	0.8 to 1	0
3	0.4 to 0.6	0 to 0.2	0 to 0.2	0 to 0.2	0.2 to 0.4	0.6 to 0.8	0
4	0.6 to 0.8	0.8 to 1	0 to 0.2	0.8 to 1	0.6 to 0.8	0.2 to 0.4	1

In the first line, we have one principle that is considered as very well mastered, namely 'bounce back' symbolized by the letter D, and only two principles, which are

well mastered. We refer to 'weigh the options' (P), and 'turn adversity into opportunity' (A). Consequently, the option can be qualified as non-resilient (result = 0). In the second row, for example, we have no principle, which is very well mastered. However, four principles are deemed as well mastered, which are 'adapt or pivot where required' (S), 'weigh the options' (P), 'Do more than is required' (K), and 'feel self-confident' (J), so the decision is considered as resilient (result = 1).

Some summary statistics, such as the mean value, the standard deviation (stddev), the minimum and the maximum, were also calculated. These values are represented in Table 10.

Table 10. Dataset's summary statistics

Summary	S	P	A	K	J	D	Result
count	1200	1200	1200	1200	1200	1200	1200
mean	0.4984	0.5038	0.5055	0.4882	0.4992	0.5030	0.2491
stddev	0.2856	0.2903	0.3005	0.2896	0.2928	0.2853	0.4327
min	0.0	0.0	0.0	0.0	0.0	0.0	0.0
max	1.0	1.0	1.0	1.0	1.0	1.0	1.0

According to the mean value, the typical mastery level of ER and its principles is 'moderately mastered' since they run around 50%. As per the standard deviation, its low value indicates that the columns' values are closed to the mean.

The correlation between each principle and the Entrepreneurial Resilience was determined as well. As illustrated in Table 11, the positive correlation coefficients indicate that the increase of ER principles values results in a rise in the result, which stands for the ER value. In addition, the fact that the correlation coefficients range between 0.24 and 0.3 states that there is a weak uphill linear relationship between the six principles and the ER.

Table 11. Correlations between ER and its principles

	S	P	A	K	J	D	Result
Correlation to results	0.2413	0.2519	0.2953	0.2735	0.2779	0.2767	1.0

Then, a subset of our database (723 of 1200 elements) is selected in order to build and train the logistic regression model. Table 12 shows a summary of the resulting model.

Table 12. Summary statistics of the model

Summary	Result	Prediction
count	723	723
mean	0.2351	0.2102
stddev	0.4243	0.4077
min	0.0	0.0
max	1.0	1.0

After that, the model is evaluated by comparing the generated predictions with the actual data. By taking into consideration the two columns, displayed in Table 13,

namely 'Result' and 'rawPrediction', which reflects the direct confidence calculation, we can proceed to the identification of the model's accuracy. In our case, it is about 95%.

Table 13. Summary statistics of the model

Features	Result	RawPrediction	Probability	Prediction
[0 to 0.2, 0 to 0.2, 0.8 to 1, …	0	[5.2503…	[0.9947…	0.0
[0 to 0.2, 0 to 0.2, 0.8 to 1, …	1	[-0.1942…	[0.4515…	1.0

The last step is to save the model and then upload it back to the environment. Lastly, the model is subjected to a test using a file of 10 lines containing only the values of the ER principles as represented by Table 14, and the model calculates the value of the class to which the option belongs.

