Decision-making in Small-Medium Enterprises: A qualitative research on the scientific method

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Ilaria Marini - ID 131135

Supervisor: Arisa Shollo

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ABSTRACT

Evidence-based management has highlighted the importance of grounding organizational decisions on objective and unbiased data. However, most of the theories developed in this field focus on large, established firms. This thesis focuses instead on small-medium enterprises (SME). The analysis aims at understanding whether a scientific approach to managerial decisions creates differences in the way SMEs approach decision-making and if it favours an increased ability to identify new opportunities.

The basis of this study is a randomised control trial conducted on 259 SMEs that tested the effects of the scientific method by comparing, over a period of eight months, the process followed by treatment and control group. This thesis focuses on a sample of 30 SMEs that performed a radical pivot. For each SME, it considers the baseline interviews and the interviews in which they mention the pivot.

The treated companies in this sample show the following four characteristics compared to the control group: Higher tendency to use surveys to test the entrepreneur's hypothesis; Greater ability to detect new features that improve the original value proposition; More frequent use of A/B testing to collect data regarding the performance of their solutions; Increased awareness of biases and factors that can reduce the quality of the data.

The main contribution of this study is to provide qualitative evidence on how the scientific approach changes the way in which decisions are made and on whether it contributes to the identification of new opportunities. The study also finds that, while the treated group exhibits these characteristics more frequently, there is heterogeneity in the behaviour of the two groups. In fact, not all the treated firms comply fully with the scientific method. Further research could focus on the factors that influence the absorption of the treatment.

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1. INTRODUCTION

The present work takes inspiration from the concept of evidence-based management, according to which the use of data and facts can improve the quality of the decisions taken in organizations. In particular, it aims at exploring how the decision-making process in small-medium enterprises (SMEs) changes after being exposed to the scientific approach to decision-making. A randomize control trial was carried out with the participation of SMEs based in the United Kingdom, divided in treatment and control group, with the objective of analysing the possible differences in the decisions made after the participation to the experiment.

Managers and decision-makers' reliance on their gut feeling and opinions persisted in the years and it has always been under analysis of the academic world, which proposed several models to reduce the impact of biases on final decisions. An important contribution in this field is provided by Daniel Kahneman (2011), who identified the presence of two systems in the brain and explained how these are used when a decision must be taken.

After the discovery of the fallacies of the human brain, several researchers focused on creating different approaches to improve the decision-making process. Kester *et al.* (2011) compared three different ways in which corporations can organise their decision-making process, which are evidence-based, opinion-based, and power-based decision-making. However, the acknowledgment that human decisions are exposed to biases was not enough to drive a change in managers' behaviour. As a consequence, the focus has been shifted to the creation of guidelines on how to become evidence-based. Different authors have contributed, such as Pfeffer & Sutton (2006) or Rousseau (2006). The building-block of the evidence-based decision-making is the belief that data and facts must be incorporated in the decision-making process of firms so that decisions can be based on objective and reliable information rather than personal opinions and intuitions. This would render the final decision more legitimate in the eyes of the stakeholders, favour a more efficient use of resources and bring value to the society at large.

The relevant literature in the field of evidence-based decision-making covers mainly established corporations due to the fact that their reliance on well-defined structures often impedes an adequate adjustment to a complex and fast-changing world, which instead requires a constant rethinking of the value proposition. However, in line with the course of studies followed, it could have been of interest to shift the focus on innovative projects undertaken in small companies or start-ups. In these cases, the benefits of applying a rigorous method for decision-making can be significant since, due to scarcer resources and the uncertain environment in which they work, a failure can hinder the existence of the company itself. Indeed, several approaches to entrepreneurship have been proposed during the years, such as Agile Development, Design Thinking, Discovery-Driven Planning and Lean Start-up. One of the core ideas that associates the different theories aforementioned is the centrality of the customers, in particular their involvement in the development process and their feedback, used in order to understand how to best deliver value. Another common factor among these theories is the emphasis on the value of learning, through which the entrepreneur will be able to identify the value of the opportunities before fully investing in it and direct resources towards the most profitable option. However, these methods only help the entrepreneurs to frame a decision already taken and render its execution smooth. The drawback is that they do not explain how the decision-making process should be carried out in entrepreneurship. For this reason, the scientific method was developed with the aim of providing such indications.

The scientific approach to entrepreneurial decision-making was recently developed by Camuffo *et al.* (2018) and no qualitative evidence of the contribution of such method was present. In this light, the current study is classified as theory-testing: In fact, the data collection and analysis aim at testing, through a deductive approach, the main propositions supporting the theory considered.

The research questions addressed are two:

1. What are the differences in the way in which scientific entrepreneurs make decisions

regarding their value proposition?

2. Is there an enhanced ability to identify new business opportunities in the decision-making process of treated SMEs?

The method chosen to answer the research questions is a qualitative analysis of interviews conducted on a sample of small-medium enterprises, divided in treatment and control group, that were part of a large randomized control trial. The interviews were coded and then compared to evaluate whether significant difference in the decision-making process was observed between the two groups.

The main findings of the study confirm that firms are indeed more accurate in their decision-making when introduced to the scientific method. More precisely, the following aspects emerged: First, treated business owners use specific tools for testing their hypotheses. Significant evidence was related to the use of surveys, which allow to assess the market's characteristics in a more objective way, and A/B testing, which removes the dependency on people's statements in favour of the direct observation of their actions. Second, treated SMEs become more aware of the quality of the data and the possible presence of biases. Third, SMEs receiving the treatment had an enhanced ability to identify new aspects that could boost the adoption of their solution and hence possibly lead to a pivot, in line with the findings of the original research (Camuffo *et al.*, 2018).

These aspects proved to be representative of the treatment group, as these constituted a main difference with respect to the companies belonging to the control group. However, with respect to other aspects analysed, the behaviour adopted by the two groups was not significantly different, and there were still cases of treated SMEs who continued relying on heuristics or approximate methods. The heterogeneity in the absorption of the treatment is also given by the fact that the frequencies of the dimensions observed are relatively low.

In terms of academic relevance, this research offers a systematic, in-depth analysis of the

value of the scientific method. In fact, the approach followed in the current study differs from the standard approaches adopted beforehand, since no qualitative evidence was present up to now. Moreover, the current thesis expands the scope of the scientific method since this was initially tested on early ventures and start-ups only, while with the new experiment considered in this paper, the scope was expanded to a new category, namely SMEs.
In terms of practical contribution instead, the results of this study constitute an important source of information for both start-ups and small-medium enterprises that seek to understand the practical benefits that can be gained by applying the scientific method.

This paper is structured as follows: The literature review compares the different perspectives regarding evidence-based management. Then, a closer look on how evidence can be integrated in entrepreneurial settings will be also presented. The methodology section explains the philosophy of research applied, the approach chosen, the type of data used in this study and then a detailed description of the data collection and data analysis techniques. Then follows the analysis of the results, divided into dimensions constituting the main findings of the study, dimensions that were either less frequent or present in both groups without significant difference and finally the dimensions that were not among the main variables under observation but which offer relevant insights. The discussion section presents a critical evaluation of the results obtained, in comparison to the relevant literature considered. Then the conclusion and point of reflections for further research are discussed.

2. LITERATURE REVIEW

2.1. RATIONALITY AND BIASES

Four Nobel Prizes were awarded to researchers (Herbert Simon, Daniel Kahneman, Robert Shiller and Richard Thaler) “whose scientific work demonstrates that human judgement

systematically deviates from rationality" (Barends & Rousseau, 2018, p.64).

Systematic errors are the result of the human predisposition to see patterns and casual relations, to process information in a way that confirms our existing beliefs, expectations and assumptions and to be overly optimistic and over confident (Barends & Rousseau, 2018).

Due to the complexity of analysing and comparing all the possible alternatives, the human mind uses ways to make thinking less effortful, called heuristics. Heuristics are mental shortcuts that allow to make judgements quickly, through which missing information is substituted by mental processes, especially when there is not enough time to search and analyse data. This belongs to what Daniel Kahneman (2011) classified as System 1, which is fast, intuitive and emotional. On the contrary, System 2 is low, effortful, deliberate and rational. While the former is crucial from an evolutionary point of view, since it enables quick responses to signals coming from the external environment, such as life-threatening situations, it also introduces serious cognitive biases impairing the quality of decisions. Considering that the outcome of the thinking process depends on the interaction of these two systems and knowing that the System 2 is involved less frequently due to the higher effort required, the tendency is to continue relying on System 1, as this proves to be successful most of the times (Barends & Rousseau, 2018).

Among the different types of cognitive biases, some are particularly relevant in the managerial field. The first one is the predisposition to see patterns and causality relations. The ability to identify patterns is very valuable to humans and improves the predictive capability. This is also known as *association learning* and it is due to the attempt of System 1 to seek patterns also when, in reality, they are not present. This explains phenomena like superstition, in which people link random events to specific outcomes. In fact, since the brain is not able to distinguish between right and wrong causal relationships, System 1 continues to assume that the pattern is true until the contrary is proven.

The second type of bias is the confirmation bias, which is the tendency of System 1 to

confirm prior beliefs. The brain actively seeks information in line with the expectations and ignore what is against it. This is why, to be as objective as possible, evidence challenging the initial judgement should always be sought (Barends & Rousseau, 2018).

Finally, another bias is group conformity, which leads to adapt to the opinion of other people in the group even when this is against the personal one. This is explained by the tendency of System 1 to strive for consensus and avoids confrontations.

Other biases are less severe but may still be relevant to managers. Among these there is the availability bias, which is the tendency to believe something is true only because there is a higher familiarity with it, compared to something never seen before. Authority bias is the phenomenon of accepting the opinion of someone who is in an authority position and tacitly becoming less critical. Overconfidence bias is also common and consists of an excessive reliance on personal abilities, knowledge and skills. Social desirability bias is instead the tendency to answer questions in a way that will be positively perceived by other people.

Years of studies have been devoted to come up with management theories that could help practitioners in their daily tasks of decision-making. Due to the consequences that these decisions can have on society, the academic world has constantly inquired the reasons behind the fallacies observed and tried to create frameworks that could improve the decision-making process. To achieve this objective, the first step is recognising the presence of biases. This can be done by “acquiring, appraising and applying multiple sources of evidence” (Barends & Rousseau, 2018, p.74). Besides, it is advisable to formulate the theory before evidence has been collected, so to avoid the temptation of fitting the theory to the available facts.

Initial assumptions should be kept falsifiable and practitioners should actively look for evidence that contrast the initial hypothesis so to obtain a more objective view. To bring this to the extreme, Alfred Sloan, former president of General Motors, claimed that decisions should not be finalised until someone highlights why the preferred option may be the wrong

one (Sloan, 1964). The underlying logic is that disagreement decreases the risk of groupthink and authority bias.

Cabantous, Gond & Johnson-Cramer (2008) describe the rational decision-making process as made up of four stages. The first is the formulative stage, where the problem is structured. Then follows the evaluation stage where the utility of the various alternatives is assessed, considering an estimate of the probability that each event realises. The third is the appraisal stage and it consists of comparing the different alternatives and select the one with highest expected utility. The final one, implementation stage, requires that relevant actions are taken in order to put in practice the selected solution. These steps represent a strong form of rationality, which is referred to as *substantive rationality* (Cabantous, Gond & Johnson-Cramer, 2008, p.5). This is usually considered at an individualistic level, and it is indeed used by economists to conceptualize problems like consumer choice and investment decisions (Mas-Colell *et al.*, 1995). In the organizational settings instead, it is possible to talk of *procedural rationality,* which assumes a satisficing, rather than maximising, approach that tries to get the best outcome possible given the conditions. The decision to mould the rational view in the organizational settings renders it more realistic and ensure that phenomena like politics, external forces and mistakes are taken into account.

2.2. DECISION-MAKING: DIFFERENT PERSPECTIVES

Kester *et al.* (2011) identified three different types of decision-making: Evidence-, opinion- and power-based. These three methods are not univocally used by a firm. Rather, a combination of these can be used, according to the inputs available and the objectives of the firm in terms of being more rational and objective or whether politics and intuitions are also accepted.

In *evidence-based decision-making,* assumptions on business ideas must be backed up by

primary data, i.e. information of various nature generated by the project itself. Discussions are usually cross-functional and managers are invited to present the logic behind the different decisions. Then, those who are supported weakly will not be accepted. In *power-based decision-making,* distinct groups present their objectives and, in the end, one group will strictly dominate the others. In this situation, decisions usually reflect the interest of a particular unit of the company, rather than considering the best interest of the organization and how a particular endeavour fits within the high-level strategy. In the *opinion-based decision-making,* mere personal experiences and opinions are used as substitutes of facts. Discussions in this instance appear like an exchange of personal opinions in front of the CEO, who then expresses his or her preference. Since no specific piece of evidence is used in this case, it is more likely that conflicts arise.

All the approaches exhibit pros and cons. Power- and opinion-based allow the company to maintain more flexibility but, on the other hand, there is the risk that only the pet projects of senior managers will be financed. On the contrary, the evidence-based may hinder the flexibility of the firm as more time is needed to gather the data and analyse them. Moreover, there is the risk that the use of evidence inevitably favours short-term projects, since long-term performance is more difficult to predict. Consequently, the difficulty of finding compelling evidence about a breakthrough product may hinder the ability to innovate, which is instead easier when the opinion- and power-based methods are used.

Despite the drawbacks, using evidence-based management can encourage critical thinking. On the contrary, when power-based processes are used, the likelihood that participants question the validity of the presented assumption decreases (Kester *et al.*, 2011). The authors highlight as well the fact that a successful implementation of these practices relies on three main factors. The first is trust, which is fundamental to enable the cross-functional collaboration needed to gather information from all departments and engage in constructive discussions. In cases where politics prevail, trust is not likely to emerge. The second factor is collective ambition. It refers to the extent to which all functions share and work towards

the same goal and it is negatively associated with politics. The third factor is transformational leadership: Leaders and managers who adopt this style support the sharing of cross-functional expertise by leaving room to open argumentation. This is likely to foster critical thinking and promote learning.

Among the three approaches identified by Kester *et al.* (2011), this research will focus on evidence-based decision-making. This particular theory is increasingly gaining relevance since, in a complex and fast era like the current one, it is unlikely that the professional expertise of individuals is enough to deal with all the situations that a company may face.

2.2.1. EVIDENCE BASED MANAGEMENT

Different researches focus on exploring the efficacy of the use of evidence in the decision-making process and explaining how the failure to do so can increase the chances of observing adverse results. For example, strategic initiatives may fail because they are designed on faulty assumptions which were not verified. Hence, executing a strategy based on wrong assumptions will inevitably result in failure (Morgan, Levitt & Malek, 2008).

Evidence-based Management is proposed as a solution to the problem of mis-execution of strategies and waste of resources. Management is often seen as a craft since it requires the ability to make decisions under pressure and with incomplete information, which can be learned only through practice and experience (Pfeffer & Sutton, 2006, p.3). However, in uncertain settings, evidence can help decision-makers to get closer to the right choice.
Pfeffer & Sutton (2006) identified the steps necessary to implement this mindset into a company:

- *Demand evidence*: Ask for evidence in support each proposal;

- *Examine logic*: Challenge the logic behind the data that are presented and understand the causal relationship behind it. This will render people in the organization more disciplined about their own thinking and create commitment towards evidence-based management. This also involves unpacking the assumptions behind the presented claims;
- *Encourage experimentation*: Prompt managers to conduct experiments to test the viability of their proposals. The best evidence comes from the company's data rather than from external research;
- *Reinforce continuous learning*: Managers need to constantly update their professional education, so to expand their knowledge and enrich their assumptions.

However, in the everyday practice, professionals feel confident about their own expertise and do not seek additional information, even when acting on better logic and evidence would allow their companies to win the competition (Pfeffer & Sutton, 2006). On the contrary, when presented with evidence disconfirming their beliefs, they fail to abandon their point of view and do not update it with the new knowledge. This happens because of the common belief that evidence is specific to a company's context and hence finds limited applicability in other firms. Another reason is that evidence acts as levellers of hierarchies: When decisions are based on facts, then everyone's facts count equally; When decisions are based on people's opinions, then some will count more than others (Pfeffer & Sutton, 2006). Moreover, when the evidence is against the opinion of senior executives in the organization, this may be perceived as an attempt to their formal authority (Barends & Rousseau, 2018). This is why replacing power and authority with data requires clarifying the priority of managers, namely whether they care more about being told that they are right or about the performance of the organization.

Another research in this field is presented by Rousseau (2006), who defines evidence-based management as "a paradigm for making decisions that integrates the best available

evidence with decision maker expertise and customer preferences to guide practice toward more desirable results" (Rousseau, 2006, p.258). The aim of evidence-based management is to move decisions away from personal preferences and encourage the use of the best scientific evidence. In particular, principles from research should be identified and translated into practices for organizations. Indeed, the fact that scientific evidence is tough to interpret and it is not easily transferred to the workplace results in weak, poor-quality decisions. A possible way to address this issue is to treat the organization like an unfinished prototype, so to boost trial programs, pilot studies, experimentation and reward learning achieved from these activities, regardless of the outcome. Another obstacle to the implementation of this method is the fact that there is a long time-lag before the outcome of a decision is observed and, consequently, little feedback is provided. These two aspects combined facilitate moral hazard since, before the quality of a decision is discerned, the person who was responsible for it may have moved to another company (Jaques, 1976).

