Opportunity Exploitation in Software Startups. A Human Capital View

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Abstract. *Background* – Transforming a business opportunity to a valid business case is a crucial process of an early-stage software startups. Prior literature on entrepreneurship defines two types of opportunity exploitations, opportunity discovery and creation, and proposes models describing the exploitation processes. The factors affecting a startups abilities to conduct the exploitation are, however, addressed only to a limited extend. *Aim* – This research aims at increasing the knowledge on those factors by studying empirically the effects of the available human capital on the opportunity exploitation processes in software startups. *Method* – We conducted a multiple-case study on a group of software startups in Italy, Norway and Finland. We focused on the founders of the startups, examining their opportunity processes, their human capital, and the interdependencies between the opportunity processes and human capital. *Results* – Our results reveal that both opportunity discovery and creation processes *co-exist* in the early stages of software startups, independently of how the opportunity was initially recognized. The results confirm the findings of the prior research, which point out that *uncertainty* is the key differentiator between the process types. They also highlight *missing human capital* as a key reason for the uncertainty. We conclude that in software startups the availability of human capital plays a bigger role in the exploitation of opportunities than their types, discovered or created, because even exploitation of a-priori existing opportunities turn to opportunity creation processes in case of human capital shortages.

Keywords: Software startup · Opportunity discovery theory · Opportunity creation theory · Product development process · Human capital theory

1   Introduction

Founding a software startup is a realization of a business opportunity. Identifying an opportunity, innovating a product or service fitting to the opportunity, and being able to turn the innovation to a business case are crucial tasks of an early-stage software startup. The phenomena of opportunity exploitation have been studied from the perspectives of business case creation by several authors. Alvarez et al. [1, 2] presented the opportunity discovery and creation theories, and Sarasvathy [3] the effectuation theory. Ries [4], Bosch [5], and Ojala [6] propose startup models describing the processes of a successful business case creation.

The opportunity discovery theory focuses on opportunities that exist independently of direct human involvement, waiting to be discovered by alert individuals or teams [1, 2]. The opportunity creation theory, in turn, suggests that new opportunities are created by individuals or teams working actively to initiate new businesses [1, 2], instead of just looking for existing opportunities. The effectuation theory focuses on phenomena caused by the unavoidable uncertainty of building up a new enterprise [3].

The theories [1–3] and the models [4–6] address the exploitation of opportunities by focusing on the innovations and the processes to create business cases, paying less attention to the new enterprise's abilities to conduct the exploitation processes. That leaves a gap in knowledge, what are the factors affecting these abilities. In this research, we studied the opportunity exploitation in software startups from the viewpoint of the human capital [7]. We opted for human capital (HC) because it was identified as a key contributor of startups' business performance in the prior literature on entrepreneurship [7–9].

For this study, we divided the human capital into three broad dimensions, human capital in business, human capital in software, and human capital in application technology. We defined the application technology as all other technology areas but software, used to implement the product.

The research was conducted on eleven startups in four European locations. We identified the characteristics of the startups' opportunity exploitation processes, defined the founders' human capital, and studied how the human capital affects the exploitation processes.

For our study, we asked the following research questions:

RQ1: What are the characteristics of the software startups' opportunity exploitation processes?

RQ2: What are the effects of the founders' human capital on the opportunity exploitation processes?

Our results indicate that, independently of the circumstances how the opportunity originally appeared, the opportunity exploitation in software startups is a process where 1) the characteristics of both opportunity creation and discovery *co-exist*, 2) the founders take actions typical for one or another theory on a *context-dependent* and *situational* basis, 3) a determining factor of the process type is the *uncertainty*, and 4) the *human capital* is both an origin of, and a means to manage, the uncertainty.

The rest of this paper is structured as follows. Section 2 focuses on the background of and the motivation for the study, reviewing prior research on the opportunity discovery and creation theories and the HC theory. Section 3 presents the research design, including the case selection and research data analysis. Section 4 deals with the results, and Section 5 discusses the study's findings and relevance. Section 6 concludes the paper and offers suggestions for future research.

2 Background

In this section, we review prior research on the opportunity exploitation and the human capital in order to gather the theoretical basis for our empirical study. This study is

based on theories of opportunity creation and opportunity discovery, as defined by Alvarez and Barney in [1], Alvarez et al. in [2], and by Sarasvathy in [3, 10], and on the human capital theory as defined by Becker in [7].