Table 14. Test sample

S	P	A	K	J	D
0.6 to 0.8	0.8 to 1	0.8 to 1	0.6 to 0.8	0.6 to 0.8	0.6 to 0.8
0.4 to 0.6	0.2 to 0.4	0 to 0.2	0.8 to 1	0.2 to 0.4	0 to 0.2
0.4 to 0.6	0.4 to 0.6	0.6 to 0.8	0.8 to 1	0 to 0.2	0.8 to 1
0.8 to 1	0.8 to 1	0.2 to 0.4	0.8 to 1	0.4 to 0.6	0.4 to 0.6
0.2 to 0.4	0.4 to 0.6	0.6 to 0.8	0.4 to 0.6	0.8 to 1	0.4 to 0.6
0.2 to 0.4	0.8 to 1	0.4 to 0.6	0.8 to 1	0 to 0.2	0.8 to 1
0.6 to 0.8	0.4 to 0.6	0 to 0.2	0.6 to 0.8	0.8 to 1	0.8 to 1
0.2 to 0.4	0.8 to 1	0.4 to 0.6	0.4 to 0.6	0.6 to 0.8	0.4 to 0.6
0.2 to 0.4	0 to 0.2	0.4 to 0.6	0.6 to 0.8	0 to 0.2	0.2 to 0.4
0.2 to 0.4	0.6 to 0.8	0.6 to 0.8	0.8 to 1	0.4 to 0.6	0.8 to 1

The results are shown in Table 15. According to the predictions of the model, only three of the ten options can be classified as resilient.

Table 15. Test results

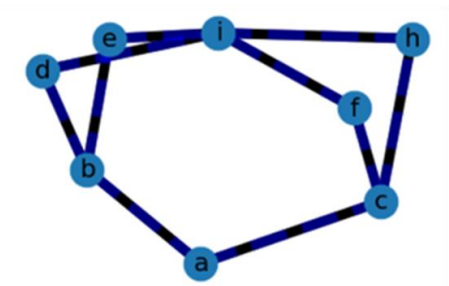
Features	Prediction
[0.6, 0.8[, [0.8, 1], [0.8, 1], [0.6, 0.8[, [0.6, 0.8[, [0.6, 0.8[	1.0
[0.4, 0.6[, [0.2, 0.4[, [0.8, 1], [0.8, 1], [0.2, 0.4[, [0, 0.2[	0.0
[0.4, 0.6[, [0.4, 0.6[, [0.6, 0.8[, [0.8, 1], [0, 0.2[, [0.8, 1]	0.0
[0.8, 1], [0.8, 1], [0.2, 0.4[, [0.8, 1], [0.4, 0.6[, [0.4, 0.6[	0.0
[0.2, 0.4[, [0.4, 0.6[, [0.6, 0.8[, [0.4, 0.6[, [0.8, 1], [0.4, 0.6[	0.0
[0.2, 0.4[, [0.8, 1], [0.4, 0.6[, [0.8, 1], [0, 0.2[, [0.8, 1]	0.0
[0.6, 0.8[, [0.4, 0.6[, [0, 0.2[, [0.6, 0.8[, [0.8, 1], [0.8, 1]	1.0
[0, 0.2[, [0.8, 1], [0.4, 0.6[, [0.4, 0.6[, [0.6, 0.8[, [0.4, 0.6[	0.0
[0, 0.2[, [0, 0.2[, [0.4, 0.6[, [0.6, 0.8[, [0, 0.2[, [0.2, 0.4[	0.0
[0.4, 0.6[, [0.6, 0.8[, [0.6, 0.8[, [0.8, 1], [0.4, 0.6[, [0.8, 1]	1.0

It must be emphasized that this method can be ideally used during brainstorming sessions, for instance, in order to filter out instantaneously resilient and non-resilient options. Nevertheless, the identification of the optimal decision is not attainable under this approach, which is dedicated exclusively to classification. Therefore, an additional method, supporting this objective, needs to be provided. However, we noted that, in certain cases, the optimal decision is not reduced to a single option to

select, but it can include a series of alternatives that should be applied one after the other for purposes of achieving objectives in the most resilient way. In light of this, the next proposed method sets out to determine the most resilient way to reach objectives by employing logical thinking and operations research, more precisely, graph theory.

