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Key words: Knowledge transmission, R&D outsourcing, IT consulting start-up

ABSTRACT

In today's day and age, start-ups face immense competition to stay updated with the latest trends and to act on them swiftly. A firm that sticks only to an incremental approach to innovation, finds itself in a position of despair against incumbent players in their respective fields. Firms make investments and decisions that could either help propel the company to long-term sustainable growth or result in short-term profit maximisation but long-term deterioration. Existing big players like Google Inc. (now Alphabet Inc.) and Amazon that have enjoyed immense success including unconventional investments in their investment portfolio, that are vastly different to their main business. The large amount of capital and existing internal knowledge base help larger firms pursue such initiatives. To put it concisely, in order to stay competitive, the start-up has to stay updated with current and future trends, widen their customer base and find opportunities to diminish their shortcomings and resource gaps.

In the case of an IT consulting start-up, knowledge is a key resource and it's exploitation is fundamental to the firm's innovative performance. Firms seek various networking strategies to fill in the gaps in their competencies and resources. While gaining access to knowledge is a task in itself, through research of existing literature we can infer that the internal capability of the start-up is key in absorbing, assimilating, transforming and exploiting the external knowledge received. The relationship between the variables within the boundaries of the firm clearly influence the internal capability of the firm, and analysing this prior to accessing external sources could aid in saving time and money for firms.

Using the relationship between the different variables based on our systematic literature review, we created a model to study and assess the internal capability of an IT consulting firm. Using psychometric data collected through questionnaires and tools to measure the variables that impact the Internal R&D team's capability, the firm could make informed decisions at the Managerial level using the Managerial decision-making tool for R&D outsourcing and Partner selection (Kunttu, 2017).

ASTRATTO

Al giorno d'oggi, le start-up affrontano un'immensa concorrenza per rimanere aggiornate con le ultime tendenze e agire rapidamente su di esse. Un'azienda che si basa solo ad un approccio incrementale all'innovazione, si trova in una posizione svantaggiata nei confronti degli operatori storici nei rispettivi campi. Le aziende effettuano investimenti e decisioni che potrebbero aiutare a spingere l'azienda verso una crescita sostenibile di lungo termine o portare alla massimizzazione dei profitti nel breve termine ma al deterioramento degli stessi nel lungo termine. Grandi player esistenti come Google Inc. (ora Alphabet Inc.) e Amazon che hanno riscosso un enorme successo, includendo investimenti non convenzionali nel loro portafoglio di investimenti che sono molto diversi dal loro business principale. La grande quantità di capitale e la base di conoscenza interna esistente aiutano le aziende più grandi a perseguire tali iniziative. Sostanzialmente, per rimanere competitiva, una start-up deve rimanere aggiornata con le tendenze attuali e future, ampliare la propria base di clienti e trovare opportunità per ridurre le proprie carenze e le lacune di risorse.

Nel caso di una start-up di consulenza informatica, la conoscenza è una risorsa chiave e la sua valorizzazione è fondamentale per la performance innovativa dell'azienda. Le aziende cercano varie strategie di networking per colmare le lacune nelle loro competenze e risorse. Sebbene l'accesso alla conoscenza sia un requisito di per sé, attraverso la ricerca della letteratura esistente possiamo dedurre che la capacità interna della start-up è fondamentale per assorbire, assimilare, trasformare e sfruttare la conoscenza esterna ricevuta. La relazione tra le variabili all'interno dei confini dell'azienda influenza chiaramente la capacità interna dell'azienda e analizzarla prima di accedere a fonti esterne potrebbe aiutare a risparmiare tempo e denaro per le imprese.

Utilizzando la relazione tra le diverse variabili in base alla nostra revisione sistematica della letteratura, abbiamo creato un modello per studiare e valutare la capacità interna di una società di consulenza IT. Utilizzando i dati psicometrici raccolti attraverso questionari e strumenti per misurare le variabili che influiscono sulla capacità del team interno di ricerca e sviluppo, l'azienda potrebbe prendere decisioni informate a livello Manageriale utilizzando lo strumento Decisionale Manageriale per l'outsourcing di ricerca e sviluppo e la selezione dei partner (Kunttu, 2017).

1. INTRODUCTION

1.1 PURPOSE OF THE STUDY

Knowledge and it's transmission are key aspects to any firm's R&D efficiency. Smaller firms usually have lower access to resources and competencies relative to incumbents, encouraging them to pursue options outside the firm.

This study aims to explore what an IT consulting start-up can do in filling in their gaps in R&D and how the same organisation can build an efficient framework around what exists within the firm. The chapter will provide an introduction to the study, starting with the context and background, the research problem at hand, aims of the research and the future scope.

Digitizing traditional companies, providing counsel for client firms that have IT problems, managing a company's IT infrastructure and introducing new products are just a few examples of the activities an IT consulting firm conducts on a regular basis. In short, these firms like any other enterprise, provides an output that helps other firms solve issues that they are not prepared to handle with the resources and competences they inculcate over time. The primary output provided in the case of an IT consulting firm is IT expertise i.e. organized information in the field of Information technology, in other words knowledge that solves a customer's IT woes. The R&D team is a key component in such firms, playing a role in testing and improving existing products, services and processes, troubleshooting peculiar issues and working on new innovations. In smaller firms, often new projects that could contribute to long-term growth, take a back step, due to capacity constraints. A profit maximizing organization always looks to maximize output by utilizing their available inputs. Resources like time, capital (human and monetary) are often scarce and not unlimited. This could hamper growth prospects of firms.

At the corporate decision-making level, firms are left with key decisions with regard to their business plan. Firms need to focus their efforts on business decisions in line with their key skills, competencies and available resources, since efficient capital and resource utilization are critical to their survival and long-term growth. Traditionally, firms only outsourced activities that were irrelevant to their competitive advantage. But, in this age of digitization, where ICT has evolved and the rate of innovation is rapidly increasing, firms that do not keep up with the pace of innovation do not survive. Outsourcing has evolved from reasons

of only cost reduction for firms to being strategic in nature. Firms sometimes outsource early stage research in order to focus on their key competencies and some firms buy research in it's entirety. This depends on various factors internally and externally. But this is not as simple, if the key resource is knowledge. In the case of an IT consulting start-up, the key resource is knowledge. Firms have to be internally capable to handle knowledge transmitted. We have gone on to explore the theoretical background about, how firms have successfully transferred knowledge, the various intricacies involved like type of knowledge, the networking effects involved and other information that are relevant for a firm with capacity constraints.

1.2 BACKGROUND

In order to understand the evolution of knowledge transmission and it's current prevalence in our society, we have to delve deep into where knowledge transmission started, the different forms it took and the accessibility at different points in time. This is key to our study of R&D outsourcing decision-making at the consulting firm, since this is a knowledge transmission is a key activity.

One of the earliest known iterations of knowledge transmission took the form of cave drawings in 15,000 BC. From there, documentation became more sophisticated, evolving from imagery to alphabets, and from walls to scrolls. Monks and academics took on the role of transcribing books and organizing encyclopaedias, storing knowledge away in exclusive libraries. The invention of the printing press in 1440 was the first time information was easily distributed via print material. It wasn't until over 400 years later that libraries were available to the general public.

The 1900s saw incredibly rapid changes in knowledge sharing and transmission, starting with real-time radio broadcasting at the beginning of the century and then culminating with the invention of the internet in the 1980s. As information grew more and more accessible, it was harder to imagine functioning without the technologies enabling this new level of connectivity. It quickly became clear that a means for managing this excess, albeit incredibly useful, information was greatly needed.

Consultants were amongst the first professionals to seriously explore and consider the best means of sharing knowledge. Some consulting companies relied on key players to manage and share knowledge via person-to-person interactions, whereas other organizations turned to computers to codify and store information in databases. Using computers allowed them to communicate knowledge rather than simply store it. As companies grew and technology improved, one lesson had been made clear: knowledge if not used and shared would never get realized into something of value. But, knowledge to an entity is valuable only when there is a clear use-case and if it can be put into practice. Firms have explored ways to use knowledge and have understood the importance of being able to absorb, assimilate and transform it to their need.