2.1   Prior Research on Opportunity Discovery and Opportunity Creation

The opportunity discovery theory [1, 2] assumes that business opportunities exist as objective phenomena, just waiting for getting discovered. The theory proposes that such opportunities are generated autonomously by changes in competitive imperfections that in turn are based on changes in the business environment. Discovering new business opportunities created by such changes is then depending on an individual's abilities to discover them, on the individual's 'alertness' to the opportunities.

The prior existence of opportunities enables the alert individuals or teams to figure out a product or service addressing the discovered opportunity [1, 2]. The predictability of the exploitation outcome is the key attribute of the discovery theory, out of which its other characteristics derive.

The opportunity creation theory, in turn, proposes that opportunities can be created by actions of individuals or teams [1, 2]. The creation theory proposes that the opportunity creation process itself is the driving force that changes the business environment. It creates totally new customer demands or markets, and creates a slot in the business environment for the new product or service [1, 2]. The non-existence of a prior competitive imperfection means that the outcome of the opportunity creation process cannot be defined in advance. Like the predictability of the exploitation outcome is the key of the discovery theory, the uncertainty of the outcome is the key of the opportunity creation theory.

The key differences of the theories are presented in table 1.

Table 1. General assumptions of opportunity discovery and creation theories [1]

	Opportunity discovery	**Opportunity creation**
Nature of opportunities	Opportunities exist independently of entrepreneurs	Opportunities don't exist independently of entrepreneurs
Nature of entrepreneurs	Differs from non-entrepreneurs in advance by being more 'alert' for the opportunities	Do not necessarily differ from non-entrepreneurs in advance
Nature of decision making context	Risky	Uncertain
Decision making	Decisions based on risk evaluations	Iterative, inductive, and incremental decision making
Human resource practices	Recruitment of task-specific human capital	Recruitment of general and flexible human capital

Sarasvathy studied creation of new firms in [3], and defined an approach of human reasoning to address the uncertainty of the creation process, effectuation, as an opposite of a more traditional causation. She defines effectuation as on actor-dependent process, where the goal is to tackle contingences instead of reaching a pre-defined or known target [3, 10]. Causation, in turn, is a reasoning process driven by a pre-defined target.

The means to reach the target and their selection criteria are defined to fit the target [3, 10]. The key differences of causation and effectuation are presented in table 2.

Table 2. Selected differences of causation and effectuation [3]

	Causation	**Effectuation**
Target	Target is known	Aspirations of possible targets, means for striving for the target
Decision making criteria	Criteria helping to choose between means to achieve the target	Criteria helping to choose between alternatives provided by the available means
Competencies employed	Focusing on utilizing knowledge	Focusing on exploiting possibilities
Nature of unknowns	Predictable aspects of an uncertain future	Controllable aspects of an unpredictable future
Outcomes	Competitive products for existing markets	New products for new markets

An existing opportunity provides an entrepreneur with a possibility to run the process with causation-type reasoning. Creating an opportunity, in turn, is a process where an entrepreneur's effectuation-type actions bring the exploitation from her early aspirations towards more tangible goals.

Ojala reports in [6, 11] a longitudinal study on the business model creation of a Finnish ICT company. The study verifies empirically the opportunity exploitation theories [1–3, 10], stating that an opportunity creation is an iterative process, where the entrepreneur verifies the values of her actions by responses from the markets and adjusts the next steps accordingly. One of the key findings of Ojala [6, 11] is that an opportunity created once isn't necessarily stable, but needs further modifications driven by changes in technology, customer preferences, and markets. Based on the findings, Ojala presents an iterative model for business model creation and development [6].

The lean startup model [12] and the early-stage software startup development model [5] propose iterative processes to validate the business feasibility of an product idea. The validation is implemented in a build-measure-learn (BML) loop, the purpose of which is to identify a product with a problem-solution fit and a product-market fit.

2.2 Prior Research on Human Capital Theory

The HC theory [7] describes the effects of human capabilities and talents on the performance and success of human activities at many levels, ranging from individuals to nations, and finally to the mankind. Applied on entrepreneurship, the research on the HC theory studies individuals' and teams' contribution to a firm's business performance from the viewpoint of capabilities, knowledge, and talents [13].