3.3.3. Method N° 3: Determination of the most resilient route to reach objectives using logical thinking and reasoning and graph theory

As already explained in method 1, when dealing with independent options, the optimal solution that can be selected is the one with the highest value of entrepreneurial resilience. Still and all, our studied situation implies interdependent alternatives and thus should be handled differently. For this purpose, a method, aiming at identifying the most resilient path leading to objectives achievement, is introduced. It is conceived from the inspiration of the Dijkstra's algorithm for solving the shortest path problem (Enayattabar et al., 2018). First off, a weighted graph representing the information gathered in Table 2, Table 4, Table 5, Table 6, Table 7, and Table 8, is created using Python, and more specifically, the Networkx library, which is designed for the study of graphs and networks (Modarresi & Symons, 2019). In this graph, the available options are the nodes, and the ER values are the weights. The obtained graph is shown by the following figure (figure 2).




```
G.add_edge("a", "b", weight=0.175)
G.add_edge("a", "c", weight=0.1)
G.add_edge("b", "d", weight=0.145)
G.add_edge("b", "e", weight=0.175)
G.add_edge("c", "f", weight=0.125)
G.add_edge("c", "h", weight=0.1)
G.add_edge("d", "i", weight=0.16)
G.add_edge("e", "i", weight=0.175)
G.add_edge("f", "i", weight=0.1125)
G.add_edge("h", "i", weight=0.1)
```

Figure 2. Weighted graph for determining the most resilient path

The node ‘a’ corresponds to the identified problem or the triggering event. In this case, it is about the product change demand by the customer and whether or not approving this request. Regarding the nodes from ‘b’ to ‘h’, they are referring to the available options, ‘b’ is relative to the option “following the change”, ‘c’ stands for the option “opposing the change”, ‘d’ represents the option of adaptative approach, as for ‘e’, it designates the transforming option, On the other side stands ‘f’ for the planning approach as alternative, and ‘h’ denotes the option for visionary paradigm. The last node ‘i’ means goal attainment. In fact, the weight of each edge connecting points ‘d’, ‘e’, ‘f’, ‘h’ to the node ‘i’ is the average of the other weights of the edges forming the same chain. To give an example, the weight of the edge between the two vertices ‘d’ and ‘i’ (weight=0.16, cf. figure 2) constitutes the arithmetic mean of the weights of the edges connecting ‘a’ and ‘b’ (weight=0.175, cf. figure 2) and the nodes ‘b’ and ‘d’ (weight=0.145, cf. figure 2). This means that the approach followed between ‘a’ and ‘d’ to achieve the objective ‘i’, which is, in this case, reaching product commercialization, is 16% resilient.

In order to detect the most resilient path on our graph, we commence by drawing a table with lines and columns corresponding to the nodes of the graph. In each cell of the table, we enter the weight of the edge connecting two consecutive nodes. If it is

not applicable, the field is greyed out. This step is illustrated with the table below (Table 16).

Table 16. How to identify the most resilient path?

	a	b	c	d	e	f	h	i
a		0.175	0.1					
b				0.145	0.175			
c						0.125	0.1	
d								0.16
e								0.175
f								0.1125
h								0.1
i								

Thereafter, we select the largest value for each line. In our case, we take the value 0.175 for the first row. For the second one, we choose the value 0.175. To find the most optimal path, we apply the following rule: If the highest value of a selected row is greater than or equal to the minimum of the values selected in the previous rows, we take that value, otherwise we go to the next row. Regarding the line 2, we have 0.175 which is equal to the value 0.175 selected from the first row, that is why we retain this value. In the third line, we have 0.125 and 0.1, which are less than 0.175. Therefore, none of these values are adopted, and thence we move to the fourth row, which contains a single value that does not satisfy the conditions (0.16 < 0.175), so this value is not considered. In the fifth row, we have 0.175. This value is included in our list. In the last two rows, no value (0.1125, 0.1) is valid. To sum up, the selected values are the fields in green. By replacing these values with the corresponding nodes, we obtain the most resilient path with respect to the situation under study: MostResilientPath = [a, b, e, i]. This path corresponds to the option of transforming. It is the most reliable strategy for achieving goals from a resilience perspective, and the obtained result for the present situation, applying our rational resilience-based decision-making model, is in line with the recommendations of the effectuation theory.

