Business Plan

track it
accurate mobile positioning

"TrackIT provides a revolutionary mobile positioning technology that calculates ones position more effectively than current solutions."

Team:
Eric Graf | Maximilian Hoene | Arra Khararjian | Manuel Noras
Fredrik Tufvesson | Johan Karedal | Anders J Johansson

May 6th, 2011

Note: This business plan has been revised for publication purposes

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I. EXECUTIVE SUMMARY

Throughout the last several years, mobile positioning has taken on an increased role in user function. However, current methods do not work well indoors, are power consuming and not as accurate as users desire. Our technology will change the way users get their mobile positions.

Scientists at Lund University have been researching in the field of mobile positioning systems in order to take interactive localization to the next level. Our research team has come up with an algorithm that relies on core components of most modern mobile phones (accelerometer, gyroscope, antenna, processor) to provide customers with enhanced mobile positioning possibilities by allowing mobile phones to efficiently calculate their positions both indoors and outdoors with estimated accuracy levels of 5-10 meters.

Through licensing agreements with chip manufacturers and strategic partnership with Original Equipment Manufacturers (OEMs - here: Mobile Phone Manufacturers) and Carrier Service Providers (CSPs), TrackIT will work towards having the algorithm embedded into mobile phones. We expect to break even by year four of operation. A patent for the technology was filed in May 2010 and is currently pending.

Our team consists of seven professionals whose skills complement each other to give TrackIT an attractive balance of business and science. The management team consists of four Masters in Entrepreneurship students and the research team is composed of three PhD Scientists from Lund University.

This business plan describes the commercialization process of this innovation, identifying several steps that need to be taken into consideration.

II. OUR STORY

In early 2008, Lund University Associate Professor Fredrik Tufvesson and his team were conducting a research project about directional properties of radio channels when they thought about how nice it would be to use measurements from a person running with an antenna over a large area. This would result in a never been seen before resolution for directional estimation using a vast array of antennas and having hundreds of virtual antenna elements present. With these ideas in mind, TrackIT's technology was born.

After additional research and several rounds of discussion, Fredrik and his team discovered that with a single antenna element and accelerometer (used on aircrafts to calculate positioning), the idea could become feasible. Early investigations were done and the results, combined with previous knowledge from earlier projects, were promising enough for the team to move forward with the idea and implementation of this technique in positioning involving base station triangulation.

With the advent of the iPhone and other new highly functional Smartphones, the market for positioning services was and still is in its early stage, and promises to become the "New, New Thing". Fredrik realized that if this technique really worked as theorized and also worked indoors, it could have tremendous commercialization potential because of the limitations of existing positioning techniques.

The project was offered to and accepted by a team of four Masters in Entrepreneurship students who currently form the management team. With the researchers technological ideas and the entrepreneurs commercialization dreams, the business of TrackIT has begun to take shape.

PART 1:
BUSINESS IDEA

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VALUE PROPOSITION

The value and customer savings of this technology cannot simply be put in monetary terms at this point, but several customer benefits can be identified:

TrackIT's technology will significantly improve the accuracy, especially indoors, of navigation and location based services in general, and thus adds value to a mobile phone by improving its functionality. Location Based Services (LBS) are those services that use the knowledge of the users' location to provide appropriate information like weather, nearby stores, etc. Specifically, our technology can increase the performance of: mapping and directions, advertisements, gaming, indoor tourism, parental control, rescue services, social networking etc.

Navigation and location-based services have been growing, catching attention and attracting more and more consumers, implying that consumers are willing to pay a premium for improved services of that kind. OEMs can therefore gain a competitive advantage by having our technology integrated in their mobile phones.

Additionally, the technology will make everyday use of mobile devices more convenient. The energy-consuming GPS chip built into mobile devices will not necessarily become obsolete, but will be used less. This means that the mobile device does not need to be charged as often, which adds to the convenience of the mobile phone user experience.

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PART 2:
TEAM

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TEAM

Eric Graf, Maximilian Hoene, Arra Khararjian and Manuel Noras are assigned by Lund University researchers Fredrik Tufvesson, Johan Kåredal and Anders J Johansson to carry on the commercialization of the technology. In addition, Lund University's technology transfer office LU-Innovation helps the team with business advice, patent applications and financing. At this point the ownership is held by the researchers. A letter of intent determining the parameters of the collaboration was signed by all three parties on March 1st, 2011.