1.3 PROBLEM DESCRIPTION

In this age where technology and digitization has enabled the rise of several innovative start-ups, firms that do not radically innovate fall short of their goals. But, unfortunately some firms have capacity constraints that prevent them from competing at the best level. In the case of an IT consulting firm, where knowledge is a key resource, firms have to decide how they can utilise knowledge not easily available within their boundaries.

In this report, we will be addressing the below questions:

1. Is it feasible for an IT consulting start-up to outsource some of its research and development?
2. What is the difference between R&D outsourcing and traditional outsourcing activities?
3. What are the networking activities available in the market?
4. What are the factors that can affect the choice of outsourcing?
5. What could be a suitable decision-making framework for R&D outsourcing?

2. STEMATIC LITERATURE REVIEW

In our theoretical background study, we focus on knowledge transmission activity. We have included a brief study on IT consulting firms in order to show how they fit in with knowledge-intensive services. By showcasing how they fit in with knowledge-intensive services, we aim to show how knowledge is a key resource and one of the sources of differentiation for consulting organizations.

2.1 IT CONSULTING SERVICES AS A KIS

The earliest and closest link to the term “Knowledge-intensive services”(KIS), was in the use of the term KIBS or Knowledge-intensive business services in the 1995 report "Knowledge-Intensive Business Services: Users, Carriers and Sources of Innovation" that was sent to the European Commission. The report stated that KIBS are basically services and business operations heavily reliant on professional knowledge. In today’s context, we can clearly see that KIBS have moved past it’s initial periphery of just business services and evolved towards sources of knowledge diffusion.

Knowledge-intensive business and services (KIBS), as an industry has been known to be a contributor to innovation of firms as well as economies. For example, we can see the relevance of KIBS in the fields of pharmaceutical drug research, especially in today’s day and age. With billions of lives at stake because of the pandemic, the fast ramp-up of the Covid-19 vaccine production has been possible only because of the advent of ICT and the prevalence of specialized research labs. Even though, the efficacy of the vaccine is still under scrutiny, we can definitely say that this is progress.

The purpose of introducing KIBS was in order to induce innovation by introducing a new pattern of business innovation to traditional firms (Miles, Kastrinos, & Flanagan, 1995).

An OECD report published in 2006 on Innovation and Knowledge-intensive service activities has taken it a step further by mentioning that KIBS act as both sources and carriers of knowledge that influences and improves the performance of public and private individual firms, value chains and industry clusters across different industries and economies at large. IT consulting services

as a sector, falls in the broad area of KIS (Knowledge-intensive services) (Pina & Tether, 2016).

IT consulting services involves providing specialized and professional advice and support to client firms using IT infrastructure and related services. The service entails characteristics such as a source of knowledge transmission to clients and an inducer in diffusion of innovative new information technology solutions to the economy. The IT consulting industry essentially follows suit to the aforementioned ideology and purpose of KIS.

2.2 KNOWLEDGE TRANSMISSION

One of the core objectives of this thesis is to understand how an IT consulting start-up can gain access to knowledge and information, that aid in providing solutions to their clients. For a consulting firm, knowledge is a key resource in their production function, since their output revolves around giving key insights to customers requiring solutions. To get a better idea of knowledge transmission or knowledge transfer, we have gone on to define the resource that is of focus to our case, i.e. knowledge.

2.2.a KNOWLEDGE

According to the innovation literature, Knowledge was categorized as "organized information" back in the OECD Conference held at Copenhagen in 1994, giving it a static outlook. But ever since this was first used, economists have tried to give it a more suitable meaning. Firstly, whenever firms seek to absorb information, they often deal with two kinds of knowledge resources: Formal or explicit knowledge and tacit or implicit knowledge (Miles, Kastrinos, & Flanagan, 1995).

Explicit knowledge, in It's simplest form is usually derived from books, reports, teaching programmes, patents, etc. This information is usually available to firms, universities and organizations, allowing them to make use of the information available for their benefit and improving the knowledge base available to the economy as well. From the resource based theory and it's knowledge-based extension, we can infer that explicit knowledge is easier to imitate and appropriate(Grant, 1996).

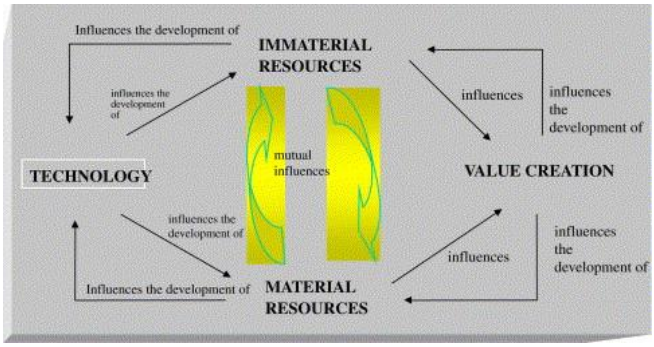
Tacit knowledge is much more difficult to absorb - and in the context of innovation it has several dimensions. This is knowledge acquired over time by application(Søberg, 2012).

Tacit knowledge is key to a firm looking to beat it's competition. Diving deeper into literature regarding the same, we learnt about the following attributes of tacit knowledge and it's importance with regard to a firm's growth.

We understand that tacit knowledge plays a vital role in differentiating a firm's delivered service or product in order to secure a competitive advantage. The adaptability of a firm is dependent on how quickly they can learn by doing. Tacit knowledge plays a fundamental role with regard to expansion of the organization's existing knowledge base and a central role in internal learning and development (L&D)(Howells, 1996; Johannessen et al., 2005).

But due to the implicit nature of tacit knowledge, the information possessed by individuals can be transferred to competing organizations, if the organization is not organized to absorb information in a structured and systemic manner. Information received is mostly not utilized in the same manner by all parties involved. It often depends on the existing competencies and skills inherently available at the firm's disposal. This highlights the importance of the knowledge transmission system, knowledge integration capability and the inherent skills involved in utilizing the knowledge to achieve the differentiating advantage over their competition.

Knowledge as an intangible resource has grown in importance over time, becoming a core competence in value creation. In an age where innovation is rapid and products reach the shelves rapidly, firms innovate to be ahead of the curve. This could be in the form of creating a new product or changing the existing meaning of a service or product. But, in every case intellectual know-how has proven to be critical in achieving the same. The paper has further highlighted it's importance in knowledge-intensive services(Johannessen et al., 2005).