3. Results and discussions

In this study, the following methods were proposed. Firstly, the calculation of the entrepreneurial resilience (ER) value for a given available option through a logical analysis of the six corresponding ER principles by responding to these questions: Regarding the studied option, what are the estimated rates of adaptation and pivot, wisely weighing the options to minimize risks, turning adversity into opportunity and uncovering hidden opportunities, paying particular attention to the consumers' needs, feeling confident about one's capacities and products, and the ability to bounce back? Once these rates are obtained, the ER value is calculated. The ER values help us classify the available options on the resilience scale and identify the most suitable solution from a resilience perspective, but only in straightforward situations. This method reveals its limitations when there are numerous connected alternatives or with options of the same rank. The second method is introduced to address this issue. It is conducted in two stages: the first consists in classifying the available options into resilient and non-resilient alternatives using a logistic regression model. The output is a shortened list containing only the resilient options. The second and last step is identifying the most resilient path to achieve objectives. This goes

through applying the first method to the shortlist of resilient options obtained thanks to the binary classification and determining the most resilient path using a weighted graph with the table implemented to interpret this graph. To demonstrate the trustworthiness of these methods, we have decided to apply them in a situation that falls under the effectual logic. In the result, the findings obtained are on the same wavelength as the recommendations of the effectual logic. This opens the discussion about the need to further incorporate resilience into the logic of entrepreneurial decision-making, particularly the effectual logic that emphasizes control over prediction (Goel and Karri, 2006). It has been established in the scientific literature that coupling control, a strategy for ensuring system performance, with resilience to deal with change under uncertainty allows the creation of an optimized system (Hoekstra et al., 2018). In our earlier works, we have addressed a variety of topics, including the relationship between resilience and response capability in the context of unfavorable occurrences, as well as the benefits of enhancing resilience on resources (Said et al., 2019) and process functioning optimization (Said et al., 2020). All of which is to say that resilience may be thought of as a universal and all-encompassing indicator, which can embrace and satisfy all the crucial features of any organization (new venture or already existing system).

4. Conclusions

During the drafting of this manuscript, it was observed that making decisions based on their resilience is not widespread despite what is at stake, especially for economic activities performed in an uncertain context, such as new venture creation. To make up for this shortfall, we proposed a novel process designed to help small business owners who need to improve and optimize their decisions. We are talking about a rational resilience-based decision-making model (R^2DM). To better explain the practical use of this model, we have chosen effectual customer co-creation as the studied situation. This gives rise to four alternatives (planning, visionary, adaptative, and transforming) that can be considered as input in the decision-making process. Once the problem is identified, the second step is to select the criteria based on which the decision is taken. In our case, Entrepreneurial Resilience (ER) principles (adapt or pivot where required, weigh the options, turn adversity into opportunity, do more than is required, feel self-confident, and bounce back) are the parameters against which the available options are assessed. Afterward, we laid out in detail three methods that can be used, optimally, in conjunction, or separately, if necessary, to assess the available options and then select the most suitable one. The first method involves calculating the entrepreneurial resilience (ER) value through a logical appraisal of the selection criteria for each option. The second proposed approach suggests a classification of the available alternatives through the use of a newly developed logistic regression model, which is aimed at pushing down the list of the eventual options by distinguishing the resilient alternatives from the non-resilient ones. The last method was introduced to determine the most resilient path to achieve objectives, more specifically, when dealing with interconnected options, by implementing a weighted graph. The results obtained after carrying out this study using the proposed methods are closely aligned with the recommendations of the effectuation theory. This can be interpreted as a sign that resilient decisions are informed and enlightened decisions that guarantee, first and foremost, long-term small-business continuity and success. On the other hand, by examining the three methods detailed in this essay, we notice that they are mainly predicated upon