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LUND UNIVERSITY

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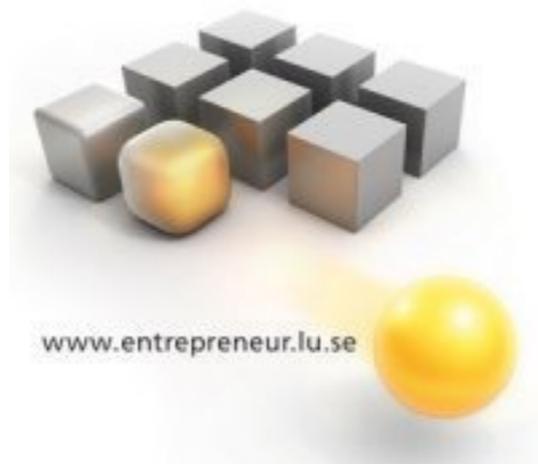
MANAGEMENT TEAM

Eric Graf

Growing up in a family of diplomats, Eric lived in many different countries and experienced their cultures. After completing high-school in New York, he spent a year in the army as a tank driver in an armored infantry battalion. The forms of hierarchies in the army inspired him to study organizational structures during his liberal arts degree in The Netherlands, approaching this topic from the fields of psychology and economics at the same time. Following his graduation, he worked in Corporate Human Resources at BOSCH and later joined a small project oriented consultancy in Berlin, focusing on the socio-technological implications of renewable energies, biogas in particular. Eric brings into the project an affinity to technology in general and team management skills in particular.

Maximilian Hoene

Maximilian holds a master degree in business from Freie Universität Berlin, Germany. He specialized in strategic management and marketing. He has worked in the international marketing and sales department at Volkswagen AG. His team successfully developed pricing strategies for Volkswagen cars in various international markets, such as Africa, the Middle East and Russia. His expertise will help find a suitable business model to carry the project into the future.

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MANAGEMENT TEAM

Arra Khararjian

Arra holds a degree from the University of California, Davis in Economics. He worked for two years as the Junior Financial Analyst at Lieff, Cabraser, Heimann, & Bernstein, a nationwide plaintiffs class action law firm where he worked extensively on major class action lawsuits and investigations. Arra also has interned at ETX Capital (formerly TradIndex) in London as a trader support intern where he worked on various projects including the marketing and promotion of TradIndex. Arra will assist with finance and legal issues.

Manuel Noras

Manuel has a bachelor degree in Business Administration and ten years working experience in the healthcare industry. At University Manuel achieved valuable knowledge in managing, developing and organizing businesses. He worked in product and trade show management as well as company organization, business communication and marketing strategies. Manuel explored various markets and business cultures. His practical and theoretical background helps the team to manage the young company and find smart commercialization strategies.

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RESEARCH TEAM

Fredrik Tufvesson, PhD

Fredrik Tufvesson received his M. Sc. degree in Electrical Engineering in 1994, the Licentiate Degree in 1998 and his Ph. D. in 2000, all from Lund University. After two years at a start-up company developing mesh network technologies, Fredrik is now working as associate professor in Radio Systems at the Department of Electrical and Information Technology at Lund University. His main research interests are channel measurements and modeling for wireless communication, including channels for both MIMO and UWB systems. Fredrik is a previous Venture Cup winner and is co-founder of ResQU AB, a start-up company providing equipment for cell phone based search and rescue operations.

Johan Kåredal, PhD

Johan Kåredal received his M. Sc. degree in Engineering Physics from Lund University in 2002, and his Ph. D. in Radio Systems in 2009. Currently he is a postdoctoral fellow of the Communications group at the Department of Electrical and Information Technology. His research interests includes channel measurements and modeling for multi-antenna (MIMO) systems and ultra-wideband systems (UWB).

Anders J Johansson, PhD

Anders J Johansson received his M. Sc. (1993), Licentiate (2000) and Ph. D. (2004) degrees in Electrical Engineering from Lund University. From 1994 to 1997 he was with Ericsson Mobile Communications AB developing transceivers and antennas for mobile phones. Since 2005 he is an Associate Professor at the department of Electroscience at Lund University. His research interests include antennas and wave propagation for medical implants as well as antenna systems and propagation modelling for MIMO systems.

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BOARD OF DIRECTORS

Fredrik Tufvesson, PhD

Along with being the head of the research team Fredrik will also be part of TrackIT's Board of Directors.

Sven Olsson

Sven is Business Development Manager at LU Innovation and represents the technology transfer office at Lund University. The mission of LU Innovation is to facilitate the transfer of knowledge created at Lund University into commercially approachable innovations. Sven was also the CEO of Signal Control Sweden AB where he brings 15 years of working experience within the Professional Training & Coaching industry to the Board of Directors

Tomas Karlsson, PhD

Tomas has several years of international educational experience, as a PhD student at Stanford and the University of Alberta; and as a post-doctoral fellow at Wilfrid Laurier University and Queensland University of Technology. Since fall 2009, he has been employed as Associate Professor in Entrepreneurship at Lund University. He is currently responsible for the Master program in Entrepreneurship.

TBA

Currently we are working on the recruitment of a highly experienced person, both from a technical as well as a management side, from the cellular industry. At this point in time, no names are mentioned in order to avoid premature announcements and guarantee individual privacy until official appointment.