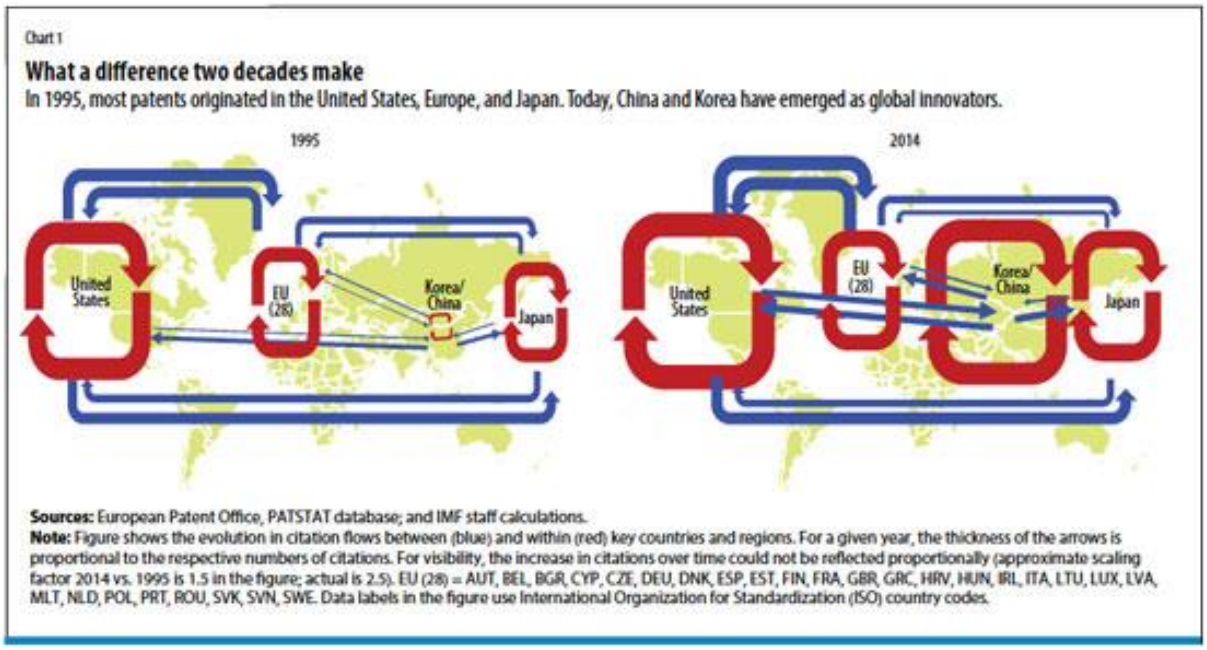


The Cambridge Business English dictionary has highlighted the main points with regards to the meaning of knowledge as, "skills or information about something that has been acquired through study or experience". This shows that information unused or in other words static, doesn't let companies' benefit. Knowledge as such is a dynamic resource, since it requires firms to continuously adapt to external path dependent processes and routines in order to make use of the organized information.

2.2.b DEFINITIONS OF KNOWLEDGE TRANSMISSION

Knowledge transfer or transmission is an act of elaboration of existing knowledge bases between two parties that can contribute to each other's interest. Even though both the parties may agree to be beneficial to each other equivalently, the transfer is rarely symmetrical (Miles, Kastrinos, & Flanagan, 1995).

The IMF through the article "How Knowledge Spreads", went on to say that more rapid diffusion of know-how is a critical benefit of Globalization. The article goes on to speak about the role of knowledge transfer in growth of new economies, providing new products, services and employment. Using cross-patent citations as a proxy for explicit knowledge transfer, they analysed how knowledge transfer trends have changed over time due to Globalization. In their analysis, they were able to see how emerging economies like China have grown, capitalizing their access to global markets and in turn their knowledge, enhancing their innovative capacity and productivity(*Globalization and the Rapid Spread of Knowledge – IMF Finance & Development Magazine | September 2018*, n.d.).



As important as relevant external knowledge contributes to the added value for the organization of the development of new processes or products, but is also related to the prior knowledge existing in the firm. This definition is congruent with the concept of 'knowledge relatedness' (Breschi et al., 2003), which has been identified as a key factor in firm's technological diversification.

According to (Chauvet, 2003), the propensity of knowledge transfer coupled with the firm's absorptive capacity are key contributors to the organization's competitive advantage. The ability of a firm to absorb, assimilate and apply the external knowledge obtained is dependent on the intrinsic knowledge available within the firm. The absorptive capacity of the firm could be a deciding variable in factoring if firms should source R&D or not, since it is a multi-faceted factor that includes the organizational context, internal knowledge base and an innovation framework to finally commercialize the input received from the knowledge supplier.

In entrepreneurial ecosystems, knowledge transfer is "to ensure the effective application of intellectual capital within the company or network to achieve certain objectives(Flores et al., 2017).

Tapering in from the big picture, where we consider knowledge transmission in terms of transfer between two entities, we should mention that the exchange of information between two individuals with regard to their experience and in the context of work within a firm are as important a factor in increasing the firm's knowledge base (Tassabehji et al., 2019).

Knowledge transmission is not a matter of just diffusion of information, but requires firms to absorb, organise and adopt this information. It is an active process, that involves entities exchanging organized information and the application of the new findings. The nature of knowledge transmission is often ambiguous. Even when organizations lay out plans on curtailing leakage of sensitive information, there can be instances of spillovers. This struggle with knowledge transmission is due the tacit nature of acquired information. Firms usually absorb knowledge through exposure and specialized knowledge availability, that is stronger for larger firms that have scale. Firms use various networking strategies through public/ private organizations. One such way is to collaborate with suppliers, competitors, customers, universities and research institutes. But, as unhealthy as it is for firms to lose information to any of their partners due to spillovers, in the process firms using collaborations as a networking strategy profit as well (Belderbos et al., 2004) .

2.3 OUTSOURCING

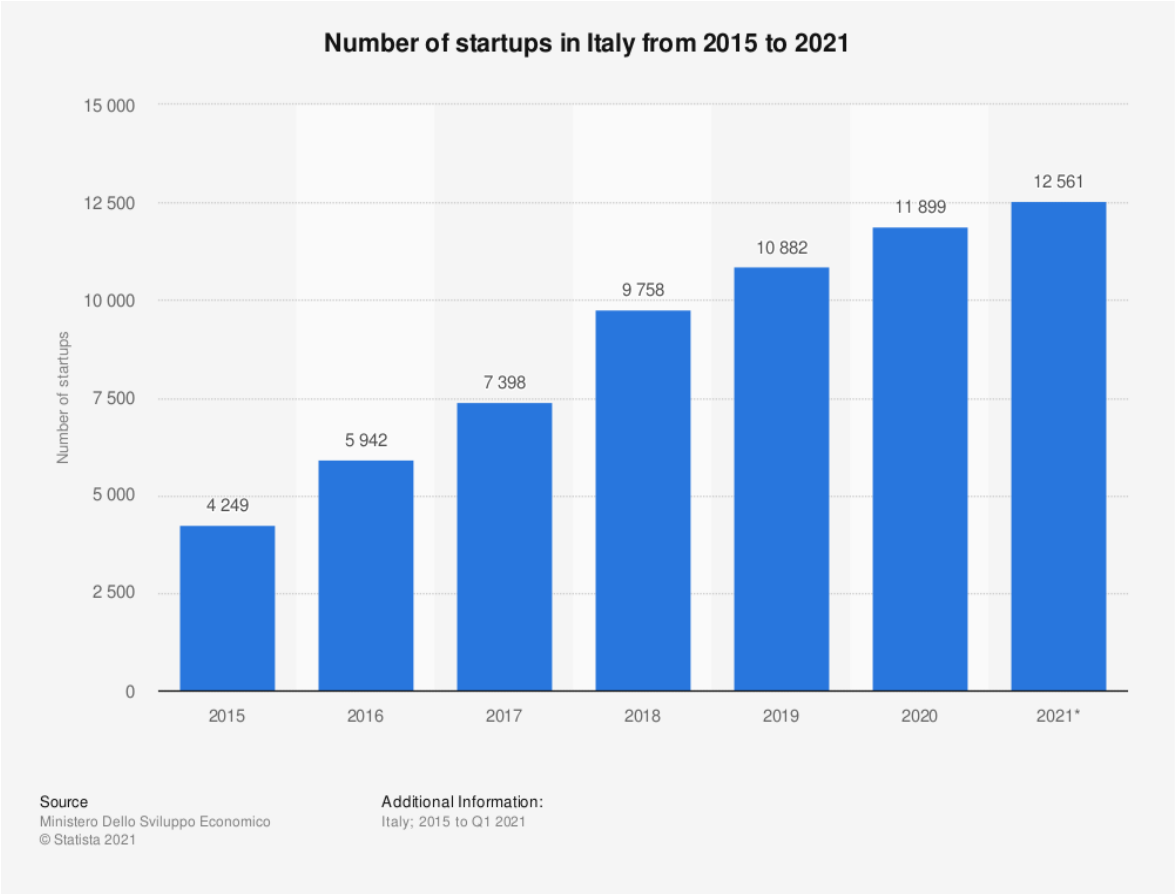
When making decisions to setup a business plan, firms usually classify activities that they are competent at and those that are outside their area of expertise. According to Jacobides & Billinger (2006), firms can be conceptualised as organisations in which individuals continuously and simultaneously take 'make' or 'buy' decisions.