logical thinking and reasoning. Nevertheless, cognitive scientists and neuroscientists have pointed out that humans are mentally predisposed to making erroneous judgments because of some unconscious mechanisms, such as the confirmation bias that leads to the neglect of strategic data or other possible readings and scenarios, and the groupthink, which represents the existence of insidious pressure to conform to the dominant opinion even if this latter is manifestly wide of the mark. In our future work, Natural Language Processing (NLP) can be employed to increase the accuracy of the rational resilience-based decision-making model. The intention is to obtain a model allowing the identification of the mastery level of each principle by relying directly on the textual description of the given option. Furthermore, we can also examine the most common and occurring reasons why startups and new ventures fail, and review, based on this study, the ER principles (add, amend, or reposition them), and eventually, suggest additional methods devoted to decreasing the probability of failure of the new ventures through making resilient decisions. As a further matter, the table used to identify the most resilient path based on the weighted graph should be converted into an automated tool to ensure effective running regardless of the importance of the size of the options list.

Author Contributions: Conceptualization, S.S.; methodology, S.S.; software, S.S.; validation, S.S., H.B. and M.G.; formal analysis, S.S.; investigation, S.S.; resources, S.S., H.B. and M.G.; data curation, S.S., H.B. and M.G.; writing—original draft preparation, S.S.; writing—review and editing, H.B. and M.G.; visualization, H.B. and M.G.; supervision, H.B. and M.G.; project administration, S.S., H.B. and M.G.; funding acquisition, N.A. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Data Availability Statement: Not Applicable.

Conflicts of Interest: The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Abzug, Z. M. (2017). The neurocomputational basis of serial decision-making. DukeSpace. Retrieved December 6, 2021, from https://dukespace.lib.duke.edu/dspace/handle/10161/16361.

Akinboye, A., & Morrish, S. C. (2022). Conceptualizing post-disaster entrepreneurial decision-making: Prediction and control under extreme environmental uncertainty. International Journal of Disaster Risk Reduction, 102703. https://doi.org/10.1016/j.ijdrr.2021.102703

Aldianto, L., Anggadwita, G., Permatasari, A., Mirzanti, I. R., & Williamson, I. O. (2021). Toward a business resilience framework for startups. Sustainability, 13(6), 3132. https://doi.org/10.3390/su13063132.

Branicki, L. J., Sullivan-Taylor, B., & Livschitz, S. R. (2017). How entrepreneurial resilience generates resilient smes. International Journal of Entrepreneurial Behavior & Research, 24(7), 1244–1263.

Cardon, M. S., Stevens, C. E. (2004). Managing human resources in small organizations: What do we know? Human Resource Management Review, 14(3), 295–323.

Chrisman, J. J., Chua, J. H., & Steier, L. P. (2011). Resilience of family firms: An introduction. Entrepreneurship Theory and Practice, 35(6), 1107–1119. https://doi.org/10.1111/j.1540-6520.2011.00493.x

Curran, S. (2010). The impact of the recession on companies' strategies in the Irish airline industry. Researchgate. Retrieved September 20, 2021, from https://research.thea.ie/bitstream/handle/20.500.12065/279/Sacha_Curran_20130918082309.pdf?sequence=1&isAllowed=y.

d'Andria, A., Gabarret, I., & Vedel, B. (2018). Resilience and effectuation for a successful business takeover. International Journal of Entrepreneurial Behavior & Research, 24(7), 1200–1221. https://doi.org/10.1108/ijebr-11-2016-0367

De Winnaar, K., Scholtz, F. (2019). Entrepreneurial decision-making: New Conceptual Perspectives. Management Decision, 58(7), 1283–1300. https://doi.org/10.1108/md-11-2017-1152

El Bouchefry, K., & de Souza, R. S. (2020). Learning in big data: Introduction to machine learning. Knowledge Discovery in Big Data from Astronomy and Earth Observation, 225–249. https://doi.org/10.1016/b978-0-12-819154-5.00023-0.