Moreover, according to Rousseau (2006), evidence-based practices can boost the understanding of cause-effect connections. This is very important since distinguishing the symptoms of the problem from the root causes ensures that the solution proposed will be effective in relieving the consumers from their pain points (Barends & Rousseau, 2018). In the evaluation of the cause and effect mechanisms, the goal is to understand whether the entrepreneur's intervention is indeed the cause of the result obtained. To do that, confounding factors must be isolated. In this respect, Barends & Rousseau (2018) suggest to either use a treatment and a control group or to perform an A/B test. They also consider the concept of baseline, defined as the measurement of the metrics of interest before the execution of the decision, which can reduce the problem of reversed causality. In case of impossibility to implement the previous options, another solution is the so-called *After-Action Review* (AAR), which consists of a before-after measurement in order to assess the outcome of the decision adopted (Barends & Rousseau, 2018).

The idea behind evidence-based decision-making is that decisions supported by hard facts and analysis are sounder than decisions based on instinct and anecdotal evidence (Tingling & Brydon, 2010, p.71). However, evidence-based management should not completely replace managerial judgement, rather it should be seen as a supporting tool to achieve better decision-making.

Unfortunately, in the real world, the role of evidence is often unclear and managers prefer to continue using intuition and opinion. In particular, three different situations can verify. Evidence is used to *make* a decision, when the decision is a direct outcome of the evidence collected and it is more likely to happen in highly structured environment such as supply chain and planning. The second use consists of *informing* a decision, when subjective information is combined with hard evidence in order to make the final choice. Third, evidence can serve to *support* a decision, and this happens when data are collected in a way that lends legitimacy to a decision that had already been made. This supportive role is called by Tingling & Brydon (2010) as “Decision-based evidence-making”.

An additional perspective on this topic is provided by Barends & Rousseau (2018), who provided an explanation of what evidence-based management is and how it can help individuals and organizations to make better decisions. The pillar of this method is the idea that “good-quality decisions require both critical thinking and use of the best available evidence” (Barends & Rousseau, 2018, p.2). In the first place, it is important to distinguish sound evidence from what could just be unfounded beliefs, personal opinions or anecdotes. Recognizing the quality of evidence is essential to avoid “bad decision, poor outcomes and not understanding why things go wrong” (Barends & Rousseau, 2018, p.2).

According to the authors, the following six steps are necessary to “make conscientious, explicit and judicious use of the best available evidence from multiple sources […] and increasing the likelihood of obtaining a favourable outcome” (Barends & Rousseau, 2018, p.2):

1. *Asking*: Translate a practical problem into answerable questions;
2. *Acquiring*: Systematically searching and retrieving evidence;
3. *Appraising*: Judging the trustworthiness and relevance of evidence in a critical way;
4. *Aggregating*: Pulling together evidence;
5. *Applying*: Incorporate the evidence into the decision-making process;
6. *Assessing*: Evaluating the outcome of the decision made.

Additionally, four main sources of evidence are identified. One is evidence coming from the scientific literature, which provides the decision-maker with general knowledge about a topic. The use of this type of evidence requires keeping constantly updated with new research and being able to evaluate the trustworthiness and relevance of the sources. Practitioners claim that academic evidence is of limited usefulness since it covers broad concepts while every situation is unique. However, according to Peter Drucker, “most management issues are repetitions of familiar problems cloaked in the guise of uniqueness” (Lowenstein, 2006). Thus, managers should develop the capability to identify the relevant aspects in order to apply the generic knowledge to their case.

The second source consists of evidence specific to the organization. This can be internal data like measures of performance (e.g. return on investment), employees’ satisfaction, operational efficiency or external, when the source is the client itself. Pfeffer & Sutton (2006, p.3) claim that “information acquired first-hand often feels richer and closer to real knowledge than words and data in journal articles”.

In the third place, evidence from practitioners refers to the specialized knowledge or the practice with specific activities acquired through professional experience, and consequently it is different than personal opinion and intuition. This source of knowledge can be relevant in determining, for instance, if a managerial issue requires attention or if a solution can work in a particular context. Despite the fact that professional experience is a legitimate source

of information, basing the decision solely on personal judgement can lead to systematic errors, due to the limited cognitive and processing abilities of humans (Bazerman, 2009; Simon, 1997). In fact, it has been shown that professional judgements informed by hard data or statistical models are more accurate than judgement based solely on individual experience (Lewis, 2003).

Finally, evidence collected from stakeholders is also considered a precious source of information. This refers both to internal stakeholders, like employees and board members, and external stakeholders, like shareholders and the general public. The impact that the final solution will have on them, their concerns and values are important factors to consider during the decision-making process.

Particular attention is posed by Barends & Rousseau (2018) on professional judgement. In fact, while this is a very common source of information thanks to its accessibility, it is also the most prone to biases. In particular, if the focus on practitioners is too strong, the outcome obtained would be very specific to that particular set of people and not representative. Moreover, it is important to consider the way in which evidence was acquired from practitioners: Asking their opinion in the workplace has more chances of being prone to biases than conducting a survey on a large sample of practitioners. Besides, accumulated experience does not automatically translate into expertise. The conditions to deem it reliable are the presence of numerous opportunities to practise, the regular exposure to direct and objective feedback and a predictable work environment. The last point in particular is not aligned to the circumstances faced by managers, where conditions change significantly from time to time and this hinders the chances to develop valid and reliable professional expertise (Hamori & Koyuncu, 2015). Another problem is the limited applicability of this type of evidence. In fact, in case of novel or complex decisions capable of affecting not only the organization but the industry at large, it might be particularly harsh to find someone with the right experience or previous knowledge. For this reason, it is important to maintain a high level of flexibility: While the few available evidence should be implemented through a

process of sense-making and learning-by-doing, constant experimentation and assessment of the outcomes are required so that the new insights gained can be integrated in the knowledge base of the firm and improve performance moving forward.
In conclusion, it is recommendable to include evidence from practitioners in the decision-making process as this can help connecting evidence coming from scientific research or organizational data to the specific context where the decision will be made.

Looking at the variety of the different types of evidence, it is possible to state that its limited use is not due to the unavailability of appropriate data but rather to the lack of specific training or skills, which makes it difficult to access information, especially scientific knowledge. In fact, a survey conducted on almost thousand HR practitioners showed significant discrepancies in terms of what they deemed to be effective and what it is actually effective according to scientific research (Rynes, Colbert & Brown, 2002). This is really relevant also for society and governments since this type of misalignment translates in money being spent on ineffective solutions, to the detriment of stakeholders. For this reason, a new field of science has emerged, called “implementation science”, which aims at identifying methods to promote the inclusion of evidence in the everyday practice (Bauer *et al.*, 2015).

However, providing practitioners with the required evidence is not a guarantee that they will review their opinions. In fact, people’s beliefs are resilient in the face of contradictory evidence (Barends & Rousseau, 2018). A study carried out in 2010 showed that when people are provided with hard evidence, this can backfire, making them more attached to their biases and misperceptions just for the sake of protecting their beliefs (Nyhan & Reifler, 2010). Furthermore, humans are reluctant to review a decision that has already been made and they prefer dealing with the consequences (Burnett, 2017). To address this issue, accountability must be established: Studies show that enforcing accountability leads managers to adopt an information-seeking behaviour, more openness to external evidence

and, consequently, less biased decisions.

Misconceptions regarding the concept of evidence are also an obstacle in promoting its adoption. One of the arguments is that most managerial decisions must be made quickly, leaving limited time to the identification of the best possible evidence. However, split-second decisions are not very frequent: In the majority of cases, decisions are made over periods of time long enough to discuss and coordinate with the different business units.

Another critique is that in a fast-paced world, it is pointless to make a decision based on past evidence since customers' preferences change rapidly. To address this issue, evidence-based management encourages constant experimentation through techniques such as pilot testing and prototyping.

A common error among practitioners is using other organizations as benchmark to identify the "best-practices" and apply it in their companies. However, these practices may be successful only in the specific context of a firm and a copy-and-paste strategy will inevitably lead to disappointing results.

Barends & Rousseau (2018) stress the fact that evidence comes with uncertainty and hence does not provide the answer on its own: What decision-makers deal with are probabilities and hypotheses. Hence, an additional drawback is the fact that evidence informs about the possible correlation between two variables, but it does not provide insights on how to turn this into action. In fact, the purpose of evidence is helping making better-informed decision rather than giving the answer.

According to Barends & Rousseau (2018), in order to apply evidence-based management properly, one should start with a precise identification and framing of the problem, then ask meaningful questions to uncover the underlying assumptions, seek evidence to support the effectiveness of the different solutions and then select the most feasible one. The identification of the problem is a delicate part of the process since, if this is incorrect, using evidence-based management will lead to a waste of time and resources anyways. Hence, it

is important to dedicate the appropriate amount of time before jumping to the solution part. Moreover, the deeper the assessment of the problem and the clarifying questions asked, the shorter the time needed to actually solve the problem (Barends & Rousseau, 2018). To make this task easier, the problem can be broken down into smaller parts to have a deeper understanding of each “chunk” and establish priority among them.

For this method to be successful, managers must become acquainted to prefer evidence over personal opinion and incorporate it in their judgements (Barends & Rousseau, 2018). Moreover, full readiness for the evidence-based management is achieved when the entire workplace supports the use of evidence. This means that all the people inside the organization must be familiar with the method and regularly get evidence in the conversation. In this regard, leadership and culture play a crucial role in determining the absorption of the method in the organization.

Other factors that determine the success of the evidence-based management inside the organization are: The *focus of attention*, i.e. whether the leadership cares more about sustaining good-quality decisions and the employees’ ability to think critically or more about the short-term outcomes; The *reaction to crises and incidents* is also a signal, since this establishes to which extent learning from mistakes is valued; *Ability* is another factor and requires that people are trained to get the appropriate skills; *Motivation* can be enhanced through the establishment of norms regarding the use of evidence in the decision-making process; Lastly, *opportunities to practice* must also be provided by managers, who act as a model and reward employees when they follow the indications.

A famous management expert, Henry Mintzberg (1990) affirmed that “no job is more vital to our society than that of a manager. It is the manager who determines whether our social institutions serve us well or whether they squander our talents and resources”. In line with the statement, Barends & Rousseau (2018) agree on recognising evidence-based management as a moral obligation to use best available evidence when making decision, considering the impact they can have on society.

2.2.1.1. WHAT IS EVIDENCE

Evidence is not the same as data: While the latter “can be number or figures that exist on their own, evidence only exists in the context of a claim or an assumption” (Barends & Rousseau, 2018, p.248). This means that evidence is such in relation to something, and not per-se. Evidence can be also categorised as “information, facts or data use to support or contradict a claim, assumption or hypothesis” (Barends & Rousseau, 2018, p.3). Besides, evidence is different from proof, which is a concept that implies having no doubt and it is mostly used in the realm of mathematics. In fact, evidence only provides an estimation of the different probabilities rather than representing the truth (Barends & Rousseau, 2018).

2.2.2. INTEGRATING EVIDENCE IN ENTREPRENEURIAL DECISIONS

This section examines the different methods proposed for the integration of the evidence in the decision-making process of entrepreneurial ventures. While the first four methods put the emphasis on the decision-making ex-post, namely on the framing of evidence in the planning and organization of the work, the scientific method proposes a new approach on how to actually take decision in a company.

2.2.2.1 THE LEAN START-UP

The Lean Start-up method proposed by Eric Ries (2011) builds upon previous management and product development ideas, including, among others, design thinking and agile development. The method represents “a new approach to creating continuous innovation” (Ries, 2011, p.4) through the application of lean thinking. It focuses on discovering the needs of customers without directly asking them and it involves the use of a scientific approach to decision-making.

The Lean Start-up is guided by five principles:

- *Entrepreneurs are everywhere*: The definition of start-up, namely a human institution designed to create new products and services under conditions of extreme uncertainty, can refer to any person working for company of any size, any sector or industry who is involved in an innovative endeavour;
- *Entrepreneurship is management*: A start-up is an institution, not just a product, and as such it requires a specific management geared to its context;
- *Validated learning*: The objective of start-ups is to build a sustainable business. The learning should be validated by running frequent experiments to test elements of the entrepreneur's vision;
- *Build-Measure-Learn*: Start-ups turn ideas into products, measuring how customers respond and learning whether to pivot or persevere. A successful process should accelerate the feedback loop;
- *Innovation accounting*: It is a new kind of accounting designed for start-ups, which consists of measuring progress, set up milestones and prioritise work.

The author highlights how tools of traditional management "are not suited to the chaos and uncertainty that characterize start-ups" (Ries, 2011, p.15). For this reason, specific techniques and metrics are required. Particularly, performance should not be evaluated in relation to criteria such as being on budget or on time, but on whether the enterprise is building the right product. This can only be achieved by spending an appropriate amount of time on researching, testing and learning. However, since learning is intangible, spending time on it can be perceived as unproductive and hence, in the practical world, entrepreneurs may overlook its importance. More closely, validated learning is defined as "the process of demonstrating empirically that the team has discovered valuable truths about a start-up's present and future business prospects" (Ries, 2011, p.38) and it constitutes one of the pillars of the Lean Start-up movement. It is a concrete, accurate and fast procedure that aims at

obtaining feedback as soon as possible so that the entrepreneur can recognise early in the start-up's life cycle which efforts are value-creating and which are wasteful, i.e. not bringing value to customers. Thus, validated learning relies on "empirical data collected from real customers" (Ries, 2011, p.49) with the aim of finding a synthesis between the entrepreneur's vision and what customers would accept. In fact, everything a start-up does can be seen as an experiment to achieve validated learning.

The Lean Start-up method requires to systematically break down a business plan into smaller components and testing each of them through the scientific method: This means having a clear hypothesis regarding what is expected to happen and then test those predictions empirically. For instance, rather than asking abstract questions, by building a product it is possible to directly observe the customer's reaction. In this case, the entrepreneur should not be concerned with having the best version of the product, advanced features or the nicest design: The target of the experiment are indeed early adopters who need the product, forgive mistakes and they are eager to give feedback.

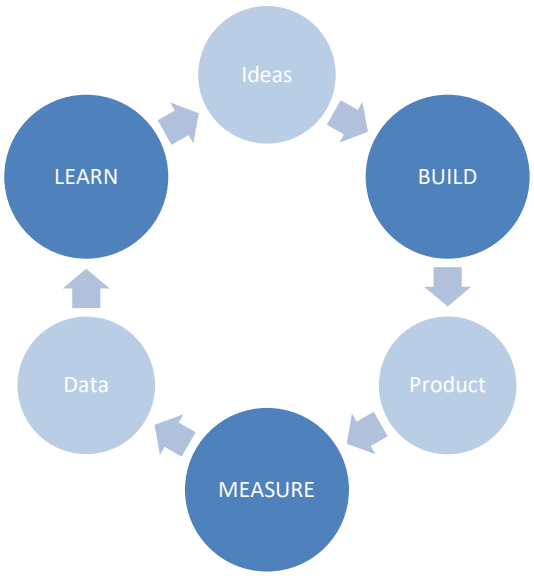


Figure 1: The Learn-Build-Measure feedback loop (Ries, 2011)

The Lean Start-up methodology is summarized by the Build-Measure-Learn cycle

represented in Figure 1. According to Ries (2011), the first step is figuring out what must be learnt and then work backwards to see what product will grant that learning. The objective is getting into the loop as soon as possible and then accelerate the process over time. For this purpose, a Minimum Viable Product (MVP) can be used to achieve validated learning by testing fundamental business hypothesis and uncovering the false ones. This procedure creates capital-efficient companies that avoid spending excessive time and money on delivering a perfect product that nobody would use. This can take different forms such as showing a video and count the sign-ups, using a concierge MVP or conducting in-home visits to deliver the product and collect feedback. The MVP is also part of what the author defines as “innovation accounting”, as it allows the company to gather real data about its current position in terms of conversion rates, sign-ups, customer life-time value, and so on. Micro-changes and optimizations can be added when moving from the baseline toward the ideal version.

After the test, the entrepreneur faces the decision regarding whether to pivot or persevere. Pivoting is also an important decision point that the entrepreneur must consider after the analysing the feedback received. A pivot is defined as a new strategic hypothesis, that in turn will require another MVP to test it and it can be deemed successful when activities become more productive than before.

The Lean Start-up works only if the organization is as adaptable and fast as the challenges it faces. Applying the Lean start-up method is not only beneficial for the early steps of a new venture, rather it should become part of its *modus operandi* even in the scaling-up and growth phases so to achieve operational excellence.