Outsourcing has been defined as transferring a business activity or function from a company to an external contractor who takes control of the activity's inputs and then performs that function, selling it back to the company (Tadelis, 2007).

Initially outsourcing was thought of as an activity that was considered to be done mainly to reduce the costs of activities deemed by manufacturing firms as non-value adding activities like unskilled labour, transportation and other costs. As digital transformation has played an important part in the development of industries, the need to outsource more technical aspects of the firm has come into play. For instance outsourcing has grown beyond the cost reduction aspect of services like to transportation services, human capital and logistical services to strategic outsourcing reasons like hiring IT and business consulting services, system infrastructure provision and management. But, then again this depends on what a firm seeks to specialise in or if their output is a product, service or experience. For example, an oil and gas firm would outsource the above activities reducing operational costs, avoiding major investment costs in technology, providing consistent and improved service delivery, accessing current technology and expert knowledge and focusing more on core business activities (Nyameboame & Haddud, 2017).

In our study, the firm that is the subject matter of discussion is an IT consulting start-up that provides knowledge-intensive business services. A study on the outsourcing practices among 802 small knowledge-intensive service firms in Iceland through surveys and interviews has helped us infer that small knowledge-intensive firms are known to outsource more than regular service firms, the prime reasoning being cost reduction and strategy in order to focus on their core competency and gain access to external knowledge (Edvardsson, Óskarsson, & Durst, 2020). Two ideas can be inferred from the above

information. Firstly, an IT consulting start-up's reason for outsourcing is to cut costs, but in a lean manner in order to not affect services offered to their clients. Secondly, the strategic significance of outsourcing research that the firm is usually not specialized at handling or activities that are needed, but essentially do not impact the differentiation of the product or service the firm plans on selling. R&D activities are of strategic importance and highly relevant in the KIBS industry (Holcomb & Hitt, 2007; Howells et al., 2008). With existing capacity constraints being a barrier to innovation, smaller firms could lose ground to their competitors if their focus is fixated on only short-term profit-maximizing initiatives and not to disrupt the market. Outsourcing R&D can help these smaller firms capture value and not lag behind the incumbents in the market. In fact, based on the resource based view, firms sometimes completely substitute internal R&D for external R&D at some levels, especially when the level of R&D budget is low(Spithoven & Teirlinck, 2015). But, this can't be the case in IT consulting firms, since knowledge is a key resource and the service provided is in the diffusion of the same.



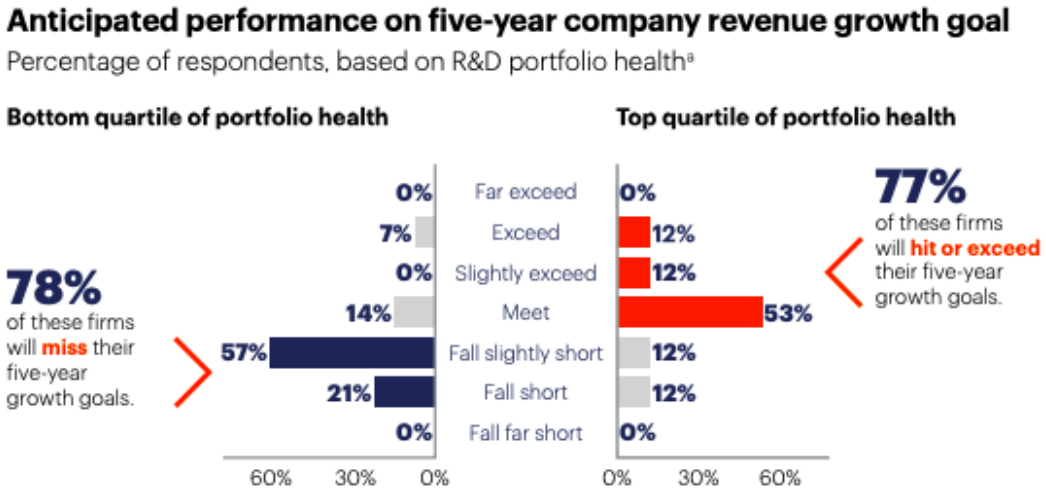
Using data from (*Italy*, n.d.), with the number of innovative start-ups increasing at Italy at a CAGR of 10.69% in the past six years and the majority being in the services sector, firms should focus on research and development

(R&D) of products and services that give them an edge over their competition. There are two kinds of projects that firms focus on, incremental and transformational projects.

Incremental projects are nothing but, projects designed to support existing products or services (Gartner, Inc, 2019).

Transformational projects are new-to-market innovation proposals that have a high likelihood of growth in the future (Gartner, Inc, 2019).

In a survey taken by Gartner, one in four R&D leaders were satisfied with their portfolio management process — the process companies use to manage the mix of R&D projects underway. Less than half of R&D leaders believed that their portfolios contained a sufficient number of high-value projects and that spending matched strategy, and less than one-third thought their portfolios were balanced, maintained an appropriate number of projects, and were free of undue delays. This lack of portfolio health matters: of companies with the unhealthiest R&D portfolios, most (78%) anticipate missing their five-year revenue growth goals.



Companies are putting their growth goals at risk by allowing R&D resources and attention to shift away from transformational projects to incremental ones. But, the report has also stressed that transformational projects are not a sure path to success, rather the business decisions taken in balancing their R&D portfolio in such a way that saturated incremental projects outweigh the possibility for new opportunities the market offers must be in consideration (Gartner, Inc, 2019).

Like other tangible activities like manufacturing and labour that are more or less binary, outsourcing R&D is not straight-forward. It is multi-faceted. There are various strategies by which firms can acquire knowledge externally. Rather, there is a continuum of options along degree, stage, breadth and form that makes it a multifaceted phenomenon (Spithoven & Teirlinck, 2015). For example, firms profit by acquiring early stage research by independent inventors or companies (García-Vega & Huergo, 2019).

Literature on knowledge-intensive services further assert that businesses foster productivity, competitiveness and innovation with the employment of highly qualified professionals and skilled technicians. Although this is important, the paper also suggests that innovation linkages and public/private/academic partnerships are essential for innovation. It stresses the importance of networking activities as a source of obtaining knowledge (Casanova et al., 2018). It is important to note that external sources of knowledge act as complements rather than substitutes to internal R&D (García-Vega & Huergo, 2019). Many papers provide empirical evidence into the positive and significant impact of networking strategies on a firm's innovative performance (Nieto & Rodríguez, 2011), whereas research according to Dachs et al. (2012) on the cons of networking activities on innovative performance of the firm, has rendered the argument scarce.

Businesses have to look for knowledge externally through networking strategies to survive and to adapt to more dynamic and global markets. To enter new markets there is a need at times to understand the regional context of the potential market. Firms often find it more likely to gain access to information and improve their innovative performance by offshore outsourcing for region-specific investment choices (Nieto & Rodríguez, 2011). When a firm looks for opportunities abroad, they might lack the context and might be faced with entry barriers that prevent them from taking advantage of opportunities that may arise.

Scholars have looked into the effect, regional contexts play into the firm's networking strategy decisions. Although a firm's characteristics are more relevant than the regional context, something that's already been stressed in recent studies, the regional context explains an important part of the variability of firms' innovative performance. Most studies have considered two main technological networking strategies – R&D outsourcing and technological

cooperation. They have asserted that although, firms exist in highly knowledge endowed regions, the sector in which knowledge exists is highly important in a firm's choice between choosing technological cooperation and R&D outsourcing. We can draw from their analysis that, firms existing in regions where knowledge exists in a sector they would like to research, should look for a cooperative approach. Firms with inferior knowledge endowed regions, should in fact look into outsourcing (Tojeiro-Rivero & Moreno, 2019).