Bosma et al. studied Dutch startups and found that investing on the entrepreneur's human and social capital had a significant effect on the startups' business performance [8]. Unger et al. [14], in turn, discovered that a priori existing capabilities and skills contributed more to the success of new enterprises than education or learning. Contrary findings were made by Martin et al. [15] indicating that entrepreneurship-specific education was a valid source of entrepreneurship-specific HC.

Shrader and Siegel found that an enterprise's long-term performance was strongly affected by the fit between the enterprise's strategy and the team's experience, especially the team's technical experience [16]. Hatch et al. [17] found that gaining a team's experience from external sources reduced learning.

The relationship between an entrepreneur's HC and the radicalness of the innovation was studied by Marvel and Lumpkin [18]. The study divided the experience in two dimensions, the experience depth and the experience breadth, and concluded that the experience depth affected positively to the innovation radicalness while the experience breadth did not. Partly opposite result was concluded by Lazear indicating that entrepreneurs were generalists with several skills, but not necessarily experts in any specific area [19].

The results of the prior research manifest the importance of the entrepreneur's proper human capital for the success of a new enterprise. However, at a more detailed level they are mixed, giving reasoning for the objective of our study.

3   Research Methods and Design

To answer the research questions, we studied a group of software startups following the guidelines set up by Runeson and Höst for case study research in software engineering [20]. Runeson and Höst propose a five-step process: 1) designing the study, 2) preparing the data collection, 3) collecting the data, 4) analyzing the collected data, and 5) reporting. We opted to use interviews of key persons as the data collection method [20, 21] and a combination of thematic and narrative synthesis as the data analysis method [22], as presented in detail in the following sub-sections.

3.1   Designing the Study

The target group of our study were founders and other key persons of software startups. We interviewed eleven persons from twelve software startups, including one startup in Italy, two startups in Norway, and nine in Finland. Eleven case startups created own software-intensive products, while one offered software services. We contacted software startups in a snowballing process using local startup incubators as the starting point.

Table 3. Descriptions of the case founders.

	Location	Product type	Founders
A	Finland	Embedded product	Team of experienced professionals
B	Italy	SW product	Mixed team of an experienced professional and students
C	Norway	SW product	Team of just graduated
D	Norway	SW product	Just graduated individual
E	Finland	Embedded product	Internal startup team, experienced professionals
F(a,b)	Finland	Embedded products	a) Individual experienced professional, b) team of experienced professionals
G	Finland	SW product	Experienced professional individual
H	Finland	SW product	Just graduated individual

I	Finland	SW product	Team of experienced professionals
J	Finland	Embedded product	Team of experienced professionals
K	Finland	SW service	Team of experienced professionals

The founder F founded first a startup alone and then another as a team member. Both startups targeted to products for the health and fitness business segment, and we handle them in a single case. Out of eleven product-developing startups five had established businesses, two were discontinued, and four had functional prototypes under testing. The service provider had a ready service concept to offer.

3.2 Collecting and Analyzing the Research Data

The research data were gathered by utilizing semi-structured interviews and applying the key informant technique as defined in [21]. Most interviewees were founders or co-founders. One interviewee was a chief executive officer (CEO), who was hired to run the administration, but had a founder-level understanding of his company. The interviews were conducted face-to-face, recorded, and transcribed, following the thematic interview guides [23]. All interviews were held in English.

For the research data analysis we opted to use a combination of thematic synthesis and narrative synthesis, as presented in [22]. We started the analysis with a thematic synthesis utilizing the deductive approach, as presented in [24]. The initial codes of the deductive synthesis were derived from the research questions and from the utilized theories. The thematic synthesis was conducted by using NVivo11 tool. The list of the initial codes is shown in table 4a.

Table 4a. Initial codes of the thematic synthesis.

Code	Description
Founders	Individual founder or a team
Product	Product or service innovation
Opportunity	Business opportunity
Opportunity discovery	Discovery approach utilized
Opportunity creation	Creation approach utilized
Uncertainty	Type of experienced uncertainty and possible ways to manage it
Opportunity realization	Actions taken in the exploitation process of the opportunity, their results, covering both the initial idea and its potential modifications
Human capital	Founders' human capital
Iteration count	Complexity of the iterative opportunity exploitation process, including pivoting [12]
Learnings	Customer feedback and other lessons learned in exploitation

Coding with initial codes revealed that the founder's human capital consisted of several different areas, as proposed by [19]. Based on the initial findings we divided the human capital further to three more detailed codes, as shown in table 4b.