Comparing this approach with the four sources of evidence identified by Barends & Rouseeau (2018), in the lean start-up evidence from the organization takes particular relevance, in particular external data coming directly from the clients. Customers’ feedback is indeed the core of this approach. Less importance is instead given to evidence from

professional judgement. The reason is that Ries (2011) stresses the fact that the customers must be induced to reveal their preferences through direct experience with the product. In terms of how to obtain these data, the Lean Start-up is also aligned with the steps proposed by Barends & Rousseau (2018), according to which it is important to test the business owners' assumptions through continuous experiments.

2.2.2.2. DESIGN THINKING

Design Thinking has emerged as a powerful methodology for innovation (Leifer & Steinert, 2011). Its strength is based on the human-centred approach that integrates technological, business, and human elements to create innovative products, services, and enterprises (Meinel & Leifer, 2012). It is based on fast learning in order to adapt to changing environments and achieve radical innovation.

Different definitions of Design Thinking are provided. According to Kelley & Kelley (2013, p.24), it is "a way of finding human needs and creating new solutions using tools and mindsets of design practitioners". Brenner, Uebernickel & Abrell (2016, p.6), instead, see it as a way to "create entrepreneurial value through customer value". Regardless of the definition considered, in order to be successful in rapidly changing environments, strategy design must be forward-looking and offer a superior understanding of the customers' needs, the pain and the sought-after gains (Diderich, 2020).

Design Thinking originates from architectural and industrial design, where problems are incomplete by nature and thus cannot be addressed by traditional problem-solving techniques. In fact, in the perspective of a designer, problem-solving should be approached by adopting the view of the end user, which offers a deep understanding of the unmet needs (Diderich, 2020, p.6). For example, Berg *et al.* (2016) highlight that in new product development, especially in large and mature corporations, product features are decided in the front-end phase. This approach can be used with incremental innovation but is not suited

to radical innovation, which requires a different set of competencies and the achievement of significant improvement in performance or a reduction in costs of at least 30% (Leifer, O'Connor & Rice, 2001; Simon *et al.*, 2003, p.17).

Design thinking is based on a combination of analytical thinking and intuition. While the former's theoretical models are applied to data and used to make sensible decisions, the intuitive approach uses a restricted amount of data and it is more focused on acquiring insights through unconscious pattern-recognition and instinct, which in turn relies on experience. Hence, design thinking recombines these deductive and inductive approaches to problem-solving into an abductive reasoning framework [1]. The process starts with the research of an intuitive and simple solution. Then data are acquired to understand how this can be enhanced, until it is good enough or there is no room for improvements. In this process, the use of experiments is crucial. Indeed, many entrepreneurs mistakenly assume to know what customers want, when in reality even the customer itself does not know it. As a result, 42% of start-ups fail because there is no market need for their services or products (CB Insights, 2018). To improve the performance of their business through Design Thinking, managers should build a strategy keeping in mind the following aspects:

- What customer needs, pain-points and sought-after gains are not addressed and what customers are not served?
- How the identified needs and pain-points be addressed in a way that customers are willing to pay for?
- What are the capabilities and resources required to achieve a sustainable competitive advantage?

[1] Abductive reasoning is a form of logical inference which starts from an observation and then seeks the simplest and most likely explanation. It was developed by Charles Sander Pierce. (Diderich, 2020)

- How is the strategy ensuring that sustainable profits can be generated?

Hence, the objective is to generate value for the customers in a differentiated and sustainable way. This differs from the classical strategy schools which are characterized by a lack of customer focus, slow execution due to their analytical foundation that makes it rigid and often ineffective, difficulties in understanding it by those who have not been trained in strategy. Instead, a successful strategy design process displays characteristics such as following an agile, just in time approach, so that refinements can be introduced along the way; A focus on designing the future rather than analysing the past; Stakeholders' contribution integrated in the early design of the strategy; Targeted customers constantly at the centre of any strategy design activity.
Hence, the advantages of Design thinking are due to the fact that:

1. It is customer-centric: It requires observing and listening the customer in its natural environment and it avoids distortions, so to understand more precisely the job-to-be-done;
2. It is iterative in nature: Challenges are addressed incrementally and solutions are improved step by step;
3. It is based on prototyping and validating ideas to make sure that the designed solution works;
4. It combines analytical and intuitive thinking, resulting in an abductive reasoning approach.

The fact that design thinking is iterative in observing, learning, designing and validating allows to reduce complexity in the early steps and solve 80% of the problem with 20% of the resources (Diderich, 2020). In this optic, non-value-adding and time-consuming activities like data gathering and analysis are avoided whenever possible.
The underlying process can be represented through a two-by-two matrix. In the horizontal

axis the focus is on the thinking process, whether it is convergent or divergent; On the vertical axis instead the time period is considered, i.e. past versus future. The combination of these dimensions result in the four steps of Design Thinking, represented in Figure 2.

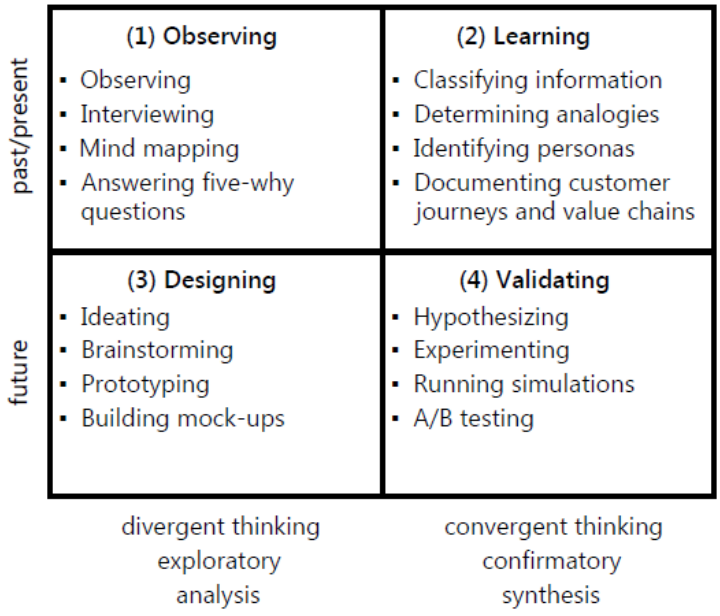


Figure 2: The four steps of Design Thinking (Diderich, 2020)

Each of the four steps identified has a precise outcome: Following the numerical order, these are insights, knowledge, prototyped ideas and validated strategy. In the design thinking procedure, one should move to the next step as soon as enough insights are gained. When the insights are instead incorrect or insufficient, it is recommended to iterate back to the previous step so to avoid non-value-adding work.

Design thinking acknowledges the impossibility of getting to the right solution at the first trial. This is why, similarly to agile and just-in-time methods, different options are evaluated iteratively and, as new aspects are learnt, the solution can be improved. In particular, Diderich (2020) describes two processes to validate assumptions. The first one is based on quantifiable hypotheses that are then tested through statistical methods and algorithms (Kuehl, 2000). Due to its reliance on historical data, this method is classified as a backward-

looking approach and it is more adapt to academic works. The second approach is instead related to a decision regarding the business model – either a specific element, the relationship between more elements or the environment. This approach is forward-looking since, rather than historical data, it aims at getting first-hand insights.
Finally, to fully apply the Design Thinking into organizations, a paradigm shift is required whereby experimentation becomes essential to obtain material for continuous evaluation (Chesbrough, 2010). In fact, Bradley, Hirt & Smit (2011) state that strategy design must be seen as a mindset rather than a procedural exercise.

Comparing Design Thinking with the requirements of evidence-based management, this process recognises the importance of combing the analytical thinking and intuition, which is analogous to what Rousseau (2006) refers to as 'the best available evidence' and the decision maker's expertise. As a common point with the other approaches to innovation, the customers' feedback is crucial to realise value and the use of prototypes is encouraged in order to collect primary data, which is another requirement of the evidence-based practice (Kester et al. 2011).
As stressed by Barends & Rousseau (2018), also in Design Thinking it is fundamental to spend all the necessary time at the "Observing Stage" (Figure 2) and mapping what is the problem at hand as this would grant a smoother data collection and results' interpretation.
Finally, Design Thinking recognises that the capabilities and the resources needed must be evaluated, in order to ensure that the company is able to deliver what the customer requires. Hence, Design Thinking considers also the different sources of evidence identified by Barends & Rousseau (2018), namely internal evidence from the organization and evidence from stakeholders.

2.2.2.3. DISCOVERY DRIVEN GROWTH

Another method built to support the use of evidence in the decision-making process is provided by McGrath & MacMillan (2009). According to the authors, companies using conventional methods to achieve exceptional growth are doomed to be disappointed: Thinking that breakthrough growth can be achieved by launching bold, new initiatives will only bring the company to take on a level of risk that exceeds the potential payoff and offers minimum learning. Indeed, many breakthrough innovations are not initiated as such but they are the result of combining incremental improvements until a winner is obtained. In fact, Discover-Driven Growth involves the systematic investment of time and effort with the objective of creating breakthrough growth in a pragmatic, low-risk way.

Making businesses and start-ups more evidence-based reduces the chances to invest money in unprofitable projects. This happens due to the so-called *escalation of commitment*: In this situation, “people and organizations keep adding resources to a project that is going monumentally off the rails” (McGrath & MacMillan, 2009, p.174). This may happen for three main reasons:

- *Psychological entrapment*: Team members feel personally committed to stay in course;
- *Rationalized entrapment*: They feel success is just around the corner;
- *Social entrapment*: People are reluctant to withdrawn from a project because of the commitments made to each other and to outside parties.

The key idea of Discovery Driven Planning is that, as the plan unfolds, the assumption-to-knowledge ratio gradually reduces. More precisely, at the beginning the ratio assumes high values because little is known about the business and assumptions dominate. As more information is acquired, the ratio shrinks. Moreover, to understand whether the opportunity is worthy, most of the times different scenarios can be analysed on paper, without spending

any money.

Throughout this discovery process, it is important to pursue experimentation and maintain tolerance towards disappointments. In fact, especially in big corporations, what suppresses the generation of new ideas is a failure-intolerant culture in which quarterly results and immediate financial returns matter the most, “distorting learning opportunities and creating inappropriate incentives” (McGrath & MacMillan, 2009, p.11).

Another concept introduced by McGrath & MacMillan (2009) is that of real options, considered as investments in learning. Options are “relatively small investments that create the right, not the obligation, to make further investments later on” (Bowman & Hurry, 1993), leaving open the possibility to interrupt them. The idea is to contain risk by limiting the downside, while maximizing the value that can be captured on the upside. Even in uncertain situations where the actual value is unknown, this enables the entrepreneur to distinguish between more and less attractive investments opportunities. “The more uncertain any project, the more it would benefit from real-options reasoning” (McGrath & MacMillan, 2009, p.56). This also gives chance to the entrepreneur to invest in a portfolio of ideas. Real options apply not only to the first investment but to the entire funding period, which should be staged and sequenced so to regularly review the investment across time.

McGrath & MacMillan (2009) also suggest the use of a reverse income statement: Given the requirements for profits and return on asset, entrepreneurs should work backward through the financial statement to identify the activities needed to build the business and develop assumptions on their execution, cost and feasibility. As the venture moves forward, the ranges of outcome shrink and predictions can be made with more confidence.

The authors criticise the fact that entrepreneurs are often excessively optimistic about the enthusiasm customers will display on their product based on technical merit. In fact, until genuine superiority is established, it is easier for customers to keep their habits, rather than switching to something unknown. Only when the company outperforms competitors on one or more key metrics, it is possible to gain a competitive advantage. In this regard, Discovery-

Driven Planning enables entrepreneurs to overcome part of the cognitive and emotional biases that prevent people from making right decisions when considering new business opportunities. For instance, sharing the initial assumptions with others can make them less vulnerable to a single point of view.

The authors point out that when innovative efforts fail, people overlook the importance of what was learned. The advantage of this approach is indeed recognising the value of failure, in the form of new knowledge and skills acquired, new know-how developed and new opportunities discovered. Hence, the logic of success, failure and progress is entirely different.

With respect to evidence-based management, in particular the vision presented by Barends & Rousseau (2018), Discovery-Driven Planning focuses on evidence from the organization and evidence from professional judgement. The former assumes a relevant role because it provides insights regarding what the customers value. One of the errors pointed out by McGrath & MacMillan (2009) is indeed the fact that managers often believe that their product will be successful, only based on the technical features. However, this is not always enough to ensure that the product will find acceptance in the market.

With respect to the contribution of professionals, McGrath & MacMillan (2009) recognises that this is needed and unavoidable. Nevertheless, they encourage practitioners to always challenge assumptions, so to decrease the exposition of the final decision to biases.

Discovery-Driven Planning is also aligned to Barends & Rousseau's (2018) point of view in recognising the role of leadership in encouraging the adoption of evidence-based management.

2.2.2.4. AGILE DEVELOPMENT

Agile is defined as a set of values and principles rather than a process or a set of practices

(Moreira, 2017). It is based on the concept that the contribution of employees and the feedback from customers can be combined to successfully deliver customer value.
The Agile method was firstly discussed in the “Manifesto for Agile Software Development” but it also applies to products and services. The manifesto lists the specific values that are relevant in the context of innovation in comparison to the tools adopted by traditional management:

- Individuals and interactions over process and tools;
- Working software over comprehensive documentation;
- Customer collaboration over contract negotiation;
- Responding to change over following a plan;

The Agile Development is based on some core principles such as the satisfaction of the customer, acceptance of changing requirement even late in the development, close collaboration between technical and business people, attention to technical excellence, prioritising face-to-face conversation with regular meetings aiming at becoming more effective and adapt behaviour accordingly.
According to Moreira (2017), Agile Development belongs to the Customer-Value-Driven framework (CVD from now on). A CVD enterprise is defined as “a company that optimises for what the customers find as valuable and what they are willing to buy and use” (Moreira, 2017, p.58). Within the CVD framework, “the Agile culture and practices provide an adaptive mindset to discover and deliver customer value in an incremental manner” in order to achieve better business outcomes (Moreira, 2017, p.22). Delivering incrementally and frequently can in fact minimise “the risk of delivery something that the customer does not want” (Moreira, 2017, p.12). Assumptions regarding what is valuable for customers must be challenged in order to uncover the false ones and remove non-value-added work to make the organization leaner and faster. In order to validate a business idea, the customer feedback is integrated along the way. The Agile mindset recommends to build part of the

product and incrementally gather the customer feedback, instead of building the full idea and deliver it to the market. These experiments should be short and inexpensive and lead to as much information as possible.

In order to achieve the promised results, the Agile requires a corresponding change in culture. The fact that Agile is also defined as mindset implies that people in the organization must adopt an adequate behaviour, which goes beyond the mechanical application of processes and practices. In particular, the shift should be from internal to external focus. The distance between the customer and the employee must be narrowed so that the latter can understand more precisely what constitutes customer value and integrate it into the decision-making process. C-levels and senior managers are not excluded: They should also be aware of who are the customer that will be using the product.

The Agile Method acknowledges that a company competes for the customers' attention since, through their monetary commitment, they allow the company to stay in business. For this reason, this method introduces a dedicated figure, the Product Owner, who is meant to be the voice of customers and takes care of engaging, soliciting and prioritise their feedback. The engagement with the customer continues throughout the life cycle of the product. The discovery mindset also deals with the fact that consumers often do not know what they want through incremental releases and demonstrations that providing a great learning opportunity for the company regarding customers' needs.

The tools used may also change once the Agile method is incorporated in the company. For example, the Business Model Canvas was firstly originated by Alexander Osterwalder (2010) during his work on business model ontology. It describes how organization can create, deliver and capture value. The aim is to present a one-page, straight forward map representing the main business elements: Value proposition, customer segment, customer channels, customer relationship, revenue stream, key resources, key activities, key partners and cost structure. In recent years, different versions have been created to address the

challenges faced by new ventures.

The Lean Canvas (Maurya, 2012) is used to evaluate new problems and opportunities and hence it is more suited for the Agile culture. In fact, it is meant to evolve as new pieces of information are acquired and to accommodate the possibility to pivot. The components of the canvas are slightly different with respect to the traditional version (see Appendix 1). The new elements are the *Problem* that the entrepreneur is trying to solve, which must be compared with existing alternatives; The *Solution,* which describes how the problem will be solved; The *Unique Value Proposition,* which reflects how the venture differs from the competition; The *Unfair Advantage,* describing the exact elements that would put the firm in a better position compared to the alternative offerings.

Another adaptation of the Business Model canvas is the Customer Value Canvas, where the focus is being customer-value-driven (see Appendix 2). Some differences with respect to the previous versions are the *Opportunity,* which refers to the problem addressed; The *Customer Personas* are to the customer group targeted; The *Idea as Hypothesis* requires defining an hypothesis to ensure that the entrepreneur follows a scientific, data-driven approach; *Assumptions and Risks* connected to the idea are also listed; The *Feedback Loops* explain how the feedback is collected in order to validate the customer value. The Customer Feedback Loops are indeed important components of the Agile method, where the feedback from the testing activity is used to direct efforts and resources toward the right product.