2.4 NETWORKING STRATEGIES TO OBTAIN KNOWLEDGE:

Much has been said about the effect of knowledge-intensive services, knowledge transfers and their relation to innovativeness and performance of a firm. The crucial role networking activities play as sources of knowledge transfers cannot be played down. In this paper we focus on two main categories of technological knowledge transfers, mainly R&D outsourcing and technological cooperation. As seen previously in literature on knowledge-intensive services, we can infer that coupled with the right resources, networking activities play a pivotal role in the performance and growth of a firm (Casanova et al., 2018).

2.4.a R&D OUTSOURCING THROUGH ACADEMIC INSTITUTIONS

2.4.b R&D OUTSOURCING THROUGH STRATEGIC PARTNERS

[text to be added]

3. FACTORS AFFECTING THE A FIRM'S CHOICE OF OUTSOURCING:

From the paper by Spithoven & Teirlinck (2015), we have analysed different theories that have gone on to explain the important variables in question when making a decision with regard to outsourcing or internalizing research and development in firms. The paper contains a systematic literature analysis of the theories explaining R&D outsourcing and it's determinants. We have summarized the key points from the paper and it's extended literature in order to identify the key strategic drivers for our analysis and framework that fits best with our problem. Our objective is to find drivers of outsourcing that can be closely related to IT consulting firms.

Transaction cost economics

According to transaction cost economics (TCE), firms look to outsource R&D when there are low transaction costs, that is when asset specificity, uncertainty and opportunism are low or minimal. In simple terms, when the cost of external realization is lower than making it internally. Ex-ante contracts are required. These contracts are usually very complex, expensive, but not free from the risk of moral hazard. The theory goes on to say that R&D outsourcing should be confined to early stage research or standardized technology, so that the suppliers of R&D don't get access to research that is critical to the firm's perceived differentiation advantage.

Relative to the general context of outsourcing, R&D outsourcing has the following attributes, that are listed below:

- The output received is highly risky and uncertain
- Intellectual Property Right (IPR) issues are prevalent
- The resource exchanged i.e. knowledge is a strategic resource
- Depreciating internal capacity building
- Limited learning curve, because each project is unique
- Tacit nature of knowledge

Another point TCE highlights is with regard to R&D outsourcing's role as a complement or substitute to internal R&D. It states that external R&D becomes a viable substitute for internal R&D in the logic of transaction cost economics, but only when the firm's R&D budget is low or moderate.

Limitations of Transaction Cost Economics

- Largely negates the implications on organisational behaviour
- TCE ignores resource heterogeneity and the variance in firm-level specific capabilities related to value creation.

Even though the insights derived from transaction cost economics are considered to be less relevant than managerial theories (Hoecht and Trott, 2006). If we were to consider variables that would make sense for a firm to consider in

it's decision-making, we would consider the market cost of the service and searching cost, that includes negotiation costs, time and contractual costs.

Resource-based view

In essence it is a managerial theory, that focusses on how a defined mix of resources and competences within a firm's disposal can be best used to achieve a competitive advantage. The resource-based view finds it's prominence in strategy literature. Since, the decision to make or buy a service, or in other words outsource R&D or make use of what's internally available is a strategic decision and finds it's coherence to contributing to the decision-making effort behind R&D outsourcing a strong case.

The resource-based view highlights a point already covered in TCE with regard to the complementary or substitutionary property of R&D outsourcing. Two notable extensions that are relevant to our research are: the dynamic capabilities view and the knowledge-based view.

The dynamic capabilities view stresses the need of a firm to continuously adapt to external path dependent processes and routines, in contrast to a static view of the firm's resources and capabilities. It highlights variables that are of utmost importance like the absorptive capacity of a firm. Absorptive capacity entails two sub-variables – PACAP and RACAP(Vega - Jurado et al., 2008).

INTERNAL CAPABILITY OF A FIRM:

We can infer from research that as important as it is to obtain research from sources external, it is important to assess if the firm is internally capable to transform this information to suit our needs. Firms can decide

Absorptive capacity

A key variable in assessing the **internal capability of a firm's R&D** is the absorptive capability of the team. Absorptive capacity is the firm's ability to absorb, assimilate and apply new knowledge to a commercial use(Kumar & Seth, 2001). Knowledge received from external resources, if not applied in an appropriate manner would most likely result in projects being discontinued and

investment capital being wasted. This has an inverse effect on transaction costs of the firm as well. The lesser the absorptive capacity of the team, the higher the transaction costs. The higher the absorptive capacity of a firm, the greater the ability of the firm to diversify the R&D portfolio.

To measure the absorptive capacity of firms, (Vega - Jurado et al., 2008) have highlighted two determinants of absorptive capacity - PACAP and RACAP, that imbibes determinants like absorption, assimilation, transformation and exploitation of knowledge(Zahra & George, 2002). The multi-dimensional nature of absorptive capacity in relation to new knowledge is summarized in these two determinants:

PACAP (Potential Absorptive Capacity) – This includes the phases of knowledge absorption and assimilation.
RACAP (Realized Absorptive Capacity) – This includes the transformation and exploitation of the knowledge attained. In other words, this expands on what the firm does with the knowledge to meet its commercial ends.

The paper also goes on to explain how important the organizational context plays an important role as an antecedent of a firm's absorptive capacity, as much as existing knowledge base does.

The knowledge-based view stresses on the importance of knowledge as a key resource for the firm's sustainable growth. The view describes the aspect of knowledge transmission as the transfer of explicit and implicit knowledge between two partners with existing capabilities and resources. It highlights the easiness to imitate and to appropriate property of explicit knowledge and the ordeal in absorption of tacit knowledge due to its very nature of being codified(Yusuf, 2008) and present in the holder's mind. Three variables that can be derived from the knowledge-based view are: level of tacitness, specificity and complexity of knowledge.

In relation to studying the internal capability of the R&D team and their absorptive capacity, we identified four variables:

Team's Skill Diversity
Team's Collective Cognitive Ability

Organizational context/path
Existing knowledge base
[text to be added]