Enayattabar, M., Ebrahimnejad, A., & Motameni, H. (2018). Dijkstra algorithm for shortest path problem under interval-valued pythagorean fuzzy environment. Complex & Intelligent Systems, 5(2), 93–100.

Febrianto, Sulistiawati, Rahman, B., & Arifin, S. (2022). The relationship between confidence and mathematics learning achievement of Junior High School students. Journal of Physics: Conference Series, 2279(1), 012009. https://doi.org/10.1088/1742-6596/2279/1/012009

Gelaidan, H. M., & Abdullateef, A. O. (2017). Entrepreneurial intentions of business students in Malaysia. Journal of Small Business and Enterprise Development, 24(1), 54–67.

George-Weinstein, M. (2020). Flexibility and Adaptation: Key Elements for Preserving Research Continuity During the COVID-19 Pandemic. Delaware Journal of Public Health, 6(1), 66-67.

Ghorbel, F., Hachicha, W., Boujelbene, Y., & Aljuaid, A. M. (2021). Linking entrepreneurial innovation to effectual logic. Sustainability, 13(5), 2626.

Goel, S., & Karri, R. (2006). Entrepreneurs, effectual logic, and over–trust. Entrepreneurship Theory and Practice, 30(4), 477–493.

Gong, Y., & Janssen, M. (2010). Measuring process flexibility and agility. Proceedings of the 4th International Conference on Theory and Practice of Electronic Governance - ICEGOV '10, Beijing, China, 173–182. https://doi.org/10.1145/1930321.1930358

Hedner, T., Abouzeedan, A., & Klofsten, M. (2011). Entrepreneurial resilience. Annals of Innovation & Entrepreneurship, 2(1), 7986. https://doi.org/10.3402/aie.v2i1.6002

Hoegl, M., & Hartmann, S. (2020). Bouncing back, if not beyond: Challenges for research on resilience. Asian Business & Management, 20(4), 456–464.

Hoekstra, A. Y., Bredenhoff-Bijlsma, R., & Krol, M. S. (2018). The control versus resilience rationale for managing systems under uncertainty. Environmental Research Letters, 13(10), 103002. https://doi.org/10.1088/1748-9326/aadf95

Khoshnodifar, Z., Ghonji, M., Mazloumzadeh, S. M., Abdollahi, V. (2016). Effect of communication channels on success rate of entrepreneurial smes in the agricultural sector (a case study). Journal of the Saudi Society of Agricultural Sciences, 15(1), 83–90.

Khurana, I., Krichevskiy, D., Dempster, G., & Stimpson, S. (2020). Institutions, entrepreneurial adaptation, and the legal form of the organization. Journal of Entrepreneurship and Public Policy, 10(2), 261–283.

Liu, Y. (2019). Contextualising risk and building resilience: Returnees versus local entrepreneurs in China. Applied Psychology, 69(2), 415–443.

Long, D., Wang, H., Wang, P. (2021). Built to sustain: The effect of entrepreneurial decision-making logic on New Venture Sustainability. Sustainability, 13(4), 2170. https://doi.org/10.3390/su13042170

Masango, S. G., & Lassalle, P. (2020). What entrepreneurs do? Entrepreneurial action guided by entrepreneurial opportunities and entrepreneurial learning in early internationalising firms. International Marketing Review, 37(6), 1083–1119.

McCarthy, N. (2017). The top reasons startups fail [infographic]. Forbes. Retrieved September 20, 2021, from https://www.forbes.com/sites/niallmccarthy/2017/11/03/the-top-reasons-startups-fail-infographic/?sh=5c9fb3d44b0d.

Modarresi, A., & Symons, J. (2019). Modeling and graph analysis for enhancing resilience in smart homes. Procedia Computer Science, 160, 197–205.