Finally, Agile methodology introduces the concept of *Personas*, which are profiles of imaginary customers used to identify the characteristics of the people who are supposed to use the product and to improve the efficacy of future interactions. Furthermore, given that different personas may display disparate ways of using the product, in this way it is easy to highlight the desirable functionalities for the final product. Consequently, using a *persona* reduces the chances of getting feedback from the wrong target customer or not delivering

the appropriate value to customers.

The Agile Development, due to its focus on satisfying the customer, relies on primary data coming from the clients (Kester et al. 2011). In fact, this method advocates that firms should always remain flexible so to incorporate into the product any new piece of information and ensure that actual value is delivered to customers. This also implies, as Pfeffer & Sutton (2006) would advise, that the initial assumptions of the business must be constantly challenged so to understand what is not true and hence abandoned.
The learning opportunities that this constant launching activity offers are also valued, and they should be maintained throughout the product life-cycle. This is in line with the indication provided by Barends & Rouseeau (2018), who stress the fact that a rapidly changing world requires constant revision of the value proposition. Another point in common between the two approach is the acknowledgement that being evidence-based is not only about applying a procedure or executing more data collection and analysis, but rather it also requires a redefinition of the company's culture and values.

2.2.2.5. SCIENTIFIC APPROACH TO ENTREPRENEURIAL DECISION-MAKING

The research undertaken by Camuffo *et al.* (2018) explores how entrepreneurial decision-making can impact the performance of start-ups. The main contribution of the scientific approach is the reduced influence of biases such as overestimations and optimism in the final decision and the ability to assess more precisely the distribution of potential outcomes. Besides, the learning acquired through the process becomes useful in instructing the entrepreneur on how to recognise attractive opportunities in the future.

The scientific method consists of mainly four components (Novelli *et al.*, 2020):

1. Articulation of a theory to design a business model grounded on a well-defined framework of a targeted problem;
2. Formulation of hypotheses about the consequences of actions;
3. Design and execution of rigorous experiments that use data to test these hypotheses;
4. Analysis of the outcomes of the experiments, with openness to questioning and discussion.

At the end of this process, the entrepreneur will use the conclusions drawn in order to take a final decision among the following options: Continue, pivot or exit. The decision to continue is made when the entrepreneur is confident about the evidence obtained and decides to go ahead with its venture. The pivot happens when the overall idea remains the same but some strategic elements change. The exit decision is adopted when the entrepreneur believes that it is not worth pursuing the current opportunity and abandons the business.

In order to test the effectiveness of this method, a first series of experiments were carried out in Italy and were based on a group of start-ups randomly split in two groups of equal size, the treatment and the control group. The content of the program was the same for both groups, with the only difference that the treated group was instructed on how to look at the concepts taught through a scientific mindset. The control instead continued to rely on intuitions and heuristics. The start-ups selected were early ventures so to minimize the chances that entrepreneurs had already gone ahead with their venture and incurred significant sunk costs. Moreover, had more mature companies been involved, this would have caused the issue of self-selection, as only the better endowed would have survived the initial stages.

The expectation was an improvement in the inferential capability of the treated entrepreneurs, allowing them to better identify false negatives and false positives. Not only the expectation was confirmed, but additional aspects were found: Treated entrepreneurs showed an enhanced ability to formulate theories regarding the needs of the customers and

detect biases in the evaluation of their idea, reducing both false positives and false negatives as foreseen.

Another expectation of the researchers was to find an enhanced ability to identify additional aspects affecting the profitability of the business. In fact, the effort of gathering more information led scientific entrepreneurs to become better at detecting new opportunities.

Moreover, the approach to exits and pivots was also different. While the scientific entrepreneurs recognised earlier false positives and reacted by either exiting or pivoting toward a more promising ideas, non-scientific entrepreneurs pivoted or exited even when it would have been more profitable to remain in the same business, incurring in a higher number of false negatives. Hence, the average performance in the treated group is better than the control group due to a higher predisposition to exiting unprofitable opportunities, which non-scientific entrepreneurs are unable to recognise. Moreover, the opportunities identified by scientific entrepreneurs after pivoting proved to have a higher expected value than those identified by the non-scientific ones, which translates into higher revenues and faster achievement of the break-even point (Camuffo *et al.*, 2018).

In fact, from a quantitative point of view, adopting a scientific approach leads to higher revenues – with corresponding higher costs, but with revenues increasing more than the costs - higher labour productivity, an increased ability to activate customers and more time devoted to innovation. More closely, treated firms experienced a three to five-fold increase in their revenue (Novelli *et al.*, 2020, p.8) and the gap becomes wider over time, getting to a difference of 25% lower revenue for the control group by the end of the observation period (Novelli *et al.*, 2020, p.26).

From a qualitative point of view, the results confirmed that the scientific method makes entrepreneurs more conscious of what can be a profitable business idea and increases the chances of avoiding failures, pivoting towards more successful opportunities and staying in business for longer. Scientific entrepreneurs also become more cautions and develop an idea only under stringent conditions.

Comparing the scientific method with evidence-based management, it is possible to notice that both use primary data and encourage a continuous assessment of the entrepreneur's hypotheses. In accordance with Rousseau (2006), the scientific method recognises the essential role played by the professional experience, since this contains both pieces of information and biases. The method proposed by Camuffo et al. (2018) aims indeed at preserving the first part, as this may provide useful evidence in the decision-making process, as Barends & Rouseeau (2018) affirm when talking about evidence from professional judgement, and at the same time reduces to the minimum the biases, through continuous testing of the underlying hypothesis of the entrepreneur.

The scientific method is quite aligned with the core principle of evidence-based management introduced by Rousseau (2006), such as the preference towards releases of an unfinished version of the product to start grasping the perceptions of the clients and the value attached to the learning experience that comes from it.

A common point among Rousseau (2006), Barends & Rousseau (2018) and Camuffo et al. (2018) is the idea that breaking down the problem into its root components gives a more detailed overview and ensures that scarce resources will be used in an efficient way, by prioritising the different aspects.

In all the different theories that can be related to evidence-based decision-making, a common factor is the "impossibility of removing the human contribution (in terms of intuitions or judgements) from the decision-making process" and the undesirability to do so (Ries, 2011, p.149). In fact, "the hearth of the scientific method is the realization that although human judgement may be faulty, we can improve our judgement by subjecting our theories to repeating testing" (Ries, 2011, p.150).

2.2.3. PIVOTING IN ENTREPRENEURIAL FIRMS

Kirtley & O'Mahony (2020) identified a gap in the literature regarding how and when

entrepreneurs choose to change their strategies. Answers to this question suggest that firms make a strategic change when they notice a gap between the target and the expected performance (Cyert & March, 1963; Levitt & March, 1988). However, this can only work for mature firms, that can rely on performance history or comparables, while entrepreneurial firms can only adopt a learning-by-doing strategy. In particular, the paper by Kirtley & O'Mahony (2020) analyses the relation between a rigorous approach to decision-making and the frequency of pivoting.

A pivot can be defined in different ways. Ries (2011, p.149) defines it as a "structural course correction" that happens when the customer feedback violates the previous business hypothesis. According to the Kirley & O'Mahony (2020), instead, a pivot occurs when the entrepreneur discovers new information that either expands previous beliefs or is in conflict with the initial assumptions. The resulting strategic reorientation can concern either the technology, the market or the product (Furr, Cavarretta & Garg, 2012).

Kirley & O'Mahony (2020) noticed that radical pivots, i.e. completely reorienting their strategic direction in a unique instance, happen only around 20% of the times, while the remaining pivots occurred through incremental changes or strategic additions made to address emerging problems or to take advantage of new opportunities. Most of the times, as witnessed by several researches (e.g. Hargadon & Douglas, 2001; Maggitti, Smith & Katila, 2013), the decision to change strategy is due to new discoveries made after the experiments or hypothesis-testing activity.

In the experiment, only three out of seven firms pivoted and they did so both through strategic addition and strategic exits. The remaining non-pivoting firms instead only made strategic additions but never strategic exits. Hence, the authors highlighted the need of exploring whether is it still possible to pivot without an exit that frees resources (Kirley & O'Mahony, 2020). Moreover, there was no evidence of the flexibility the entrepreneurs were

expected to show: Out of the total 93 entrepreneurial decisions examined in the paper, there were only 21 strategic changes, despite the fact that start-ups chosen were all pre-sales and hence did not have any formal commitment in terms of structures, routines and activities. A possible explanation for the low number of pivots could be a strong identification feeling that makes the entrepreneur reluctant to abandon the initial business idea.

2.3 SUMMARY OF LITERATURE

Researchers highlighted how the human judgement is bounded to be irrational due to the tendency of System 1 to use shortcuts when making decisions. Due to the damages a wrong managerial decision can bring to stakeholders, the literature has focused on how to integrate evidence in the decision-making process for a sounder objectivity and legitimacy. However, this has been done only for large, established enterprises and the same attention is missing when it comes to start-ups and small-medium-enterprises. Indeed, the four methods for entrepreneurship described beforehand only explain how a decision can be framed within the planning and operation stages of a company, without giving indication on how to actually take a decision. Noticing this gap, Camuffo *et al.* (2018) proposed a new scientific approach to entrepreneurial decision-making where such indications are provided. Nevertheless, the authors primarily focused on the performance of the start-ups that received the treatment but there is no information regarding what actually differentiates their thought process and if the treated start-ups become better at avoiding false positives. These last two points constitute the focus of the present research.

3. METHODOLOGY

The current study is based on the research structure proposed by Crotty (1998), starting

with the definition of an epistemology, then the specification of the theoretical perspective adopted and finally the methods used for data collection and analysis. These aspects must be mentioned as they constitute “different ways of seeing the world and carrying out research” (Saunders, Lewis & Thornhill, 2016, p.140), and consequently they can significantly affect the final results.

The first criterion to specify regards the research philosophy. Four possible approaches are compared considering the ontology of reference, the epistemology and the typical methods found in that particular philosophy. According to the classification made by Saunders, Lewis & Thornhill (2016), there are four possible philosophies to adopt: Positivism, critical realism, interpretivism and pragmatism. Among these, the third philosophy was chosen. Indeed, in interpretivism, the ontology is complex and reality is shaped through culture, language and history (Crotty, 1998). As such, multiple meanings and interpretations created by humans coexist and differ from the physical phenomena themselves. In fact, Saunders, Lewis & Thornhill (2016, p.140) argue that humans-beings and “the social world cannot be studied in the same way as physical phenomena” and, consequently, social science is necessarily different from the natural one. To grasp this fluidity, the epistemology focuses on narratives, perceptions and interpretations. Moreover, this method favours small samples that can be analysed more in depth and where “the researcher has to adopt an empathetic stance” (Saunders, Lewis & Thornhill, 2016, p.142). In fact, qualitative analysis is more common in this case.

The features of interpretivism are aligned with the characteristics of this study, namely the need to interpret the data considered, since most of the time involves narratives adopted by the entrepreneurs, and the reliance on a small sample of 30 SMEs in order to grant a more detailed analysis and interpretation. Furthermore, in social sciences like management and decision-making, it is extremely difficult to find universal laws applicable to every circumstance, and precious insights are lost if one attempts to reduce the complexity of the human aspect that defines these situations. Taking this into consideration, the interpretive

philosophy identifies as the most adequate for this particular research, due to the necessity of providing a subjective interpretation to the phenomenon analysed.

With respect to the approach for carrying out the research, a deductive method was adopted, since the existing theory was used to formulate hypotheses, which were then tested through observations (Hempel, 1966; Popper, 1965). The purpose of this study is indeed testing two particular hypotheses, which will constitute the research questions of this thesis, regarding the validity of an existing theory, i.e. the scientific approach to decision-making. Theory-testing is particularly important in management studies because most of the theories introduced are not sufficiently supported by empirical research (Colquitt & Zapata-Phelan, 2007).

The next aspect to define is the strategy followed to actually test the theory. Strategies such as surveys and grounded theory are more appropriate for inductive methods; Case study was instead excluded due to the narrow focus on one or few enterprises, which could have undermined the robustness of the results. Hence, the experiment was chosen as strategy for testing the theory. More in details, the study was based on a randomized control trial with the use of a treatment and a control group, which gives the possibility to uncover the causal mechanisms in order to establish to what extent the scientific method was the cause of the differences observed between the two groups.
The data collected were exclusively qualitative data in the form of interviews' transcriptions. Moreover, due to the fact that the data were originally collected over a period of eight months with the objective of closely monitoring the progress, this classifies as a longitudinal study.

3.1. OBJECTIVE OF THE RESEARCH AND RESEARCH QUESTIONS

The current study aims at testing empirically the differences in the approach to decision-

making between businesses adopting a scientific approach and businesses relying on less rigorous methods based on heuristics.
Two main research questions will be addressed:

1. What are the differences in the way in which scientific entrepreneurs make decisions regarding their value proposition?
2. Is there an enhanced ability to identify new business opportunities in the decision-making process of treated SMEs?

These two research questions are grounded on the study carried out by Camuffo *et al.* (2018). The objective of the first question is understanding what are the factors that distinguish treated enterprises from their similar, in order to test the efficacy of the scientific method and favour its adoption in the business community. The second research question instead aims at understanding to what extent the scientific approach positively impacts the ability of the entrepreneur to identify new aspects that can be relevant to the customer and, consequently, to the success of the venture.

3.2. THE EXPERIMENT

The experiment analysed in this thesis is a replication and extension in the United Kingdom of the first version executed in Italy by Camuffo *et al.* (2018), aiming at providing an additional proof of the efficacy of the scientific method by exposing it to different contexts.

A randomized control trial was conducted on the owners of 274 SMEs based in the United Kingdom. To ensure that the attendees of the course were highly involved in the management of their firms and had decision-making power, the SMEs selected were micro-businesses with less than ten employees, while no restriction was imposed in terms of

industry or turnover.

Some of the participants provided data that turned out to be unreliable, while others were no longer willing to share data about their businesses, therefore these were excluded from the analysis, leading to a final number of 259 SMEs. These were randomly assigned to two groups, a control and a treatment group. More precisely, the treatment group contained 132 SME owners while the control group was made of 127.

Participants were informed about the data collection and the use of data, and the explicit consent to these conditions was a prerequisite for the admission to the program (Novelli *et al.*, 2020). In turn, privacy was granted to the participants. Indeed, the names of entrepreneurs and their enterprises will not be disclosed and a numerical ID will be used to identify the companies.

The program, called 'Strategy Insight Lab', was offered free of charge by Cass Business School, with sponsorship of the government of the United Kingdom. The sessions lasted three months, from February to April 2019, while the performance was continuously monitored through monthly-interviews from the beginning of the program until November 2019. In particular, an initial baseline assessment was carried out before the beginning of the program. Then, a first round of interview was made during the months of the training, precisely from the end of March to the beginning of April, and the remaining six rounds were performed with a monthly frequency until November, leading to a total of eight interviews per firm.

The length and the content of the training were the same for both groups and the program was split in seven sessions (see Appendix 3). Both groups were instructed on how to use the techniques introduced and on the importance of testing. However, in terms of methodology, the control group was free to choose any preferred approach, while the treated group was prompted to develop a theory underlying the business idea, then identify, at each step, falsifiable hypotheses and look for validation through testing and identification of

biases.

Contamination between the two groups was avoided by scheduling the classes at different days of the weeks or at different hours.

3.3. DATA COLLECTION

The interviews were conducted through phone by research assistants who had been purposely trained in order to ensure a uniform basis for comparison (Novelli *et al.*, 2020, p.20). The interviews followed a precise protocol and the questions asked aimed at gathering a variety of data, from the performance of the companies to the behaviours of the entrepreneurs, so to evaluate to which extend they were actually adopting the scientific method.

Even though access to the companies' data and periodical calls were conditions for being accepted to the program, some attrition verified over time, resulting in a declining number of SMEs that continued to participate regularly in the phone calls, as Table 1 shows.

Stage	Active participants	Loss due to business being discontinued	Participants not answering phone calls	Total
Baseline	274	0	0	
First observation	231	1	40	274
Second observation	210	5	59	274
Third observation	204	5	65	274
Fourth observation	189	6	79	274
Fifth observation	169	8	97	274
Sixth observation	169	13	92	274
Seventh observation	158	13	103	274
Eighth observation	150	13	111	274

Table 1: Stages of attrition (Novelli et al., 2020)

Attrition also reduced the ability to consistently follow the progress of the entire sample, resulting in a situation where information regarding the previous months, in which the interview was not conducted, had to be recovered in a unique interview, leading to a possible decrease in precision and accuracy of the information provided by the respondent.
To grant soundness of the data used for this research, a balance check was conducted by the research assistants to ensure that the samples of SMEs that continued to take part in the interviews was still balanced in terms of the different characteristics of the treatment and the control group.