3.2 MANAGERIAL DECISION-MAKING TOOL FOR R&D OUTSOURCING & PARTNER SELECTION(Kunttu, 2017):

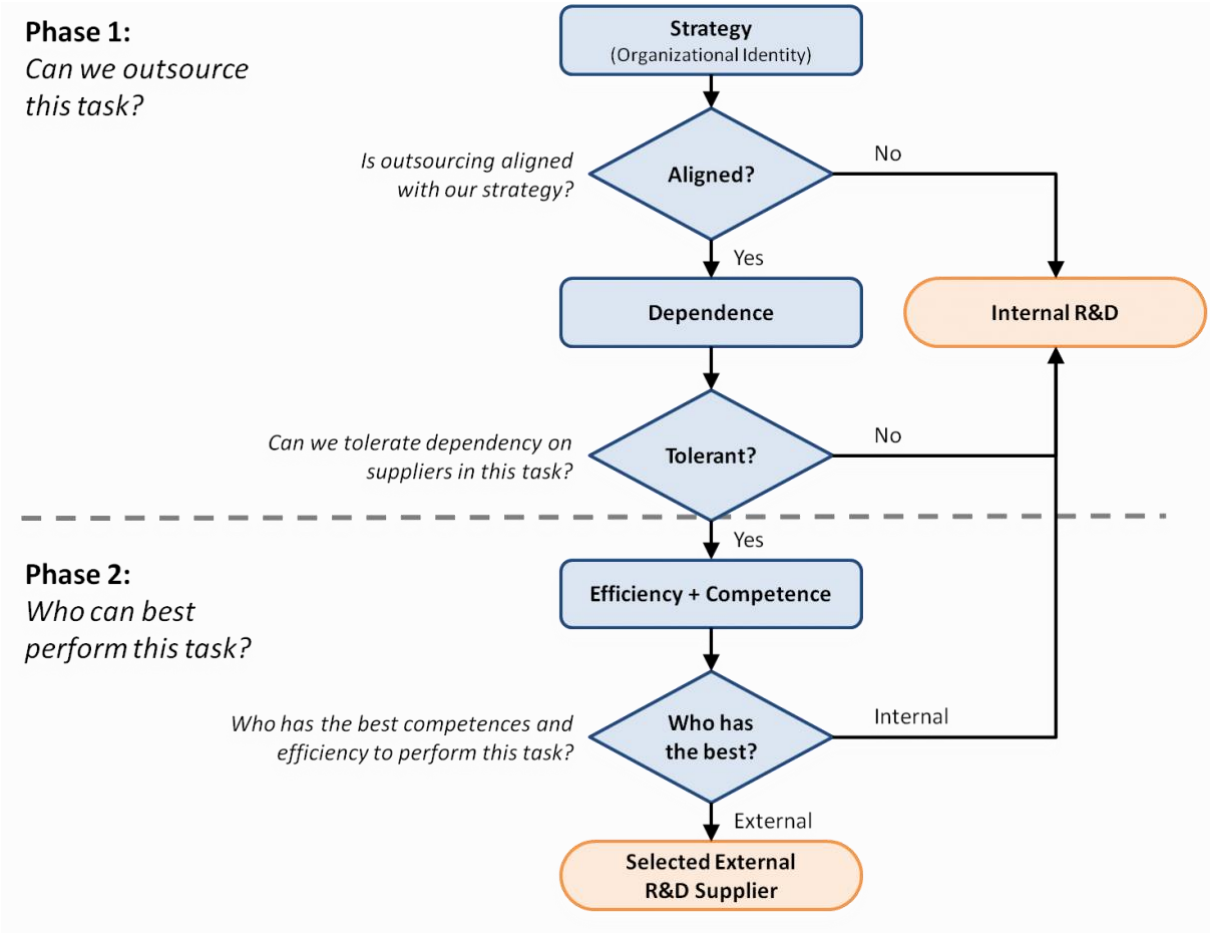
The theoretical literature on outsourcing stems from three frameworks: transaction cost economics operationalised by (Kunttu, 2017); the resource-based view (Barney, 1991) and its extensions such as the knowledge-based view (Grant, 1996a, Grant, 1996b) and the dynamic capability view (Teece et al., 1997); and the relational view (Mol, 2005; Lavie, 2006). Over the past decade these frameworks converged somewhat because of the complementary roles and co-evolution of transactional and capability considerations in the micro-analysis of firm decisions (Odagiri, 2003, Jacobides and Winter, 2005).

In selecting a framework to analyse the decision to use external research and development, we selected the Livari Kunttu model for "Managerial R&D outsourcing Decision- Making", a tool that was based upon the theories we had ventured into within our literature review. The model selected had to be applicable for a company that was technology oriented. The tool highlights, Bäck and Kohtamäki (2015) present example cases of collaborative supplier–customer relationships that were initiated largely on the basis of identity-based decision making, but which over the years of collaboration developed and grew into a form in which they were examined and analyzed in terms of identity, dependence, competence, and efficiency. The primary motivation for developing the R&D outsourcing tool presented in this article is a key conclusion of the work of Bäck and Kohtamäki (2015), which stated that managers' personal views and organizational traditions tend to dominate R&D outsourcing decisions, or alternatively the decisions are made based on a single criterion such as governance cost or competence instead of a broader range of criteria. This conclusion supports the use of objective analysis methods based on rational reasoning in organizational decision making that could challenge accepted practices and conventions.

The tool was developed utilizing interview data obtained in multiple-case studies that examined six key R&D supplier relationships of a leading

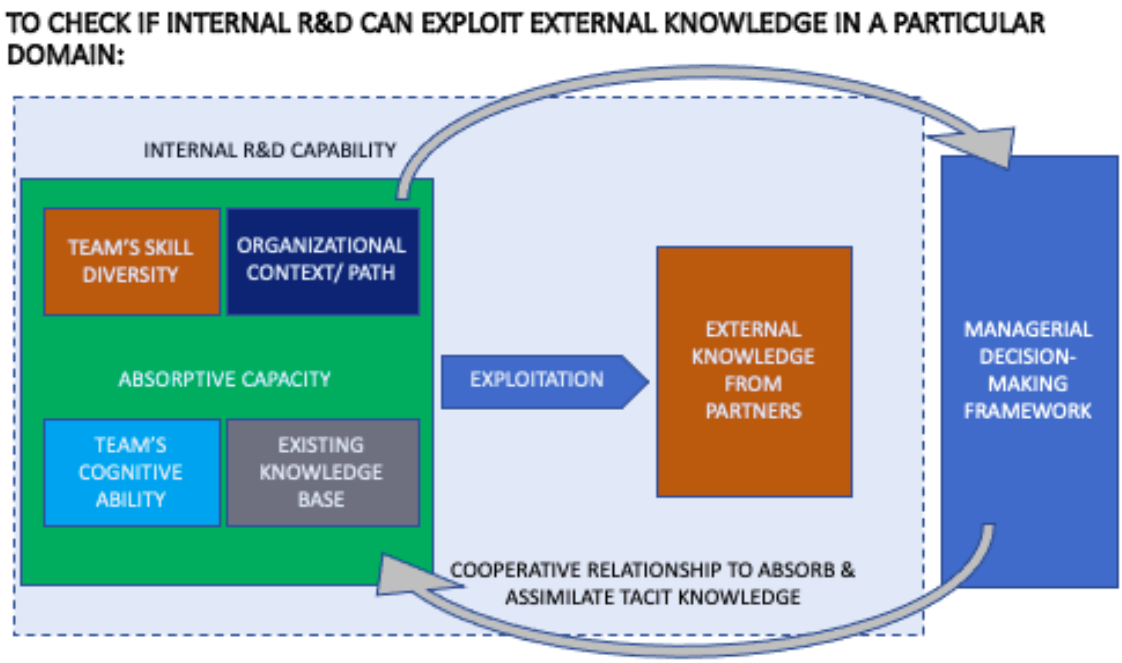
multinational corporation operating in electrical and electronic devices and systems (Bäck & Kohtamäki, 2015). The empirical data collection for the research involved meetings and discussions with senior corporate executives responsible for product development, product management, and research to collect general information on the corporation's R&D activities and supplier involvement strategy. To identify the key factors that affect the outsourcing decisions in the R&D organizations, data on outsourcing decision making were collected in interviews with R&D managers who were each responsible for one of the six collaborative relationships with R&D suppliers. Based on these key factors, which were all related to one of the four conceptions presented earlier in this article, a set of questions concerning the R&D project outsourcing was formulated. These key questions were then reviewed and analysed with the group of R&D managers participating in the interviews(Kunttu, 2017).

The R&D outsourcing decision tool supports make-or-buy decisions in the R&D area. The purpose of the tool is to analyze outsourcing decisions relating to an R&D project or task by using a template comprising two phases as presented in Figure 1. The template presented in Table 1 requires R&D managers to respond to each question related to each conception using a 5-point scale anchored with strongly agree (1) and strongly disagree (5), and to record their reasons for the decision in a description field. In Phase 1, the effect of an outsourcing decision is analyzed based on questions concerning strategy and dependency. Questions related to strategy help managers to consider how much the potential outsourcing of the selected task aligns with their firm's R&D strategy. Empirical observations in R&D organizations (Bäck & Kohtamäki, 2015). suggest that, in many cases, managers must first define the strategic goals of their organization before they can be made available to guide strategy-based decisions. At the end of Phase 1, the tool calculates a summary score for both strategy and dependency viewpoints. These scores provide an indication of whether outsourcing would be an appropriate course of action. Phase 2 involves assessing the expected efficiency and competence of the external supplier candidates against those of the internal R&D function. Again, the tool calculates a summary score for both efficiency and competence, but in this case, the scores are calculated for all supplier candidates and for an internal R&D operation separately. Thus, the user can compare the scores of internal R&D and supplier candidates and use that information as a basis for the outsourcing or insourcing decision.