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PART 3:
MARKETING PLAN

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INDUSTRY ANALYSIS – MOBILE PHONES

Chip	OS	**OEMs**	CSPs	LBS	Consumer

Further explanation in Appendix 1: Value Chain - Mobile Phone Market
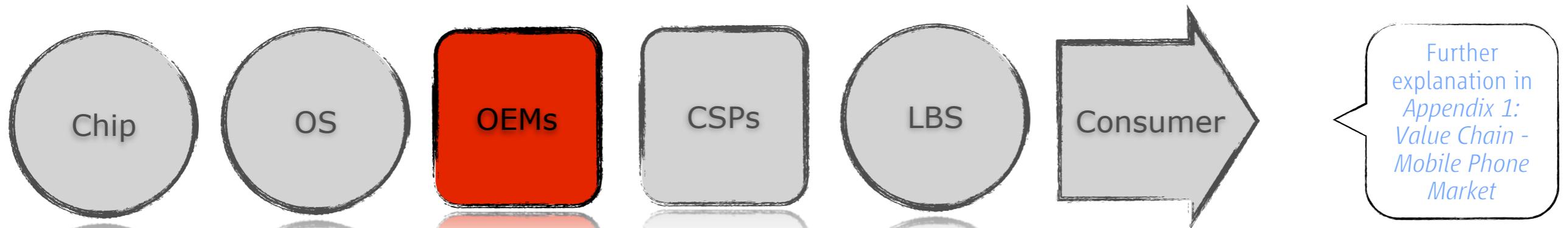
"The mobile phone market has the wind behind its sails," said Kevin Restivo, senior research analyst with IDC's Worldwide Quarterly Mobile Phone Tracker. IDC believes the worldwide mobile phone market will be driven largely by smartphone growth through the end of 2014. "Feature phone users looking to do more with their devices will flock to smartphones in the years ahead," noted Restivo. "This trend will help to drive the smartphone sub-market to grow 43.7% year over year in 2011."

In fact, according to Gartner, Inc. an information technology research and advisory firm headquartered in Connecticut, USA, Smartphone sales already grew 96% in the Q3 2010 from Q3 2009, and smartphones accounted for 19.3% of overall mobile phone sales in the Q3 2010.

The most recent analysis of the mobile phone market is based on sales from Q4 2010. According to the International Data Corporation (IDC) Worldwide Quarterly Mobile Phone Tracker the worldwide mobile phone market grew 17.9% in Q4 2010, a new quarterly high driven by smartphones. This growth accounts for the fourth consecutive double-digit increase in sales year-on-year. Mobile phone sales increased to 401.4 million units in the Q4 2010 compared to 340.5 million units in the Q4 2009. On a cumulative worldwide basis in 2010, a total of 1.39 billion units were sold, an increase of 18.5% from the 1.17 billion units sold in 2009.

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INDUSTRY ANALYSIS – MOBILE PHONES