For the scope of the current research, out of the total number of participating SMEs, a random sample of 100 enterprises was selected. Then, considering the focus on testing the ability of treated entrepreneurs to avoid false positives and pivot as soon as they receive signals contrasting their expectations, only the firms that experienced a radical pivot were considered, resulting in a sample of 30 SMEs, equally divided in treatment and control group. A pivot was classified as radical anytime the change was related to the target customers or to the value proposition and the score assigned was above 3 on a 5-point scale (Novelli *et al.*, 2020, p.23).
For these companies, the baseline interviews were analysed in order to evaluate the starting point for each of the SMEs considered. While with respect to the interviews conducted after the beginning of the training, only the interviews where the entrepreneurs mentioned the radical pivot were considered, leading to a total of 67 interviews analysed, for the equivalent of 28 hours and 56 minutes of recordings[2].

[2] The number was computed by summing up the length of the recording of each interview, reported at the end of each transcript.

3.4. DATA ANALYSIS

The research concern of this thesis was identifying the differences in the decision-making process when the scientific method is adopted and how this can enhance the ability to identify new opportunities. Consequently, due to its classification as theory-testing research, a deductive method was applied.

The paper by Hsieh & Shannon (2005) presents three methods for qualitative content analysis, namely conventional, direct and summative content analysis. Among these, direct content analysis was chosen as this is adapt to cases in which theory and prior research exist but the field would benefit from further description, with the aim of validating or extending theoretical framework. Moreover, following the deductive category application (Mayring, 2000), the existing theory contributed to determine the initial coding scheme and the possible relationship between the emerging categories. In fact, the scripts followed by the interviewers during the phone calls provided a first indication of the variables to take into account during the analysis: namely Theory, Hypothesis, Test, Evaluation, Changes.

With respect to the methodology for coding, Strauss & Corbin (1998) proposed a three-steps procedure. The first step is called open coding: The data collected are broken down into discrete parts, examined and compared to find similarities and differences, then grouped into categories dealing with the same subject and labelled with a code. This results in an indexing system, which can also have a hierarchical structure. The next step is axial coding, which requires looking for connections between the categories that are conceptually similar in nature. This phase establishes which of the categories found have a dominant role and which can be gathered around the former or simply be seen as subcategories. According to Auerbach & Silverstein (2003), relevant parts that seem not to be connected with others remain “orphan” and in the end they can either be discarded or included into a separated group. In fact, it is not always mandatory to integrate them: In some cases, “differences can

be as important as commonalities" (Auerbach & Silverstein, 2003, p.59). This phase is concluded when, even adding new data, the categories identified do not change.
The final part, called selective coding, is about creating connections between the different categories in order to have a general understanding of the mechanisms of the phenomenon under analysis. Particularly, theoretical comparison (Strauss & Corbin, 1998) involves the examination of similar or different concepts to identify what are their properties under varying conditions and to understand how often these emerge. Here categories assume the role of theoretical concepts and the name assigned can either draw on the literature or on a theory or concepts that explain that principle. Finally, the work must be reassembled in order to address the initial research concern, creating a theoretical narrative.

Applying this to the present work, the five conceptual blocks previously mentioned, i.e. Theory, Hypothesis, Test, Evaluation, Changes, constituted a structure for the open coding phase. In fact, although there are limitations when using qualitative data such as interviews in terms of omissions or specific ways to present the real data (Boeije, 2010), in this case the evaluation of each company was not made by the entrepreneur itself but rather by the interviewer through the assignment of a final score.
Then, as a second step, axial coding was applied to figure out which categories were the most relevant in addressing the research questions. Then, selective coding was performed in the analysis phase, where the connections between the different categories were identified with more precision.
Nevertheless, the process remained iterative. In fact, while performing the analysis of the interviews according to the initial structure of the codes, some dimensions revealed to be more important and they were explored more deeply. Consequently, the code structure was reviewed in a way that would have served at best the comparison of the two groups.
Starting from the codes, the dimensions found were initially divided into three main categories:

- Dimensions representative of opposite behaviours observed in the treatment and in the control group;
- Dimensions representing common elements between the two groups, differing only with respect to the frequency with which these were observed;
- Additional dimensions which were either rare or referred to concepts not included in the training program and, as a consequence, could not have been used to evaluate the efficacy of the treatment. However, these additional dimensions were included in the results section in order to give a more complete view and provide insights for future research.

Despite the initial classification, in order to favour a clearer exposure and readability of the results, the dimensions are presented in terms of relevance, hence focusing first on the factors constituting the main findings of the research and, in the second place, evidence that is less significant in addressing the research questions. The third dimension is instead unaltered.

In terms of measurements, the frequencies reported in the result section were obtained by summing a given code across documents of the same group (i.e. treatment or control). In case of repetition of the same code in a given document, these were excluded to avoid double-counting and consequent alteration of the final outcome.

4. RESULTS

The results are divided into two main categories: The main findings of the study, where there was evidence of significant differences in the behaviour shown by the two groups and thus the results are representative of the characteristics of the treated businesses; Secondary aspects for which the difference was less significant or there were not enough data points to ensure representativeness. The dimensions belonging to the two categories are illustrated

in details respectively in Appendix 4 and 5. Each appendix shows the list of the dimensions analysed, grouped according to the five conceptual areas of the scientific method. The columns instead represent the two groups of the study, the treatment and the control group. In each cell of the resulting matrix, it is possible to find a description of what emerged from the in-depth analysis of the interviews, supported by illustrative quotes extracted from the relative transcripts. The quotes are identified through the ID of the SME in question and the number of the interview in which it was retrieved.

4.1 MAIN FINDINGS

The first dimension relates to the types of evidence used to support the theory. All the different categories of evidence that the entrepreneurs mentioned during the interviews are showed in Table 2:

Codes	Treatment (1)	Control (0)	Delta	Frequency T	Frequency C
Personal experience	5	1	4	15.15%	2.86%
Comparison based	2	1	1	6.06%	2.86%
Competitor based	0	3	-3	0.00%	8.57%
Intuition or chance	2	5	-3	6.06%	14.29%
Surveys	4	0	4	12.12%	0.00%
Client based	2	9	-7	6.06%	25.71%
Experience based	7	6	1	21.21%	17.14%
Network based	6	5	1	18.18%	14.29%
Research based	5	5	0	15.15%	14.29%
Sum	33	35		1	1

Table 2: Different types of evidence used

The second and third column from the left represent the number of times people in the respective groups mentioned a particular type of evidence. The column “Delta” shows the absolute difference between the number of times the different categories were mentioned by the two groups, so to have a quicker view of the categories that constitute the greater

difference between the two groups. The columns “Frequency T” (T stands for “Treatment”) and “Frequency C” (C stands for “Control”) show the percentage of the different sources, computed as a ratio between the absolute values found in the second and third column respectively, and the total number of codes shown at the bottom. The scale of colours from dark green to yellow helps identifying which are the most and the least common source of evidence in each case.

It is possible to notice that the most common category of evidence in the treatment group is the professional experience, used 21.21% of the times and, as a second source, information coming from the personal network, such as family and friends (18.18%). Examples of the explanations provided by the entrepreneurs are reported (see Appendix 4 for complete list):

<*Because I’ve had experience on that and I’ve been working in this field for like over five years now and I’ve had similar kind of attitudes from clients*> ID405_int8

<*Well it all started by talking to parents basically, just having face to face conversations. Asking them how useful it was to them. How interested they were*> ID159_int2

The treatment group also shows instances of insights gained from their personal experience where, for example, a problem faced personally by the business owner becomes a trigger for the development of a certain business idea, as reported below:

<*Yeah, because I struggled to find a solution to it, when I couldn’t find it out, I decided to make it on my own*> ID405_int8

In the control group, the most common source of evidence in this case are the clients (25.71%).

<*When we were starting to advisory services, the [unintelligible 00:08:35] people kept*

asking us for more training> ID165_int8

<*The evidence is the constant business enquiries we get from our existing clientele and new clientele. So we know there is a need for this business solely based on the interest we have from clients*> ID233_int3

From the quotes extracted (see Appendix 4), it can be noticed how the request from the clients are at the basis of the value proposition of the SMEs in the control group.

A crucial difference between the two group is the fact that the control group never mentions the use of surveys as a source of evidence, while this happens four times in the treatment group (Table 2):

<*we did some surveys as part of the course, which just seemed to reinforce that that was a, you know, there was a potential market there for that*> ID390_int5

This quote in particular shows how the decision to use surveys as a tool to collect evidence was boosted by the participation in the training.

The use of survey is not on its own a proof of being scientific: The quality of the questions asked also matters, both when these are used in formal ways such as questionnaires and surveys or in informal ones, through personal interactions. In fact, the second dimension analysed explores this aspect. The questions asked by scientific entrepreneurs were directed towards a specific aim, such as identifying a possible obstacle to the adoption of their solution, understanding the pain points of the customers or discovering their willingness to pay. Here some examples are provided (more evidence in Appendix 4):

<*The three main questions were what would motivate you to buy into solar energy. The*

next one was if you are interested in solar what would be your most important consideration, and what has prevented you from installing solar power so far> ID407_int1

<*in-depth interviews with potential customers and just walk through their whole [...] lifecycle acquisition, property lifecycle [...] and just trying to tease out what the issues that they were facing and the problems that they were dealing with*> ID479_int5

An important aspect is the fact that, sometimes, treated entrepreneurs go a step further by trying to uncover the traits of the average client that would positively boost the adoption of the solution offered.

With respect to the control group instead, questions are more vague, open-ended, and unveil the expectation of the entrepreneurs to have the customer directly telling them what could be a desirable solution (Appendix 4):

<*How they find the product, if they had any recommendations to the brand, those are the things I'd like to understand from the customer. How can we service them better, and also their feedback*> ID238_int8

The quality of the questions asked and the ability to target the right sample are factors that positively impact the ability to forecast what could be successful in a particular setting. In fact, a more detailed and precise investigation enables the entrepreneur to identify new aspects related to the business model. This constitutes the third dimension, "New findings after the test". Precisely, in the treatment group, the fact of having pursued more accurate inquiries enabled the companies to recognise the logical mechanisms behind their value proposition so to prioritise intervention accordingly; This was also displayed through an increased ability to identify new features and services to add to the business model. Some examples are provided (Appendix 4):

<*we're actually going to start another test […] [to] understand the correlation between location [and] price*> ID159_int2

<*I'm also trying to do a cross analysis to try to see, for example, people say they prefer instalment payment plan I want to see how they relate to their employment status*> ID407_int1

The reliance of the control group on tests, and consequently evidence, of lower quality decreased their chances to find elements that would allow them to gain a deeper understanding of the business. Hence, the results obtained from the tests were only sufficient to lead to minor additions to their value proposition or to changes in the focus of the business, as it can be deduced from the following quotes:

<*So, they've got a wider solution that's got accommodation, some nice food, maybe another activity as well, and I've just launched a new product to address that*> ID297_int2

<*we now have a strategy which is more tailor-made to suit our needs and not take everything which comes our way […] just focus on things which we feel we can make good*> ID233_int8

To reinforce the conclusion that indeed the scientific method had an impact in increasing the ability to identify new aspects of the business model, the absolute frequencies with which the entrepreneurs were able to identify and add new components to their value proposition are shown in Table 3.

	Treatment (1)	Control (0)
Functioning or characteristics	2	0
Business model change	2	0
Discover from analysis	2	1
Accidental discover	1	0
Problem of adoption	1	1
Target expansion	2	0
Scope expansion	5	2
Geographical expansion	2	0
SUM	17	4
N = Documents	25	23

Table 3: Absolute frequencies of the additions made to the business model

These changes refer both to the addition of new features that left the core business scope unchanged, or, alternatively, to the identification of new needs and issues not strictly linked to the core business, which hence constitute a significant change. The dimensions listed in table 3 have the following meaning:

- *Functioning or characteristics* refer to a simple change in the futures of the offering;
- *Business model change* refers to higher-level changes such as the operations of the business or a change in the revenue stream;
- *Discover from analysis* represents insights coming from the systematic analysis of the data collected empirically;
- *Accidental discovery* refers to an addition made after a casual event brought a particular aspect to the attention of the business owner;
- *Problem of adoption* refers to an intervention of the entrepreneur aiming at changing those aspects of the offering that were negatively affecting adoption;
- *Target expansion* is when the entrepreneur decides to expand its definition of target customers;
- *Scope expansion* is when the scope of the business is expanded in order to offer a

more comprehensive service;

- *Geographical expansion* consists of the evaluation of the possibility to expand in other countries.

These are not mutually exclusive as the codes are meant to identify all the aspects that could have resulted in an addition or change to the business model, which could have been more than one per interview. Moreover, this dimension investigates the ability of the trainees to identify new aspects, with no restriction regarding the actually implementation in the business model. In fact, this will be analysed in a separate dimension.
By looking at the sum of the codes, it is possible to see that in the treatment group 17 times new aspects were identified, which is more than four times the correspondent number of cases for the control group, equal to 4.

The fourth dimension is related to the use of A/B testing. This was explicitly taught in the program and, in particular, treated ventures were instructed on how to use this technique to test hypotheses. Indeed, the use of this method in the treated group was twice as much the one of the control group (see Table 4), and it also constituted the second-preferred method, after informal conversations.

<AB test where we first got them to read an article about the benefits of arts education for children [...] once the customer had been educated on the benefits of [unintelligible 00:07:09] education […] they were a lot more interested and a lot more engaged>

ID159_int2

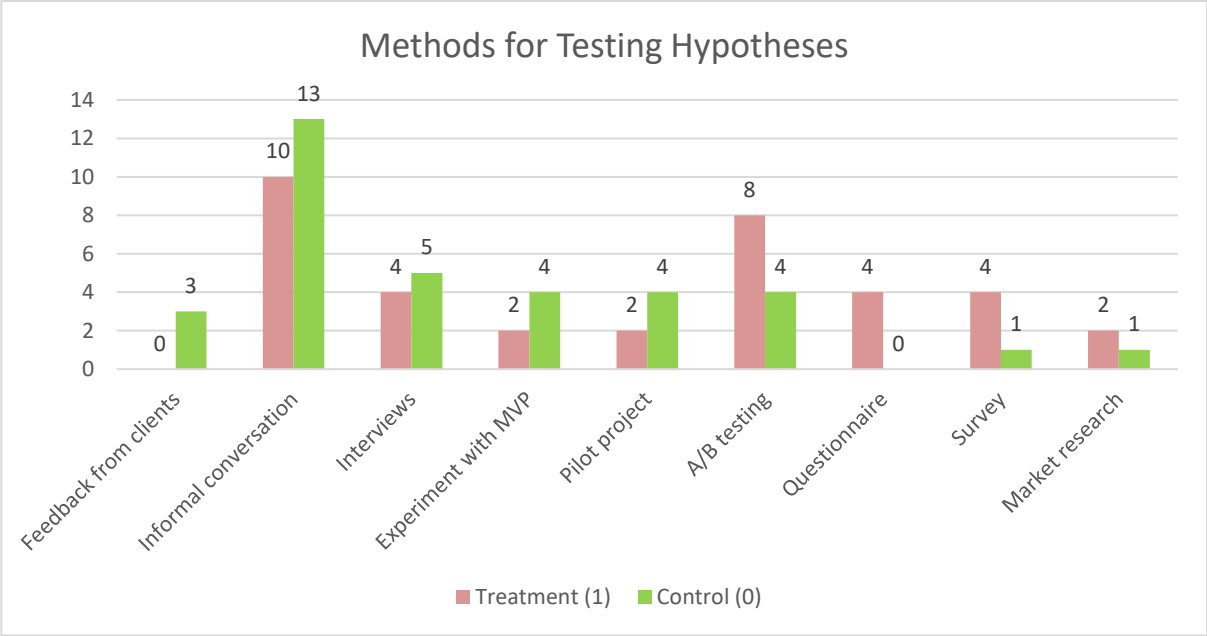


Table: 4 Different methods used for testing hypothesis

The fifth and last dimension considered, called “awareness of quality”, refers to the extent to which the business owners are conscious of the limitations of the data collected. In fact, an important aspect in the scientific method is the ability to recognise the exposition to various types of biases. Even though completely removing them is not possible, it is important that decision-makers spot them so to keep them under control. The treatment group appeared more conscious of this risk (Table 5).

	Treatment (1)	Control (0)
Awareness of quality	7	3
SUM	7	3
N = Documents	24	23

Table 5: Frequencies of the identification of issues with data

Examples of the concern and initiative taken by the entrepreneur are listed below (see Appendix 4):

<we tried to break it into two parts because we wanted to try and correlate the data and make sure that we weren't getting, people weren't skewing it because they thought we wanted a particular answer> ID390_int1

<I went about it the wrong way at the very start as I had what I wanted to build in my head [...] but I thought, let's step back and actually find out what - there might be something that I'm missing, you know, because sometimes we lead too close into it then you try and force your own assumptions on people> ID479_int5

In the case of control group, there are less SMEs that are able to identify such limitations and the concept itself is also less clear (Appendix 4):

<those are based on my assumptions and that's something I need to test before> ID238_int1

4.2. SECONDARY FINDINGS

This section presents the dimensions that, due to less significant differences between the two group, were not considered among the main findings of this research.