Phase 1:
Can we outsource this task?
Strategy
(Organizational Identity)
Is outsourcing aligned with our strategy?
Aligned?
No
Yes
Dependence
Internal R&D
Can we tolerate dependency on suppliers in this task?
Tolerant?
No
Yes
Phase 2:
Who can best perform this task?
Efficiency + Competence
Who has the best competences and efficiency to perform this task?
Who has the best?
Internal
External
Selected External R&D Supplier

3.2.a FRAMEWORK DERIVED FROM THE LIVARI KUNTTU MODEL:

Based on this model and our previous analysis of factors involved in firm's decision to outsource, we decided focusing on the internal R&D capability would be a could course of action in deciding if the firm should outsource or not. We studied this decision, based on psychometric tests.



Hypothesis used to frame model:

H1: Absorptive capacity has a positive effect on Internal R&D capability.

H2: Team's skill diversity has an inverse U-shaped relationship to Internal R&D capability and team's collective cognitive ability.

H3: Team's collective cognitive ability(B) has a positive effect on Absorptive capacity.

H4: Existing knowledge base (C) affects Absorptive capacity.

H5: Organizational context (D) affects Absorptive capacity

H6: Internal R&D capability has a positive effect on exploitation of external knowledge.

[text to be updated]

Diversity in the workplace gives firms significant variety and flexibility in organisations that want to make breakthrough innovations. Breakthrough innovation requires a wider knowledge base, and organisations increasingly rely on multidisciplinary R&D teams to identify scientific developments that bridge gaps and reduce time to market. There is supportive evidence that R&D team characteristics influence innovation outcomes, confirming our hypothesising that diversity is a valuable strategy for an organisation to pursue as it provides greater cognitive ability. Each diversity facet however has its own distinct effects depending on the novelty of innovation and industry. Yet, diversity is not solely positive and excessive heterogeneity could be detrimental to R&D team performance. In fact, in their study they found that team's skill diversity has an inverse U-shaped relationship to the team's performance. Our findings suggest that high diversity in gender or skills in cognitively diverse teams might be negative attributes to take into consideration. Senior managers and organisations should therefore consider the appropriate mix of capabilities to benefit from creativity in diverse R&D teams and avoid possible conflict and distrust associated with diversity(Garcia et al., 2016).

The insights to derive from in asserting our relationship of Team's diversity, team's cognitive ability and a firm's absorptive capacity. To analyse this variable, we studied the internal R&D team's using a questionnaire highlighting factors like intrinsic flexibility, general experience and demographic.

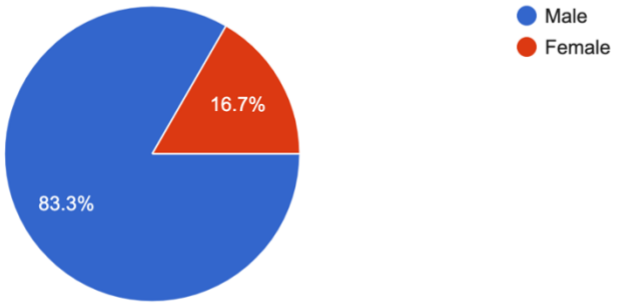
[EXPLAINATION OF HYPOTHESIS USED]

3.2.a Psychometric tools used in case study:

Results of test:

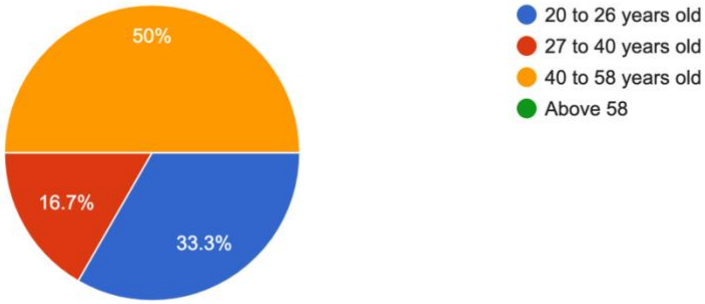
Gender

6 responses



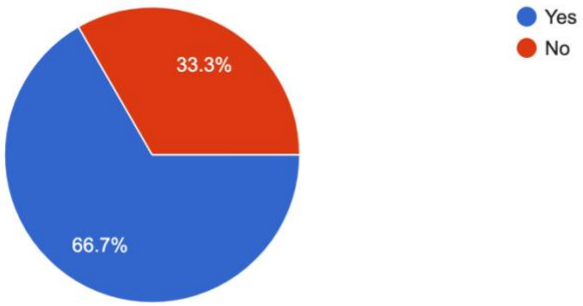
Which age bracket do you lie within:

6 responses



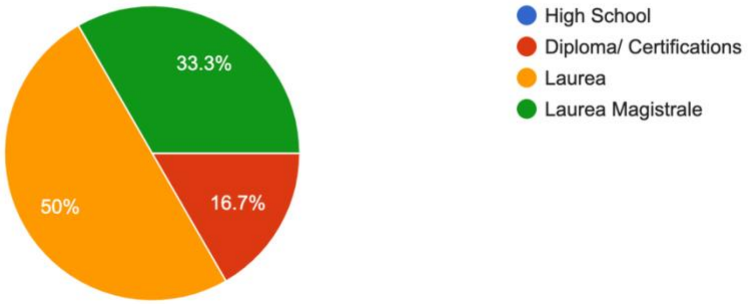
Are you an EU national?

6 responses



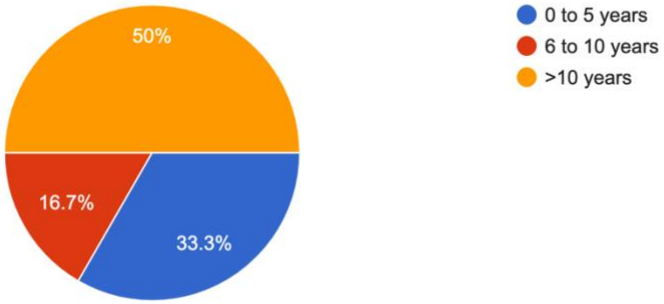
Highest level of education

6 responses



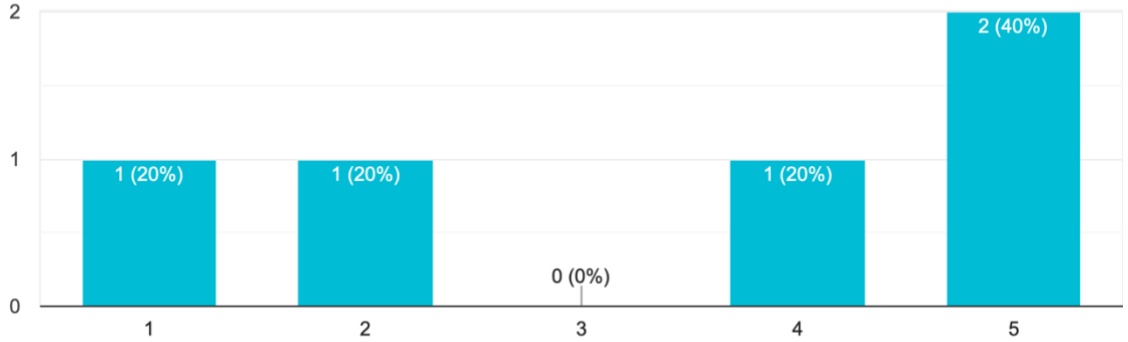
How many years of work experience do you have?

6 responses



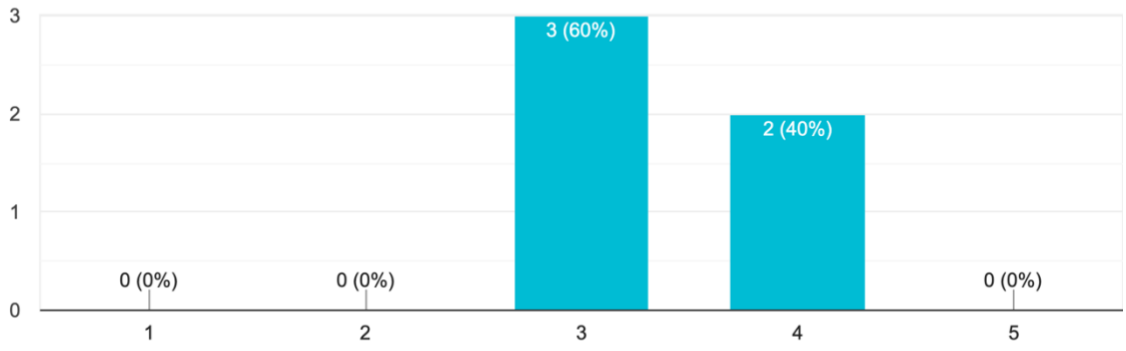
How would you classify your professional experience so far?