Table 4b. Detailed codes of human capital.

Human capital	Knowledge and understanding on …
HC on business	the potential business, the customers, and the opportunity's value to the customers
HC on software development	software development needed when realizing the opportunity
HC on application technology	application-specific technology other than software

The next step was a narrative synthesis of the research data, as presented in [22]. In the narrative synthesis, we broadened the view defined by the initial codes by two additional viewpoints, 1) the idea background, and 2) the refinements to the idea and the opportunity. In order to outline the strength of the human capital we defined a three level scale, as shown in table 5.

Table 5. Human capital scale for narrative synthesis.

HC	Description
Good	The founder has earlier experience, good skills and knowledge on the specific human capital area, is an expert
Medium	The founder has some experience, reasonable skills and knowledge on the specific human capital area, but isn't an expert
Limited	The founder has no or little experience, missing skills and knowledge on the specific human capital area

4   Results

In this section, we discuss the results of our study. The findings of the narrative syntheses are shown tables 6a and 6b, and summarized in the following.

Most of the founders were experienced professionals. In three cases the founder was a just-graduated person, though founder H had strong software knowledge and work experience in the customer organization. Even experienced founders had areas of limited or missing human capital. HC on software was the strongest area in our study group. Only three founding teams were good in all relevant HC dimensions.

Out of eleven cases we identified three partial opportunity creation and one full creation cases. All partial opportunity creation cases had also characteristics of opportunity discovery. The idea of case F was a totally new innovation. Failing in developing new technology was the main cause of the abandonment of the idea. Both iterative and linear opportunity exploitation processes were identified. The linear ones were tied to founders with good human capital, or to a fairly straightforward product.

All but two cases faced uncertainty during the opportunity exploitation process. We were able to identify three types of uncertainty sources, all typical for startups: 1) problems with technology, 2) problems with customer and markets, and 3) problems with funding. In four cases the application-specific technology was the biggest source of the uncertainty. Not being able to identify and hire competent personnel for software development was the main cause of uncertainty in three cases. Creating the customer base was uncertain in two cases. The main means to cope with the technology-related

uncertainty were iteration and networking. Funding uncertainty was tackled by deploying a variety of funding sources.

Table 6a. Summary of the findings of startups A, B, C, D, E, F

Case	A	B	C	D	E
Founders	Team of three professionals, careers in software industry	Professor, team of students	Two just graduated	Just graduated	Team of internal startup of a mid-sized company
Product	Underwater ultrasound device	Service for photo sharing and selling	Service for selling tickets to events	Intelligent emergency call service	IOT device platform
Idea background	Discovered similar product	Ideas were sought in an academic course on startups	Founders were looking for something to start with	Own accident, entrepreneurship training	Host company set up an internal startup incubator
Opportunity	Simpler, cheaper, and technically better product	Service for s specific customer segment	Simpler and cheaper product, new customer segment	Local variant of a known service with new functionality	Entering growing markets with an IOT platform for multitude of vertical use cases
Discovery	The competitor product	Yet another sales channel for photos	Product discovered through own experiences	Entrepreneurship training, family member's proposal	Idea from a national idea bank by the internal incubator
Creation	How to reach a simpler, cheaper, and better product				
Uncertainty	Targeted customers, technology	Finding customers	Opportunities, personnel, funding	Personnel, funding	None
Realization	Product with different technologies from competitor	Internet service for photo selling, initial base of 32 332 photos from 54 photographers	Internet service for ticket selling	An emergency call with positioning support and personal health information	IOT device platform with versatile functionality
HC business	Medium: founder was a serial entrepreneur	Limited	Limited: just graduated	Limited: just graduated	No data available
HC SW	Good: strong SW experience	Good: strong SW experience	Limited: just graduated	Limited: just graduated	Good: strong SW experience
HC app	Medium experience on ultrasound devices	Not applicable	Not applicable	Not applicable	Good: strong application experience
Learnings	Feedback from early customers	Difficulties in starting business	Difficulties in developing software	Difficulties in developing software	Normal product development
Iterations	Two customer segment and several technical solution iterations	Iterations in customer case creation	One iteration in business ideas, several iterations in team setup and SW development	Several iterations in team setup and SW development	Normal product development
Refinements	Refinements in technical solutions to realize the opportunity	More efforts on service marketing, technical improvements	Changes in team personnel and responsibilities, acquiring more HC	Changes in team personnel and responsibilities, acquiring more HC	Increasing number of vertical use cases