The first aspect that emerged is represented by the dimension "Research of evidence". It was noticed that treated firms continue looking for more data points, even when the results obtained in the first experiment led to the validation of their hypothesis. Moreover, the information they look for are quantifiable and precise, as it can be deduced from the following quote (see Appendix 5 for more examples):

<I've got to do some more interview and hypothesis testing of the customers to see which

things they would be willing to pay for straight away> ID479_int4

The control group instead tends to rely on a limited pool of evidence, which usually is informal information gathered from similar businesses or the potential clients, often during networking events or conferences (Appendix 5):

<*I have actually spoke to a couple of people face to face, but informally, not formally. And I have been to a couple of music conferences and stuff and doing networking with people just to find out what things are going on and what people are struggling with. But nothing solid.*> ID468_int2

The second dimension focuses on the extent to which informal conversations were used as a way to validate the initial hypothesis. Despite the fact that treatment group was instructed on how to validated the hypothesis in a more precise manner, informal conversations with client were still the most common source of evidence, accounting for the 27.78% of the cases (see Table 4). This can be witnessed by sentences such as:

<*where I go to gym there's BBC Studio and there's always a queue of hundreds of people […] So I just like went by them and approached them, and asked a few questions*> ID405_int1

The use of informal conversation is even more diffused in the control group, where there is a higher number of instances in which the entrepreneurs decide to rely on this source of information (13 cases, corresponding to 37.14%).

<*doing networking with people just to find out what things are going on and what people are struggling with. But nothing solid*> ID468_int2

A consequence of this approach is the fact that, in some cases, a particular request from the client is deemed to be representative of the market and hence the entrepreneurs integrates it in their theory, as the third dimension in Appendix 5 shows.

<*even though this particular package is not [...] listed on what we do when they [...] mention if we can do that, so I just think that maybe that's just another way out [...] in addition to what we do*> ID231_int3 (Treatment)

<*When we were starting to advisory services, the [unintelligible 00:08:35] people kept asking us for more training*> ID165_int8 (Control)

From the quotes above, it is indeed possible to notice that the logic behind is the same: The entrepreneur receives a request from the client regarding a service that is not present in their offering and they consider adding it to their value proposition. However, this happens only in two instances for the treated group (6.06%) versus the nine cases of the control group, constituting the 25.71% (see Table 2).

4.3 ADDITIONAL DIMENSIONS

In this section, aspects that were not among the main variables under analysis or that are common between the two groups are explored.

Both the SMEs in the treatment and in the control group believed that tests were not necessary in certain situations (see Table 6), despite this was presented as one of the main ways to give robustness to the assumptions of the business model during the training.

	Treatment (1)	Control (0)
No test	11	14
N = Documents	24	23
Percentage	0.46	0.61

Table 6: Frequencies of "No test"

Another aspect examined was the fact that, regardless of the groups of belonging, there may be cases of entrepreneurs who, either due of personal inclination, previous training or specific professional experience, were already familiar with concepts similar to those taught in the training program. This would imply that that some of the successful results are not caused by the exposure to the scientific method but they are attributable to a broader set of factors. Example of business owners who showed some awareness in terms of the procedures to apply in order to be more evidence-driven and rigorous are listed:

<opportunity around using the data we have an experience, probably about five years ago, where we saw how much it could help in terms of helping people understand how they can improve their services by reducing a certain practice or doing new things> ID307_int1 (Treatment)

<I interviewed about 25 people about a year ago, and then found out [...] their problems and stuff and their pain points […]. Then I come up with a pilot course, which I sold out of, which that was good> ID468_int0 (Control)

Another interesting aspect regards the use of the MVP. This is considered among the additional dimensions as it was not included in the syllabus of the program. Among the several methods available for testing their hypotheses, the treatment group chose to use an MVP just 11.11% of the times while in the control group the number of instances in which an MVP was used is double in absolute terms, with a percentage of 22.86% (see Table 4).

With respect to the ability of finding new aspects that could be added to the business model, in the previous section it has been mentioned that for the treatment group, thanks to the training received, business owners develop the capabilities to consider the entirety of factors that can influence the performance of their business. Moreover, scientific entrepreneurs devote particular attention to the delineation of what could be the typical "persona" adapting their solution, as it can be noticed from the examples provided:

<*We asked them what their food things were like, were they vegetarian, vegan, or whatever because we wondered if that was going to have a bit of an impact as well*> ID390_int1

<*it will be nice to group what people are struggling with towards the actual age brackets they're in and what level they're at. Then I can have a clearer picture of what products to target it*> ID468_int2

In the control group there are no particular cases in which different aspects of the target customers are considered as a way to predict the adoption of the service.

A last aspect refers to specific ways of reasoning in order to predict if their business idea will be successful or not. In the treatment group, examples of different countries or industries were used as a benchmark for assessing the viability of its solution.

<*how quickly the [energy drink] market was growing in California, was the reason for me to go 'hey, you know what? It'd be cool if we had more [energy drink] here in the UK'*> ID357_int8

<*The only evidence I could gather was for some of the […] similar industries*> ID357_int1

In the control group, there is only one case of an entrepreneur inferring the possible success of her product in the United Kingdom after having seen the same product prospering in the United States. The other cases were related to more casual abstraction, such as:

<The reason why it went to a balsam was because someone mentioned the balsam in one of the products and I was like, okay, that's pretty good> ID238_int8

However, these particular behaviours were exhibited just by one or few participants and it is not a recurring feature in the SMEs analysed.

4.4. FURTHER ANALYSIS

After the main dimensions of the study had been considered, it would have been of interest to further investigate any possible relation existing between different dimensions.
One of the aspects explored was the possible relation between the new aspects discovered by the entrepreneur as a consequence of the testing activity and the changes made on the business model.
As it can be noticed in Figure 3, there is indeed a correspondence between the discoveries of the entrepreneurs and the features added to their solution.

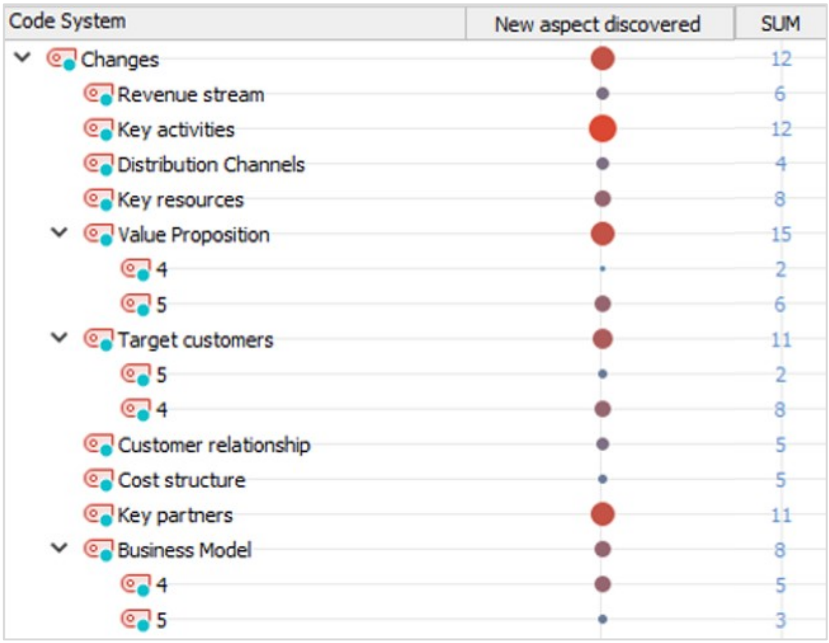


Figure 3 Relation between changes in the business model and the ability to discover new aspects

The major areas of changes according to Figure 3 are the Key activities carried out by the business owners, the Value Proposition and the Target customers. The latter two, when assigned a score equal to four or five, were used to define when the enterprises undertook a radical pivot. The other dimension on which a high number of changes were registered is the area related to Key Partners.

Another aspect that emerged during the analysis was a different tendency to use MVPs as a tool to test the entrepreneur's hypothesis. In fact, the number of cases in which the two groups adopted this technique differs, with the control group using it four times and the treatment group just two. Due to the fact that this was not taught in the program, the underlying assumption was that some of the business owners had some knowledge of the business technique even before the participation to the program. To verify this, the correlation between the use of the MVP or a pilot project and the variable "Previous awareness" was analysed. This variable identifies those entrepreneurs who displayed

knowledge of concepts typical of a scientific approach even before the beginning of the program.

As it can be seen in Figure 4, for the treatment group, the correlation between the codes indicating previous knowledge and the fact of having performed a pilot project or having used an MVP are negatively correlated and moreover the P-value equal to 38.52% indicates that the results are not significant.

	Previous awareness	Test\Experiment with MV
Previous awareness		-0,063 (p=0,3852) N=24
Test\Experiment with MVP	-0,063 (p=0,3852) N=24	

Figure 4: Correlation in the Treatment group

With respect to the control group instead (Figure 5), the correlation between "Previous awareness" and "Test\Experiment with MVP" is equal to 36.7% and it is significant.

	Previous awareness	Test\Experiment with MV
Previous awareness		0,367 (p=0,0426) N=23
Test\Experiment with MVP	0,367 (p=0,0426) N=23	

Figure 5: Correlation in the Control group

Hence, at least for the control group, it is possible to conclude that the higher tendency to use the MVP during their test is related to the knowledge that they had before starting the program.

5. DISCUSSION

The analysis conducted led to the conclusion that, along the four main dimensions constituting the core findings of this thesis, the treated group outperforms the control group.

The literature reviewed in this thesis mainly explained how to render the execution of a decision leaner, which can be only be useful after the decision has been taken. The findings of this research instead represent an addition to the literature thanks to the focus on the decision-making process, especially on the differences in terms of techniques and behaviours exhibited by treated SMEs.

In particular, differences were found with respect to the type of evidence used to support their theories. Among the several options available, the use of surveys, and thus a more objective way to collect information, was present exclusively in the treatment group. Surveys are indeed one of the tools suggested not only by evidence-based management, for instance Kester *et al.* (2011), who stress the need of collecting primary data, but also the scientific approach by Camuffo *et al.* (2018), who emphasise the importance of conducting tests that can provide the entrepreneurs with objective data, which can then be analysed so to have an impartial view of the reality.

With respect to the other type of evidence used by the SMEs that participated in the experiments, one of the most frequent sources of information was the direct experience entrepreneurs had on the field. This could be explained by the fact that being more familiar with something makes people think that it is more legitimate (Barends & Rousseau, 2018). Hence, the professional judgement of the entrepreneurs allowed them to recognise specific patterns and this contributed to create the feeling that their beliefs were confirmed. Even though this way of thinking can be biased, professional experience can be useful in "connecting the dots" around a business idea and potentially enhance the ability to infer the future trends.

Another aspect that was noticed in the analysis relates to the use of personal problems as indicators of a general need. This represent one of the expectations of the scientific method, namely the ability to reason in terms of analogy. An analogy can be defined as "an assertion

that a relational structure that normally applies in one domain can be applied in another domain" (Gentner, 1983, p.156) or alternatively as a mean through which a piece of knowledge that works in one domain can be adapted to a new domain (Holyoak & Thargard, 1995). Hence, the fact that treated entrepreneurs extend their personal problems to the wider population is legitimate. Furthermore, in the different approaches analysed, Diderich (2020) also considers the ability to determine analogies as a requirement of the learning phase in Design Thinking.

The reasoning by analogy was also found in the control group, even though, in this case, these were mainly related to the comparison with different countries or industries.

In terms of the methodology acquired by the entrepreneurs, according to the dimension "quality of questions", the treatment group presents an enhanced ability to investigate, in a precise manner, the different aspects of the business. Several times the treated SMEs investigate the actual willingness to pay of the clients by asking them a numerical reference point, which can be considered more reliable than the answer to a vague, open question (e.g. "Would you use the service?").

Treated entrepreneurs also acquire information that are apparently not directly related to the business itself but instead are of great importance in determining what are the mechanisms that could impact the adoption of the solution proposed. This is related to the recommendation of Ries (2011), according to which it is advisable to break the business plan into smaller components and test them separately. These two aspects are related since the partition of a complex problem into simpler parts provides a clearer picture of the different aspects affecting the main problem and gives the possibility to identify more precisely the category of people that will me more interested in the solution. The same is affirmed by Camuffo *et al.* (2018), according to which those who are capable of doing that have a greater ability of identifying future opportunities and thus be successful.

Firms of the control group often adopt a very distant approach to what the scientific method

would suggest, by asking open questions to their potential customers, such as recommendations regarding the product to build, the specific problems that they are facing, whether they would be interested in the service and so on.

Asking the right questions is indeed crucial to collect meaningful information and being able to act upon it. Barends & Rousseau (2018) stress the fact that evidence-based management is about asking relevant questions and framing the problem properly. Questions are needed to identify the core assumptions behind the entrepreneurial idea and check that enough evidence is found to support them. Moreover, this allows the entrepreneurs to discover the real mechanisms that determine adoption of their solution. Indeed, Rousseau (2006) explains how the implementation of evidence-based management can boost the understanding of cause-effect connections. As Barends & Rousseau (2018) also highlight, this is important in order to identify the root causes behind adoption and increase the likelihood that the final solution would be successful.

The higher quality of the questions asked by the treated groups leads to a clearer understanding of their business and the priorities of the customers, resulting in a more efficient use of resources. This is perfectly aligned with one the core objectives of evidence-based management, which is a more efficient use of resources in the interest of the various stakeholders (Barends & Rousseau, 2018).

However, despite the fact that treated enterprises are on average more precise in the framing of the questions, there are still cases in which new aspects of the business are identified as a consequence of fortuitous events, rather than as a consequence of an appropriate method.

The second meaningful dimension regards the ability to uncover different aspects of the business model. The evidence indeed shows that the treatment group reported a higher number of instances in which the entrepreneurs are able to detect new aspect of their businesses or to understand what kind of relations are worth exploring in order to obtain

precious insight.

As predicted by the scientific method, the ability of identifying different factors that relates to the main business can open up different opportunities to the entrepreneurs and in some instances result in pivoting. In figure 3, it is possible to notice that indeed those who are able to discover new aspects of their business are the same that finally implemented a change in their business model. This is in line with what was previously noticed, namely the fact that the decision of the entrepreneurs to expand their scope and define more closely the services that can be offered to the client (Value proposition) or the customer to serve (Target customer) also requires a parallel change in the way the business is structured, hence the collaborating partners or the activities that will be undertaken by the firm itself. In fact, as stressed by Barends & Rousseau (2018), flexibility is important especially when dealing with complex situations such as innovative endeavours. In this case, it is indeed crucial to be open to the new knowledge acquired throughout the process and make sure that the initial assumptions and the value proposition can be adapted over time. This is indeed what is observed in particular for the treated entrepreneur, who links the new aspects discovered to consequent changes in their business model.

Moreover, this finding is also in line with studies conducted by Hargadon & Douglas (2001) or Maggitti, Smith & Katila (2013) and pointed out by Kirley & O'Mahony (2020), namely the fact that a change in strategy happens when new discoveries are made as a consequences of experiments or hypothesis-testing activity, which contribute to turn theoretical assumptions into features of a concrete commercial product.

With respect to the third core finding, namely the use of A/B testing, Barends & Rousseau (2018) see it as a way to isolate confounding factors and reduce the risk of reverse causality, so to establish whether the results observed are actually a consequence of the intervention implemented. Similarly, in the scientific method (Camuffo *et al.*, 2018), the A/B test is seen as a low-cost technique to gather meaningful information about the business before

spending capital on a definitive product, which the market may in the end not accept. This is especially adapt when online businesses are considered, since the cost of practices such as launching different web pages or recoding videos is lower than the cost of developing physical prototypes. Along this dimension, the treated group distinguishes itself from the control group thanks to a higher number of cases in which this technique was used, more specifically, exactly in twice as many cases.

In order to improve the outcome of the decision-making process, it is fundamental to reduce to the minimum terms the biases that can affect the quality and the legitimacy of the final decision. With respect to the dimension “awareness of quality”, once again the expectation of the scientific method was confirmed, since the treatment group had a higher number of cases in which the entrepreneurs expressed concerns on this issue (7 cases for the treatment group and 3 for the control group). In particular, business owners in the treatment group were aware of the risk that they could influence the answers of the people interviewed, leading them toward a biased results. In fact, in this scenario, respondents may be subject to authority bias. For this reason, Barends & Rousseau (2018) encourage entrepreneurs to ensure that interviewees are not worried about upsetting or contrasting their view.
In some other cases, the entrepreneurs acknowledge that the view they had before the beginning of the program was prone to fallacy and hence express the willingness to go back to their original assumptions and re-assess them in a more precisely.

With respect to the dimensions constituting secondary findings, an important concept that emerges from the analysis, which is also a common point in most of the methods introduced in the literature review, refers to the fact the feedback from the clients should be integrated in an iterative manner and throughout the life of a firm, from the early stages to the growth and scale-up phases. The reason is that the initial enthusiasm exhibited by the customer can easily fade away or be captured by new competitors entering the market. Consequently,

the needs of the customers must be constantly assessed, so to ensure that the firm will be able to capture the interest of the client also in the long-run and that the excitement about the product actually materialises into a purchase. This is even more important when initial feedback is provided by early adopters, which are not representative of the mass market and hence they would not ensure long-term sustainability. This aspect is reflected in the dimension related to the willingness of treated SMEs to continue testing their hypothesis over time. While the treated entrepreneurs understood the importance of continuously obtaining customers' validation, several times the SMEs of the control group were satisfied with fewer evidence and stopped looking for additional data as soon as the clients showed enthusiasm for their product.