5 responses



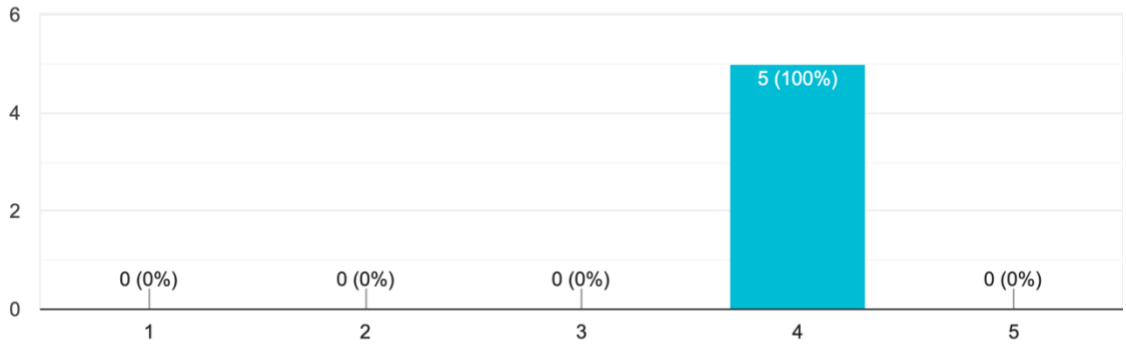
How comfortable are you when you are provided a task outside your area of expertise?

5 responses



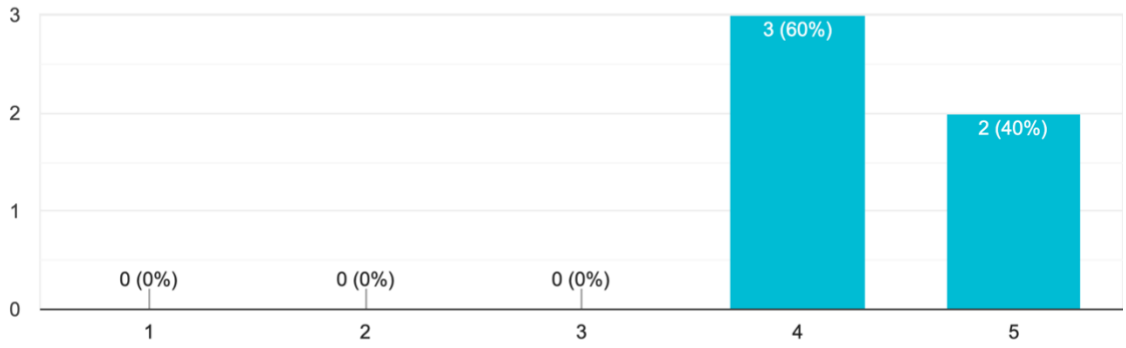
You enjoy working on multiple projects at a time:

5 responses



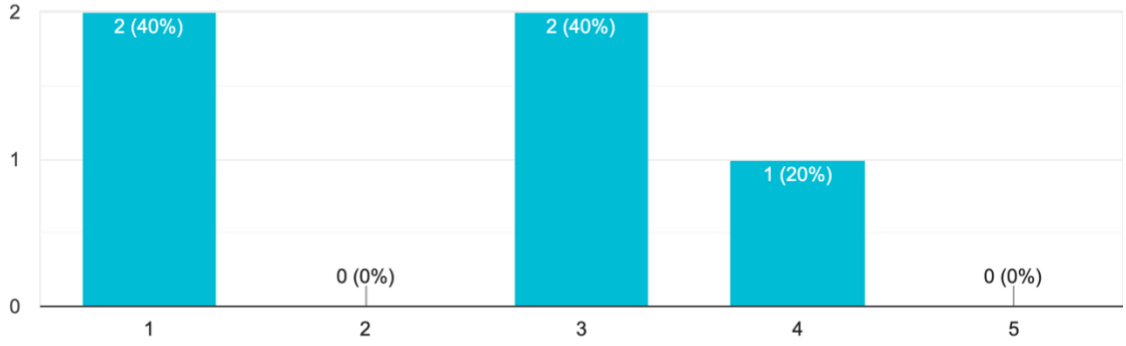
You bought a bunk-bed for your kids from Ikea and now you've got to assemble it. Would you look at the instructions manual to assemble it, as your first step:

5 responses

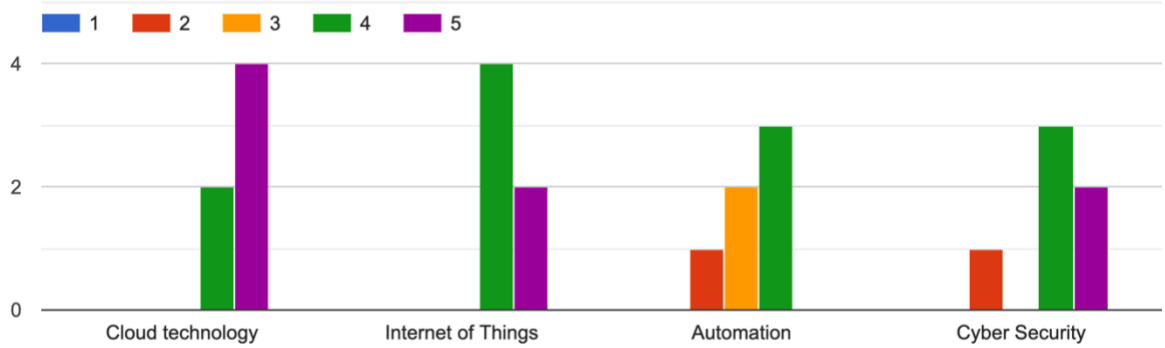


Hypothetically, if you received an air-ticket to travel to Space, but there was a chance that you may not return, would you go:

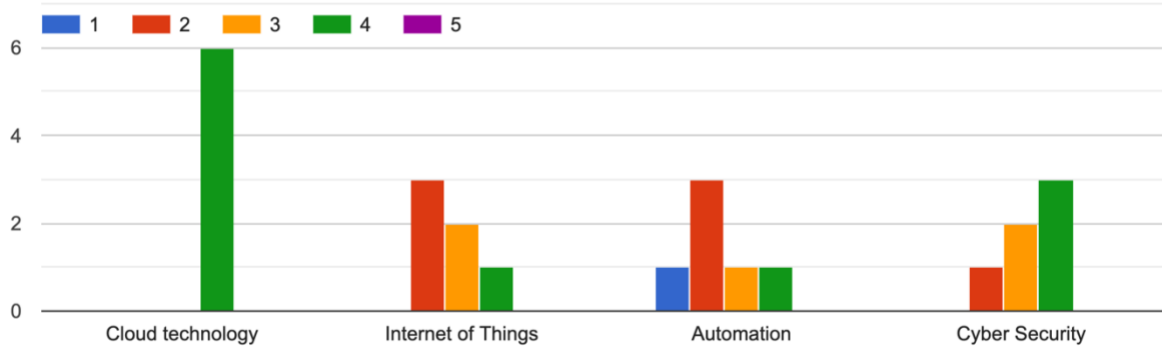
5 responses



How would you rate your interest in the following areas?



How would you rate your know-how and expertise in the following areas? 1- Very Low 5 - Very High



[Inference from psychometric test to be drawn]

3.2.c WHOLE BRAIN MODEL [awaiting results]

3.3 CASE STUDY of Furaco IT Srl

3.4 Conclusion