Table 6b. Summary of the findings of startups G, H, I, J and K

Case	Fa, Fb	G	H	I	J	K
Founders	Founder in a startup (a) and a co-founder in another (b)	Founder with long professional career in software industry	Just graduated	Two founders with long managerial careers in software industry	Team with long professional careers in software industry	Team with long professional careers in software industry
Product	Two products for physical exercise	Graphical user interface platform for smart devices	Service for improving aircraft maintenance processes	Internet service for nurseries and families	Wireless anti-noise earplugs	On-site IT support services for industrial customers
Idea background	Several years' maturing periods for both ideas, slow activation	Several years' maturing period	Founder's work in the maintenance of a big airline	Need for new job after lay-offs	Own experiences, lay-offs	Need for new job after lay-offs
Opportunity	New innovations for on-line measurement of human body	Superior UI platform through deployment of latest technology	Ideas how to improve the data management of aircraft maintenance processes	New way for communications replacing manual message sending	Wireless anti-noise earplugs	Highly qualified, professional IT support
Discovery	Slow forethought of both ideas	Own experiences with similar functionality	Own experiences with the aircraft maintenance work	Family member's proposal	Own experiences	Own experiences
Creation	How to create functional solutions	How to create functional solutions			How to create wireless solutions	
Uncertainty	Technology	Technology	None	SW competencies	Technology	None
Realization	Two instruments for human body measurements, a and b, (case a abandoned)	Scalable graphical user interface platform, optimization to small smart devices	Services for improving aircraft maintenance processes	Internet service for communications and photo sharing	Wireless anti-noise earplugs developed	On-site IT support services based on a commercial platform, specific full-time support concept
HC business	Limited	Good: experience in the business of graphical user interfaces	Good: personal experience	Medium: some experience in internet services	Medium: experience on audio functionality of smart devices	Good: strong experience in IT services
HC SW	Good: strong SW experience	Good: strong SW experience	Good: strong SW experience	Not applicable	No data available	Good: strong experience in SW
HC app	Limited	Not applicable	Not applicable	Not applicable	Medium: strong and weak areas	Not applicable
Learnings	Difficulties in application-specific technology	Several implementation approaches trialed, but not offering good enough functionality or quality	Normal product development	Need for hiring persons with software development competencies	How to handle size and functionality requirements	Learnings from customers
Iterations	Two product ideas to the same customer segment, two startups	Two implementation approaches failed, own development finally selected	Minimum-viable product, otherwise normal product development	Normal product development	Normal product development	Normal development
Refinements	Abandonment of first idea due to technical problems, new idea with known technology	Different implementation approaches, focus on software quality	Normal product development	Normal product development	Normal product development	Creation of customer segments and support concepts

5   Discussion

In this section, we first present the answers to the research questions and discuss our findings in the context of the opportunity exploitation theories [1–3, 10, 6] and human capital theory [8, 14, 16–19], [8, 14, 16–19]. Then follows the discussion on the validity of our findings, and their relevance to the academia and to practitioners.

5.1 Answering the Research Questions

RQ1: What are the characteristics of the software startups' opportunity exploitation processes?

In several cases of our study we could identify characteristics of both opportunity creation and discovery processes [1, 2], as well as characteristics of effectuation and causation [3, 10]. Out of eleven cases we categorized four as creation processes. In all four cases the opportunity was to create business by new, ambitious technical solutions that were not existing without the founders' actions. From the business perspective cases A, G and J were, however, fairly clear opportunity discovery cases, because the products were targeted to existing markets with existing products. The innovation of case F(a) was such a new one that even the business case was uncertain.

Out of the seven opportunity discovery cases, five showed clear characteristics of discovery. In those cases the opportunity was existing independently of the founders: similar products were existing and the opportunity was tied to development of a new product for different customer segments or simply to development of competitor to well-known but growing markets. Cases B and H were different. In case B the product was not a new one, neither its development turned out to be technically challenging. However, the exploitation process turned to a creation-type one on the business side. In case H the product was a unique one targeted for a unique customer. There were no similar products nor competitive imperfections, but the exploitation process created a new slot in the business environment [1]. However, it was a most typical opportunity discovery process with an alert individual, a predictable outcome, and the uncertainty tackled already before founding the enterprise by a successful minimum-viable-product [12].