It was also noticed that both the control and the treated group made a large use of informal conversations with the clients as a form of testing activity, respectively with a frequency of 37.14% and 27.78%. This highlights the difficulty in making the entrepreneurs deviate from their usual *modus operandi* in favour of a more systematic approach, despite the specific training.

The tendency to add or change elements of the business model in order to incorporate a specific request coming from the client was observed with a frequency of 25.71% in the control SMEs, versus a lower 6.06% exhibited by the treatment group. This may seem aligned to the importance of focusing on the customer and incorporating their feedback to deliver value, as stressed by the theories considered in the literature review. However, a rigorous method would advocate a more conservative approach, by translating the request of the client into falsifiable hypotheses and ensuring that there is indeed enough evidence before incorporating it in the company's value proposition. Hence, the treatment rendered SMEs more conservative.

The participation to the training program had the positive effect of increasing the accuracy

with which the value proposition was described, with a particular focus on the definition of the characteristics of a typical customer, as Diderich (2020) suggests in the validation part of Design Thinking. Despite this precision was more peculiar of the treatment group, there are also instances in which the control group tried to define the habits of the customers, perhaps in the attempt to maximise the efficacy of the communication strategy.

Another dimension among the secondary aspects is the use of the MVP. In fact, although this was not included in the syllabus of the program, the scientific method recognises the utility of such technique. More precisely, all the approaches to innovation and entrepreneurship analysed beforehand strongly advice to avoid spending months trying to get the perfect product, since technical superiority is not always a guarantee of successful adoption (McGrath & MacMillan, 2009). Indeed, in a hypothesis-driven approach, the MVP represents the smallest set of requirements to disprove a hypothesis and maximise the learning per amount of time and effort spent in testing, contributing to the gradual resolution of uncertainty (Eisenmann, Ries & Dillard, 2016). For this reason, most of the methods discussed encourage the use of prototypes to observe how customers react. The idea is indeed to “launch early and often”, as Paul Graham claimed (Eisenmann, Ries & Dillard, 2016, p.6).

In the sample analysed, it was found a different use of this method, with the control group using it four times while the treatment group just two. As a consequence, in order to investigate what could explain the difference at best, one should investigate more deeply in the background of the trainees. In fact, the variable “previous awareness” was only assigned when the entrepreneur mentioned something that referred to specific business knowledge: There might be several others having the same education or experience and did not explicitly cite it during the interviews.

Moreover, a final remark must be made with respect to the fact that in several cases, more

precisely in 46% of the documents analysed for the treatment group and 61% for the documents of the control group, no test was performed (Table 6). In this case both numbers are quite high, even though in relative terms the control group scored worse. This is yet another instance in which the results of the treatment may be highly dependent on the personal predispositions that lead the entrepreneurs to seek further evidence or remain with the one already at hand.

6. CONCLUSION

6.1 EMPIRICAL RESULTS

The objective of the study was exploring the use of evidence-based management in entrepreneurship by looking at the scientific approach to entrepreneurial decision-making, and verify if there was evidence of different behaviours in the treated companies.

The research question aimed at identifying the different factors used in the decision-making process by the treated SMEs compared to the control group and whether the former showed differences in the ability to identify additional aspects of their value proposition.

The analysis conducted led to the conclusion that, in several aspects, the treated group outperforms the control group. This is true along four main dimensions. In the first place, SMEs in the treatment group made use of surveys to assess the market during the testing activity. To fulfil the same purpose, the scientific approach encourages the use of A/B testing, which removes the dependency on subjective declarations and focuses on the actions taken by potential clients. Also in this case, the treatment group exhibited a higher number of cases in which this method was adopted, compared to the control group. These differences led to another important finding of the study, namely the fact that the scientific SMEs have a greater ability to find new aspects that can be added to their businesses in

order to increase its value. This is what the second research question aimed at exploring, and this result allows to state that indeed the scientific method have an impact on this aspect. Moreover, this is aligned one of the main findings of the original study conducted by Camuffo *et al.* (2018), according to which the scientific approach led treated companies to identify false negatives and, in particular, false positive earlier and hence a higher tendency to pivot before incurring irreversible losses.

As a fourth aspect, treated SMEs revealed to be more conscious about the possible presence of biases in their assessments and showed a higher tendency to continuously look for evidence, even after a first assessment of their business idea. Moreover, the type of inquiry made by treated entrepreneurs became more precise over time, with questions aimed at understanding precise characteristics of the target customers. This differs significantly from the vague and broad questions asked by the control group.

The aspects aforementioned are the main findings of the study as these dimensions are representative of the treatment group and, simultaneously, harder to find in the control group. With respect to other dimensions, a large variance was observed, resulting in aspects that did not exhibit particular differences between the two groups. This is true, for instance, in the dimension regarding the use of informal conversations with the clients, which constitutes the most common source of evidence for both groups, even if slightly less for the treatment group. Similarly, the instances in which entrepreneurs did not undertake any test are almost equal between the two groups.

Not only there are aspects in which significant differences are missing, but there are also cases in which a more systematic approach is adopted by the control group. An example are the MVP and pilot projects, which were used in more instances by the control group compared to the treatment. The fact that the concept of MVP was not taught in the course highlights how some of the results observed can be linked to the entrepreneurs' previous experience and not exclusively to the treatment received.

In conclusion, this research project fulfilled the aim of testing an existing theory and adding qualitative evidence to the literature. Indeed, the experiment analysed was conducted in a different country – United Kingdom instead of Italy - and on a different target- SMEs instead of start-ups – compared to the original experiment made by Camuffo *et al.* (2018). Thus, based on the results observed in the selected sample, the scientific method to entrepreneurial decision-making can benefit of a greater range of evidence that renders this method more robust and hence favour its adoption in different contexts.

6.2 LIMITATION AND FUTURE RESEARCH

For the current study, the analysis was conducted on a sample of 30 SMEs, with an average number of two interviews per firm, which limited the amount of evidence available for testing the hypothesis of this study. Moreover, for some of the dimensions analysed, the performance of few SMEs was particularly relevant in driving the results, requiring particular caution when generalising the results.

Another limitation refers to the pool of quotes that could have been used to support the results. Considering the fact that data are codes from phone interviews, the dependence of single sentences on the overall context is significant: While reading the entire interview gives an understanding of the circumstances and consequently the possibility to connect them to one of the concepts analysed, considering them separately may reduce the meaningfulness of the selected phrases and make them appear abstract, reducing the number of quotes that could have been cited for illustration purposes.

Similarly, due to the impossibility of quoting extensive passages in the analysis, in some instances the codes were assigned with the purpose of keeping track of a particular variable and ensure that this was included in the numerical count of the frequencies, even when the sentence selected on its own was not informative. For example, if an entrepreneur was

asked whether any testing activity was performed and the answer provided was “Yes”, this would have been coded under the respective dimension and included in the quantitative assessment, but the corresponding quote could not have been illustrated due to the lack of meaningfulness on its own.

Another limitation of this research is the fact that the main focus was on SMEs who performed a radical pivot and, as a consequence, only the respective phone interviews were analysed. Hence, the current study can be extended by analysing the interviews that were not considered in order to have a complete view of the evolution of the businesses throughout the period under observation.

Besides, the dimensions analysed in this work can be considered as a starting point for future research, which could be undertaken in order to assess whether the performance of the scientific firms continue to differ from the non-treated ones along those dimensions and validate, or disconfirm, the results obtained in the present research. This can be done by replicating the experiment in different countries, perhaps outside the European continent, so to have different external characteristics, such as culture, or by targeting mature industries rather than innovative projects.

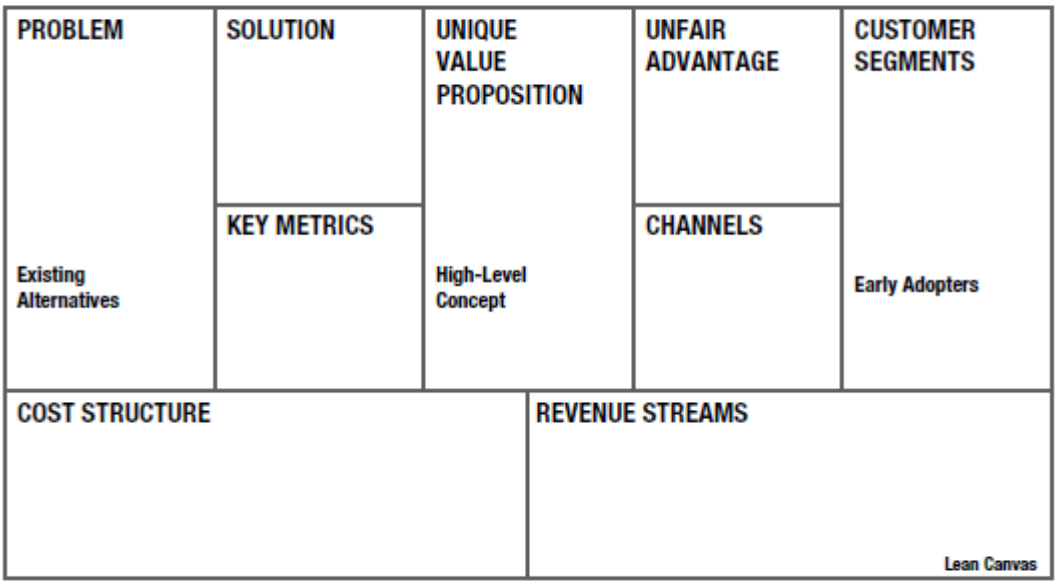
Finally, this research project highlighted the main differences in the approach adopted by the treated SMEs in comparison to the control group. However, even if the treated SMEs on average behaved differently along some of the dimensions analysed, these were not fully compliant as there were cases of SMEs using heuristics or less precise methodologies. Similarly, in some cases, business owners of the control groups were more systematic than to the scientific entrepreneur.

Given the heterogeneity of the results, further studies could explore what are the factors that can positively impact the ability of a given company to fully absorb the scientific method. In other words, the current study contributed in discovering what are the differences practices

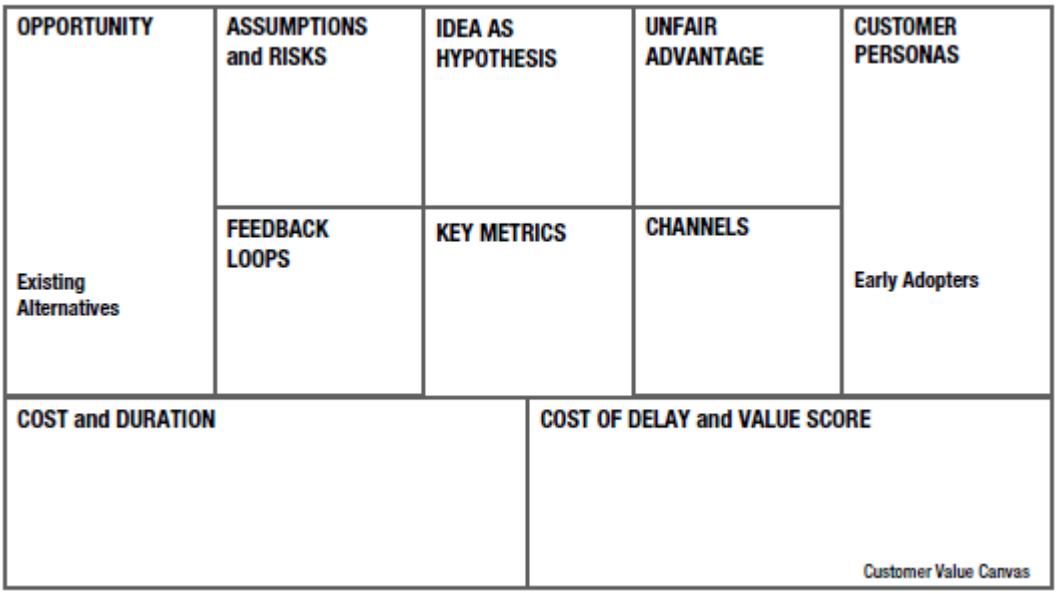
adopted by SMEs after receiving the treatment; The next step would be understanding the causal mechanisms of why this happens.

7. APPENDIX

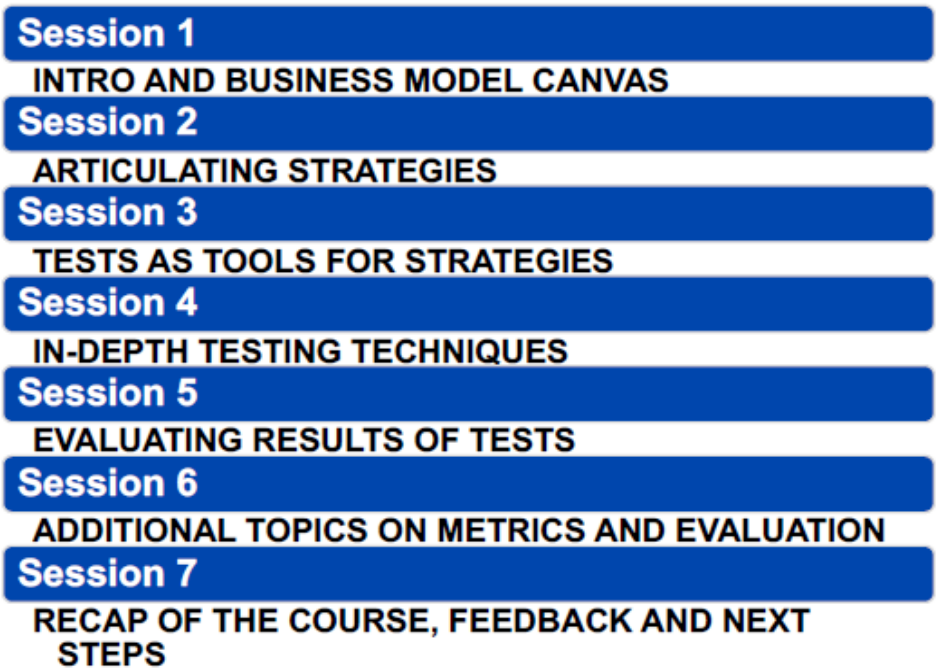
Appendix 1 Representation of The Lean Canvas (Moreira, 2017)



Appendix 2 Representation of The Customer Value Canvas (Moreira, 2017)



Appendix 3 The sessions of the training (Novelli et al., 2020)



Appendix 4 Table of the Main dimensions

MACRO-DIMENSIONS	DIMENSIONS	TREATMENT	CONTROL
THEORY	**Types of evidence used**	SMEs in the treatment group use their direct experience (21.21%) or information obtained through their personal network (18.18%) as main source of evidence. Compared to the control group, a major difference is related to the use of surveys and personal experiences. <*we did some surveys as part of the course, which just seemed to reinforce that that was a, you know, there was a potential market there for that*> ID390_int5 <*Because I've had experience on that and I've been working in this field for like over five years now and I've had similar kind of attitudes from clients*> ID405_int8 <*if they have a problem, and it seems to be, other people have the same problem, then that was a good enough reason to have a go at doing it*> ID390_int8 <*Yeah, because I struggled to find a solution to it, when I couldn't find it out, I decided to make it on my own*> ID405_int8 <*Well it all started by talking to parents basically, just having face to face conversations. Asking them how useful it was to them. How interested they were*> ID159_int2	Most of the firms in the control group rely on their experiences (17.14%) and on the clients (25.71%) as a main source. What differentiate this group is also a higher use of information retrieved from competitors, intuition and casual events. <*When we were starting to advisory services, the [unintelligible 00:08:35] people kept asking us for more training*> ID165_int8 <*The evidence is the constant business enquiries we get from our existing clientele and new clientele. So we know there is a need for this business solely based on the interest we have from clients*> ID233_int3 <*I have operated in this market for a year or two before I started this company. There is an existing market*>ID297_int7 <*I heard it second-hand that one of my competitors was doing well from this approach. So, yes, the passive observation of a competitor led me to the idea of doing this alongside my existing sales and marketing*> ID297_int2