Pacho, F. T., & Mushi, H. (2021). The effect of effectuation set of means on new venture performance: Flexibility principle as a mediating factor. Journal of Entrepreneurship in Emerging Economies, 13(5), 819-837.

Rector, J., Rector, J., Rikkert, M. G., & Melis, R. (2019). Resilience and recovery in older adults: A complex systems approach. Innovation in Aging, 3(Suppl 1): S376-S377. PMCID: PMC6840620. https://doi.org/10.1093/geroni/igz038.1380

Russell-Bennett, R., McColl-Kennedy, J. R., Coote, L. V. (2007). Involvement, satisfaction, and brand loyalty in a small business services setting. Journal of Business Research, 60(12), 1253–1260.

Rymarczyk, T., Kozłowski, E., Kłosowski, G., & Niderla, K. (2019). Logistic regression for machine learning in process tomography. Sensors, 19(15), 3400. https://doi.org/10.3390/s19153400.

Saad, N. A., Elgazzar, S., & Mlaker Kac, S. (2022). Investigating the impact of resilience, responsiveness, and quality on customer loyalty of msmes: Empirical evidence. Sustainability, 14(9), 5011. https://doi.org/10.3390/su14095011

Said, S., Bouloiz, H., & Gallab, M. (2019). A new structure of sociotechnical system processes using Resilience Engineering. International Journal of Engineering Business Management, 11, 184-199.

Said, S., Bouloiz, H., & Gallab, M. (2020). Resilience assessment of system process through Fuzzy Logic: Case of COVID-19 context. Advances in Science, Technology and Engineering Systems Journal, 5(5), 1247–1260. https://doi.org/10.25046/aj0505150

Sarasvathy, S. D., & Kotha, S. (2001). Dealing with Knightian uncertainty in the new economy: The real networks case. In J. Butler (Ed.), Research on Management and Entrepreneurship, 1, 31–62. Greenwich, CT: IAP Inc.

Sarasvathy, S., Kumar, K., York, J. G., & Bhagavatula, S. (2014). An effectual approach to international entrepreneurship: Overlaps, challenges, and provocative possibilities. Entrepreneurship Theory and Practice, 38(1), 71–93.

Silberzahn, P. (2016). L'effectuation, logique de pensée des entrepreneurs experts. Entreprendre & Innover, 28(1), 76-82. https://doi.org/10.3917/entin.028.0076

Silberzahn, P., & Enrico, G. (2016). L'effectuation en action. https://hal.archives-ouvertes.fr/hal-01892750.

Stephan, U., Zbierowski, P., Pérez-Luño, A., Wach, D., Wiklund, J., Alba Cabañas, M., Barki, E., Benzari, A., Bernhard-Oettel, C., Boekhorst, J. A., Dash, A., Efendic, A., Eib, C., Hanard, P.-J., Iakovleva, T., Kawakatsu, S., Khalid, S., Leatherbee, M., Li, J., … Zahid, M. M. (2022). Act or wait-and-see? adversity, agility, and entrepreneur wellbeing across countries during the COVID-19 pandemic. Entrepreneurship Theory and Practice, 104225872211048. https://doi.org/10.1177/10422587221104820

Kiritz, C. (2015). Weighing Options, Confronting Obstacles. Grantsmanship Center. https://policycommons.net/artifacts/1647781/weighing-options-confronting-obstacles.

Uzonwanne, F. C. (2018). Rational model of decision-making. Global Encyclopedia of Public Administration, Public Policy, and Governance, 5334–5339. https://doi.org/10.1007/978-3-319-20928-9_2474

Yauch, C. A. (2011). Measuring agility as a performance outcome. Journal of Manufacturing Technology Management, 22(3), 384–404.

Yi, Y., & Gong, T. (2008). If employees "go the extra mile," do customers reciprocate with similar behavior? Psychology & Marketing, 25(10), 961–986.