RQ2: What are the effects of the founders' human capital on the opportunity exploitation processes?

The human capital of the founders of our case startups varied from very strong to weak. HC on software was the most common good HC dimension. HC on business and on application-specific technology could be limited also in cases of founders with a good HC in software.

In our cases existing or missing HC was not identified as a direct determining factor between the initial opportunity creation and discovery. Out of the four opportunity creation cases, only one founder had a strong expertise in all relevant HC dimensions. Similarly, in cases with opportunity discovery, the founders' HC compositions varied from limited to good in all three HC dimensions.

The founders' HC profiles had a strong correlation with the uncertainty and the iterative nature of the opportunity exploitation process. Missing HC in a certain HC dimension tended to predict iterative processes, and good HC linear processes, though there were variations to both directions.

Compensation for the missing HC was common in our research group. The research data reveal that the typical compensation means varied between the HC dimensions: 1) in case of business HC a common compensation was based on networking, 2) in case

of software HC on hiring qualified work force, and 3) in case of application HC on networking and learning by iterating.

5.2   Findings on Opportunity Exploitation in Software startups

Our categorization of cases to creation and discovery, presented in section 5.1, is a simplifying overview based on the direction a particular case tends to incline. More significantly, our results indicate that in a practical situation the opportunity creation and discovery characteristics *co-exist* in the very same opportunity exploitation process – not only offer two explanation models of it. The founders' actions according to a specific theory and utilizing a specific reasoning model seems to be a *context-dependent* and *situational* choice varying over the topics of the opportunity exploitation process.

The uncertainty, mentioned as a differentiator between opportunity creation and discovery in [1], was identified in both creation and discovery cases. What are then the factors causing the uncertainty, and leading to a parallel deployment of creation and discovery processes?

We seek the answer by taking a look on the iteration, learnings and refinements rows of tables 6a, 6b, and 6c. The cases with a linear development process and learnings and refinements along to a normal product development carried characteristics of opportunity discovery processes. Excluding case I, the cases were characterized by founders being relatively good in relevant HC dimensions, business, software, and application. In case I the founders could compensate for their HC shortages through networking and recruitment, leading to a linear opportunity exploitation process.

Excluding case G, the iterative cases were characterized by shortages in one or several human capital areas. In case G the founder had strong experience in all relevant HC dimensions. He needed, however, three iteration rounds to figure out the technology solutions that fulfilled the functionality and quality targets he defined for the product.

The research data coded as learnings reveal that in the cases with a linear development process the learnings were such experiences from own actions and customers that are typical in a managed product development. In the iterative cases, in turn, the learnings were related to the founders' shortages in one or several HC dimensions.

Our findings gave a mixed picture of the nature of the entrepreneurs compared to the non-entrepreneurs. The opportunity discovery theory assumes that the entrepreneurs are more alert to the existing opportunities than non-entrepreneurs, while the creation theory points out the entrepreneurs' focus on contingencies [1]. The research data reveal that all founders but two were actively looking for new opportunities, but the level of alertness, sources of the ideas, and focus on contingencies varied.

By combining two crucial elements of a software startup's early stages, the business opportunity and the founders' capabilities to exploit it, our study deepen the knowledge on how software startups are created. It gives new perspectives to Ries' lean startup model [12], which has in the recent years gained popularity among the startup researchers. It indicates that iterative learning, as proposed by the lean startup model's build-measurement-learn cycle, happens not only in the customer interface but also internally in a startup, covering both the business-related and the technical aspects.

5.3 Effects of Human Capital on Opportunity Exploitation in Software Startups

The results of our study are in line with the results of studies on the human capital [8, 14, 16], pointing out the value of the entrepreneur's HC to the startup's business performance. The entrepreneur's good HC in relevant areas seems to make the opportunity exploitation process smoother and faster, which in turn lays a better basis for the enterprise's overall success and performance. The results do not, however, support the findings of [17], claiming that HC from external sources would be less valuable for startups. Instead, in our cases HC from external sources seemed to be a common and successful compensation for the founders' HC shortages.