HYPOTHESIS	**Quality of questions**	The treatment group shows more precision in the questions asked, aiming at investigating what could be limits in adoption, pain points and willingness to pay. In some cases, the entrepreneurs explore the possible correlation between characteristics of the target customers and the interest in the service. <*The three main questions were what would motivate you to buy into solar energy. The next one was if you are interested in solar what would be your most important consideration, and what has prevented you from installing solar power so far*> ID407_int1 <*the first thing for us was about who are [...] the beneficiaries we wanted to look after. So [...] in that segment we have to have discussions with schools or colleges to find out the pain points are. What programmes they are looking for and what they would be willing to pay for, and how much*> ID051_int1 <*what faculty, what year […] what faculty and what department are you in. Then something to do with their, whether they borrowed clothes or shared clothes at all*>ID390_int1 <*in-depth interviews with potential customers and just walk through their whole [...] lifecycle acquisition, property lifecycle [...] and just trying to tease out what the issues that they were facing and the problems that they were dealing with*> ID479_int5 <*Key things would be what they were looking for in a [energy drink], and what was currently available to them,[…] how much they're willing to pay, and if it needs to be organic, whether they'd be interested more in caffeine free*> ID357_int8	The questions asked by the control group appear less precise, often expecting insights coming from the customers by asking them more open-ended questions regarding, for instance, how they are currently addressing these problems and the solution they would need. <*how were they making these decisions now? How happy were they with that process? Were they comfortable with that process, and then how were they testing whether it was doing what it was supposed to do, or how were they testing?*> ID471_int1 <*How they find the product, if they had any recommendations to the brand, those are the things I'd like to understand from the customer. How can we service them better, and also their feedback*>ID238_int8 <*"Are you having this problem?"*> ID471_int3

HYPOTHESIS	**New aspects discovered**	There is a higher number of cases in which the entrepreneurs start considering new aspects that can be added to their business. In fact, instead of doing this based on gut feeling, they are willing to carry out additional tests to validate their intuition. . <*I'm also trying to do a cross analysis to try to see, for example, people say they prefer instalment payment plan I want to see how they relate to their employment status*> ID407_int1 <*you're prepared to lend something to someone, how much do you have to know them because we wanted to judge whether trust was one of the biggest issues because we believed that that was the case*> ID390_int1 <*We asked them what their food things were like, were they vegetarian, vegan, or whatever because we wondered if that was going to have a bit of an impact as well*> ID390_int1 <*we're actually going to start another test based solely on that to really kind of understand the correlation between location price*> ID159_int2 <*now what we're trying to do is prove whether there's more of a need for a package service to sell clients rather than selling per hour*> ID155_int1 <*They typically are most concerned with safety, anything to do with safety […]. So the bigger the company actually, the more they are worried about safety*> ID420_int2 <*I discovered that I needed something different so [...] I've decided to go for a rename for the business to attract the target customers*> ID479_int4	In the control group there are fewer instances of enterprises being able to identify new aspects for their business model. In the few cases, the information they want to get is about the characteristics of the target group and whether there will be interest in the solution they are proposing. <*The other thing that I found out about them is where they hang out. When they're finding out information, when they're searching for information. So, that changed my focus to where I would both targeting advertising budget*> ID468_int2 <*we first did the test to see if there will be acceptance for these courses. So we only developed the courses that people wanted*> ID165_int8 <S*o, they've got a wider solution that's got accommodation, some nice food, maybe another activity as well, and I've just launched a new product to address that*> ID297_int2 <*we now have a strategy which is more tailor-made to suit our needs and not take everything which comes our way […] just focus on things which we feel we can make good*> ID233_int8

TEST	**Use of A/B testing**	This method is more common among the SMEs that received the treatment since during the course it was presented as a specific manner of testing hypothesis. *<we are sending traffic to these different packages that we've created to see which one works best>* ID155_int1 *<there's a sample we're trying to compare in terms of different forms of advert that we did. So this was looking at comparing two different ones on Facebook>* ID231_int3 *<AB test where we first got them to read an article about the benefits of arts education for children [...] once the customer had been educated on the benefits of [unintelligible 00:07:09] education [...] they were a lot more interested and a lot more engaged.>* ID159_int2	The extent to which control SMEs use A/B testing is much lower. *<As to who will this balsam appeal to more. People with eczema or people with kids, or I don't know. That's what I need to figure out on the AB test>* ID238_8
EVALUATION	**Awareness of quality**	Treated SMEs appear to be more conscious of the possible limitations and biases of the results obtained. *<we tried to break it into two parts because we wanted to try and correlate the data and make sure that we weren't getting, people weren't skewing it because they thought we wanted a particular answer>* ID390_int1 *<But I presume that the people who passed this survey on probably passed it to their friends who would be similar to them, but that's just an assumption>* ID159_int2 *<I actually needed to improve on in understanding the market properly [..] So, which was one of the reasons why it's just better to step back, understand it properly and then re-strategise here>* ID231_int8 *<I went about it the wrong way at the very start as I had what I wanted to build in my head [...] but I thought, let's step back and actually find out what - there might be something that I'm missing, you know, because sometimes we lead too close into it then you try and force your own assumptions on people>* ID479_int5	Control SMEs are aware that their hypothesis must be tested, however the quality of the test considered is less precise compared to the treatment group. *<those are based on my assumptions and that's something I need to test before>* ID238_int1

Appendix 5 Table of the Secondary dimensions

	DIMENSION	TREATMENT	CONTROL
THEORY	**Research of evidence**	Treated SMEs continue to research additional data points to reinforce the theory through more objective evidence (e.g. willingness to pay). *<I probably need to do a bit more testing and then I can begin. The tenure of the instalment can be maybe a bit more realistic>* ID407_int1 *<I've got to do some more interview and hypothesis testing of the customers to see which things they would be willing to pay for straight away>* ID479_int4 *<we did a few more tests, so we did a questionnaire and the parents responded, and then we did an AB test where we first got them to read an article about the benefits of arts education for children>* ID159_int2	This group tends to ground their decisions on few data points, using no objective data but rather relying on the interest showed by the people interviewed. *<Yeah, by going through incubators, attending meetings and talking directly with them>* ID478_int8 *<end user clients that were paying for it all were very happy and they "Loved it," so that was a complete success>* ID297_int7 *<I have actually spoke to a couple of people face to face, but informally, not formally. And I have been to a couple of music conferences and stuff and doing networking with people just to find out what things are going on and what people are struggling with. But nothing solid.>* ID468_int2 *<I had a few kind of client conversations, but not obviously specifically looking to test anything>* ID471_int1
TEST	**Method based on informal conversations**	Informal conversations with prospects are the most common form of evidence, even though to a lower extent compared to the control group (27.78%). *<where I go to gym there's BBC Studio and there's always a queue of hundreds of people […] So I just like went by them and approached them, and asked a few questions>* ID405_int1 *<Well I spent time talking to my mentors who had done something similar to us>* ID051_int2 *<70% of my time and [name]'s time goes into client relationships, testing the work that we're doing with them and its applicability to other areas of their business, or other people in their network, so that we're getting feedback on, are we doing stuff that the market wants?>* ID307_int8	Informal conversations constitutes the main source of evidence for the control group, used to explicitly ask clients about their pain points and possible solution for it (37.14%). *<I have researched what people think about CBD, and there seems to be a lot of positive guidance and response>* ID238_int1 *<I had a few kind of client conversations, but not obviously specifically looking to test anything>* ID471_int1 *<doing networking with people just to find out what things are going on and what people are struggling with. But nothing solid>* ID468_int2 *<one-to-one meetings and getting some feedback from the clientele. […] getting feedback and understanding from the client where we have faltered or where the changes need to be>* ID233_int6

THEORY	**Particular request from a client considered evidence of an undressed need**	In the treatment group, there are few instances of changes in business model as a consequence of a client's request (6.06%). *< even though this particular package is not [...] listed on what we do when they [...] mention if we can do that, so I just think that maybe that's just another way out [...] in addition to what we do>* ID231_int3	Entrepreneurs in the control group adds features to their business model after receiving request from the clients or considering successful initiatives (25.71%). *<we know there is a need for this business solely based on the interest we have from clients>* ID233_int3 *<When we were starting to advisory services, the [unintelligible 00:08:35] people kept asking us for more training>* ID165_int8 *<we did a big B2B project for a global company, which went very well>* ID297_int7

8. BIBLIOGRAPHY

Auerbach, C. F., Silverstein, L. B. (2003). *Qualitative Data: An Introduction to Coding and Analysis.* New York University Press.

Barends, E., Rousseau, D. M. (2018). *Evidence-Based Management: How to Use Evidence to Make Better Organizational Decisions*. London: Kogan Page.

Bauer, M. S., Damschroder, L., Hagedorn, H., Smith, J., Kilbourne, A. M. (2015). "An introduction to implementation science for the non-specialist". *BMC Psychology*, 3(1): 32.

Bazerman, M. H. (2009). *Judgment in Managerial Decision Making*. New York: Wiley.

Berg, P., Pihlajamaa, J., Hansen, P. K., Mabogunje, A. (2016). "Measurement of Design Front End: Radical Innovation Approach". In W. Brenner & F. Uebernickel (Eds.), *Design Thinking for Innovation: Research and Practice* (pp. 41–56). Springer.

Boeije, H. R. (2010). *Analysis in qualitative research*. London: Sage.

Bowman, E. H., Hurry, D. (1993). "Strategy Through the Option Lens: An Integrated View of Resource Investments and the Incremental-Choice Process". *Academy of Management Review*, 18(4): 760–783.

Bradley, C., Hirt, M., Smit, S. (2011). *Have you tested your strategy lately? McKinsey Quarterly,* pp. 40-53.

Brenner, W., Uebernickel, F., Abrell, T. (2016). "Design Thinking as Mindset, Process and Toolbox". In W. Brenner & F. Uebernickel (Eds.), *Design Thinking for Innovation* (pp. 3–21).

Burnett, D. (2017). *The neuroscience of no regrets: Why people still support Brexit and Trump*. Retrieved May 5, 2020, from The Guardian: https://www.theguardian.com/science/brain-flapping/2017/nov/09/the-neuroscience-of-no-regrets-why-people-still-support-brexit-and-trump

Cabantous, L., Gond, J. P., Johnson-Cramer, M. (2008). "The Social Construction of Rationality in Organizational Decision Making". *The Oxford Handbook of Organizational Decision Making*, *August 2016*, pp.1–24.

Camuffo, A., Cordova, A., Gambardella, A., Spina, C. (2020). "A scientific approach to entrepreneurial decision making: Evidence from a randomized control trial". *Management Science*, 66(2): 564–586.

CB Insights. (2018). *Top 20 reasons why startups fail*. Research Brief. https://www.cbinsights.com/research/startup-failure-reasons-top/.

Chesbrough, H. (2010). "Business model innovation: Opportunities and barriers". *Long Range Planning*, 43(2–3): 354–363.

Colquitt, J. A., Zapata-Phelan, C. P. (2007). "Trends in Theory Building and Theory Testing:

A five-decade study of the Academy of Management Journal". *Academy of Management Journal*, 50(6): 1281–1303.

Crotty, M. (1998). *The Foundations of Social Research: Meaning and Perspective in the Research Process*. London: Sage.

Cyert, R. M., March, J. G. (1963). *A behavioral theory of the firm*. Englewood Cliffs, NJ: Prentice-Hall.

Diderich, C. (2020). *Design Thinking for Strategy*: *Innovating towards competitive advantage.* Cham, Switzerland: Springer.

Eisenmann, T., Ries, E., Dillard, S. (2011). *Hypothesis-Driven Entrepreneurship: The* Lean Startup. Working paper, Background Note 812-095. Hardvard Business School.

Furr, N. R., Cavarretta, F., Garg, S. (2012). "Who changes course? The role of domain knowledge and novel framing in making technology changes". *Strategic Entrepreneurship Journal,* 6(3): 236-256.

Gentner, D. (1983). "Structure-mapping: A theoretical framework for analogy"*. Cognitive Science*, 7: 155–170.

Hamori, M., Koyuncu, B. (2015). "Experience matters? The impact of prior CEO experience on firm performance". *Human Resource Management*, 54(1): 23–44.

Hargadon, A. B., Douglas, Y. (2001). "When innovations meet institutions: Edison and the design of the electric light". *Administrative Science Quarterly*, 46(3): 476–501.

Hempel, C. (1966). *Philosophy of natural science*. Englewood Cliffs, NJ: Prentice-Hall.

Holyoak, K. J., Thargard, P. (1995). *Mental leaps: Analogy in creative thought*. Cambridge: MIT Press.

Hsieh, H. F., Shannon, S. E. (2005). "Three Approaches to Qualitative Content Analysis". *Qualitative Health Research*, 15(9): 1277–1288.

Jaques, E. (1976). *A general theory of bureaucracy.* London: Gregg Revivals (Reprinted in 1993).

Kahneman, D. (2011). *Thinking, fast and slow.* New York: Farrar, Straus and Giroux.

Kelley, T., Kelley, D. (2013). *Creative confidence - unleashing the creative potential within us all.* New York: Crown Business.

Kester, L., Griffin, A., Hultink, E. J., Lauche, K. (2011). "Exploring portfolio decision-making processes". *Journal of Product Innovation Management*, 28(5): 641–661.

Kirtley, J., O'Mahony, S. (2020). "What is a pivot? Explaining when and how entrepreneurial firms decide to make strategic change and pivot". *Strategic Management Journal*.

Kuehl, R. O. (2000). *Design of experiments: Statistical principles of research design and analysis*. Boston, MA: Duxbury-Thomson Learning.

Leifer, L. J., Steinert, M. (2011). "Dancing with ambiguity: causality behavior, design thinking, and triple-loop-learning". *Information Knowledge System Management*, 10(1): 151–173.

Leifer, R., O'Connor, G., Rice, M. (2001). "Implementing radical innovation in mature firms: The role of hubs". *The Academy of Management Executive*, 15(3): 102–113.

Levitt, B., March, J. G. (1988). "Organizational learning". *Annual Review of Sociology*, 319–340.

Lewis, M. (2003). *Moneyball: The art of winning an unfair game*. Barnes and Noble.

Lowenstein, R. (2006). *When business has questions, Drucker still has answers*. Retrived

May 5, 2020, from New York Times. https://www.nytimes.com/2006/01/22/business/yourmoney/when-business-has-questions-drucker-still-has-answers.html

Maggitti, P. G., Smith, K. G., Katila, R. (2013). "The complex search process of invention". *Research Policy*, 42(1): 90–100.

Mas-Colell, A., Whinston, M. D., Green, J. R. (1995). *Microeconomic Theory*. Oxford: Oxford University Press.

Maurya, A. (2012). *Running Lean: Iterate from Plan A to Plan That Works*. O'Reilly Media.

Mayring, P. (2000). "Qualitative content analysis". *Qualitative Social Research*, 1(2): 1277-1288.

McGrath, R. G., MacMillan, I. C. (2009). *Discovery-Driven Growth*. Harvard Business Press.

Meinel, C., Leifer, L. J. (2012). "Design Thinking Research". In Plattner, H., Meinel, C. & Leifer, L. J. (eds.). *Design thinking research. Measuring performance in context.* Berlin: Springer, pp. 1-10.

Mintzberg, H. (1990). "The manager's job: Folklore and fact". *Harvard Business Review*, 53: 12–20.

Moreira, M. E. (2017). *The Agile Enterprise: Building and running Agile organizations*. New York, NY: Apress.

Morgan, M., Levitt, R. E., Malek, W. (2008). *Executing Your Strategy: How To Break It Down and Get It Done*. Boston, MA: Harvard Business School Press.

Novelli, E., Felin, T., Camuffo, A., Gambardella, A., Spina, C. (2020). A Scientific Approach to SME Productivity. In *Trial Reporting*.

Nyhan, B., Reifler, J. (2010). When corrections fail: The persistence of political misperceptions. *Political Behavior*, *32*(2), 303–330.

Osterwalder, A., Pigneur, Y. (2010). *Business Model Generation: A Handbook for Visionaries, Game Changers, and Challengers*. Jon Wiley and Sons.

Pfeffer, J., Sutton, R. I. (2006). "Evidence-Based Management". *Harvard Business Review*, pp. 1-13.

Popper, K. R. (1965). *Conjectures and refutations: The growth of scientific knowledge*. New York: Harper & Row.

Ries, E. (2011). *The Lean Startup: How Today's Entrepreneurs Use Continuous Innovation to Create Radically Successful Businesses*. Crown Business.

Rousseau, D. M. (2006). "Is there such a thing as 'evidence-based management'?" *Academy of Management Review*, 31(2): 256–269.

Rynes, S. L., Colbert, A. E., Brown, K. G. (2002). "HR Professionals' beliefs about effective human resource practices: Correspondence between research and practice". *Human Resource Management*, 41(2): 149–174.

Saunders, M. N. K., Lewis, P., Thornhill, A. (2016). Understanding research philosophies and approaches to theory development. In *Research Methods for Business Students* (Eight). Pearson Education Limited.

Simon, E., McKeough, D., Ayers, A., Rinehart, E., Alexia, B. (2003). "How do you best organize for radical innovation?" *Research Technology Management*, 46(5): 17–20.

Simon, H. A. (1997). *Models of Bounded Rationality: Empirically grounded economic reason*. Volume 3. Cambridge, MA: MIT Press.

Sloan, A. P. (1964). *My Years with General Motors*. New York, NY: Crown Business.

Strauss, A. L., Corbin, J. M. (1998). *Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory* (2nd ed.). London: Sage.

Tingling, P. M., Brydon, M. J. (2010). "Is Decision- Based Ev idence Mak ing Necessarily Bad?" *MIT Sloan Management Review*, 51(4): 71–76.