We could identify the two dimensions of HC pointed out in [18], HC depth and breadth. From the perspective of HC, our results indicate that shortages in any HC dimension of our study increase uncertainty and iteration. The findings of [19], indicating that entrepreneurs are generalists without being experts in any specific area, were not fully supported in our study.

We could identify the unbalance between the human capital and the challenges as the key reason for the uncertainty. Especially clear the relationship was in cases where challenging application-specific technology was needed. In two cases, the founders' HC shortages prevented them from hiring competent software development resources, which was then the key source of the uncertainty.

The above reveals two items in our research determining between opportunity creation and discovery as well as between effectuation and causation: 1) the founders' own human capital, and 2) their possibilities to compensate for the shortages. As long as there are HC shortages the exploitation process tends to be iterative and follow the characteristics of the opportunity creation [1–3, 10] – independently of whether the opportunity originally was an existing discovered one, or a created one. Correspondingly good, available HC tends to direct the exploitation process towards the opportunity discovery type [1–3, 10].

5.4 Validity Discussion

We discuss the validity of our findings from four viewpoints, construct validity, internal validity, external validity, and reliability [20].

The construct validity concerns whether the operational measures that are studied really represent what the researcher has in mind and what is investigated according to the research questions [20]. We conducted our study by using well-established research methods for qualitative research. We used semi-structured interviews of the founders of software startups for gathering the research data [21]. The interviews and data analysis were conducted by the first author. His over thirty years' long career in software industry helped him to analyze the interview data in accordance with the real characteristics of the study cases.

The internal validity concerns examination of causal relations [20]. When studying whether a factor effects the investigated factor, other uncontrolled, possibly unknown factors may affect the investigated factor and threaten the internal validity of the

research [20]. From our research data, we were able to identify a relationship between an iterative exploitation process and the shortages in the founders' human capital. There may be, however, other factors leading to an iterative exploitation process, not covered in this research. Therefore, we can only conclude that missing human capital seems to be one source of uncertainty.

The external validity concerns the generalizability of the findings [20]. The limited amount of study cases restricts the external validity of our findings, though the research covered a fairly broad palette of different cases in several geographical locations.

Reliability concerns the dependency of the data and analysis on the specific researcher [20]. To address the reliability issues we utilized peer work in our study. The interview schema was created together with two experienced researchers. All interview data was recorded, and the data was transcribed by an external transcription service. Analyzing the data and concluding the findings was done by the first author and reviewed by the co-authors.

5.5   Relevance to Academia and Practitioners

We studied the early stages of software startups, identifying and exploitation the business opportunities, from the perspective the founders' human capital, their capabilities, knowledge, and experience. Our research had an empirical focus, studying the real-life embodiments of the utilized theories. Our results give the academia new interesting research perspectives by indicating that the two theoretical approaches for opportunity exploitation, creation and discovery processes [1], co-exists in the early stages of the same software startup. In our study, we focused on the founders' human capital as a factor affecting the deployment of these two processes. Our study gives a model for future studies of other factors affecting opportunity exploitation in software startups.

By having a practical focus our study provides new entrepreneurs with in-depth knowledge on how to bring a discovered opportunity or an opportunity aspiration towards more tangible ideas and products. Our study indicates that a successful exploitation of an opportunity requires a broad palette of technical and business-related human capital. It points out that an entrepreneur needs access to that human capital, and proposes that networking, hiring capable work force, and learning by iterating are the basic means to gather it.

6   Conclusions and Future Research

In this study we empirically explored how a group of software startup founders exploited the opportunities, on which the founders were building their startups. We utilized the multiple-case study method, collecting the research data from semi-structured interviews of the founders or founding team members. We identified embodiments of both the opportunity creation and discovery theories in the same opportunity exploitation processes. We found that missing human capital was a reason for the uncertainty typical for opportunity creation and effectuation cases. We further

identified that the uncertainty caused by missing human capital was tackled by networking, hiring capable work force, and learning by iterating.

Our results indicate that the deployment of either the opportunity creation or the discovery processes was context-dependent and situational, varying not only between the case founders, but also between different problem areas of the same process.

The case startups were all located in West-Europe. Studies with bigger sample sizes and geographical coverage would be necessary to validate and generalize our results. Studies seeking for other factors effecting the deployment of the opportunity discovery and creation processes, would deepen the knowledge gathered in this study.

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