The mobile phone market is dominated by two major players with Nokia (33% market share) and Samsung (25% market share) providing more than 50% of the mobile phones to the world based on data from Gartner Inc. in 2010. Several companies also hold strong positions in the market with relation to market share: LG Electronics holds 8%, Research In Motion (RIM) and ZTE both hold 4%, and Sony Ericsson holds 3%. Other OEMs combined make up the final 28% of the market. Although Sony Ericsson is one of the smaller players with respect to the market, their geographical proximity being headquartered in Lund and connections with Lund University, MHBC and other local organizations make it a prime potential customer for TrackIT (see *Part 2: Team: References).*
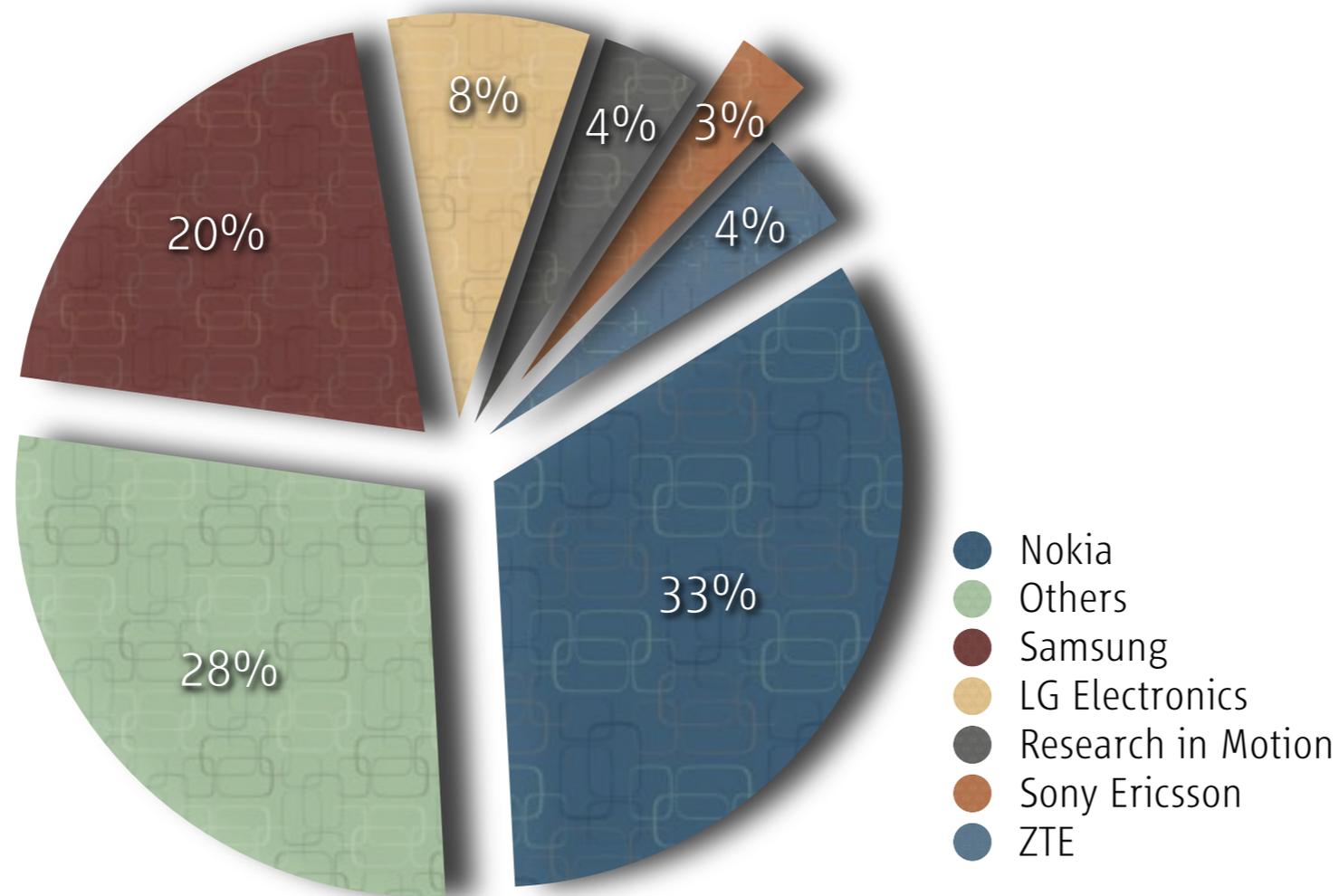

Figure 2: Mobile Phone Manufacturer Market Share (2010), according to data from IDC

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INDUSTRY ANALYSIS – INDOOR LBS

Chip	OS	OEMs	CSPs	**LBS**	Consumer
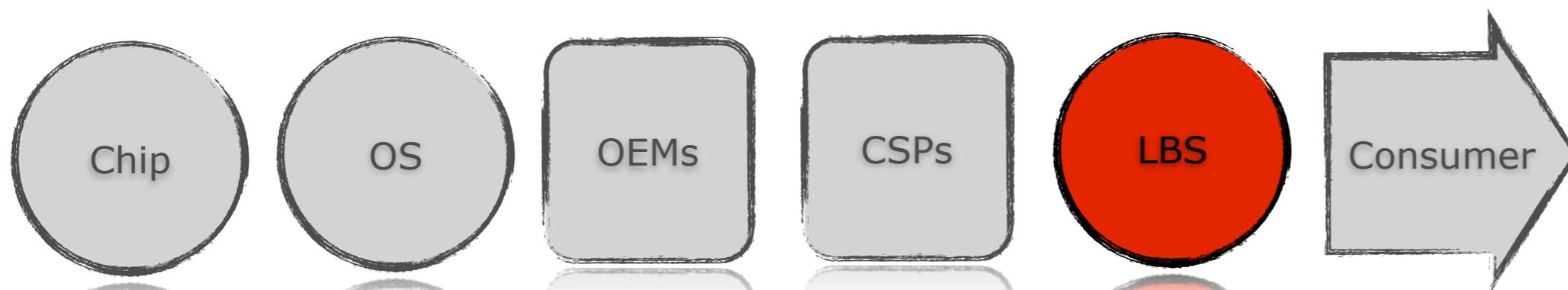
> "INDOOR POSITIONING IS A PROBLEM THAT IS OF LARGE INTEREST FOR THE INDUSTRY WAITING TO BE SOLVED." (Mats Lindoff)

Location based services (LBS) have arrived and are becoming an integral part in the everyday life of millions of consumers. In fact, Juniper Research predicts that location based services will result in revenues of over $14 billion USD by 2014, with the greatest revenues coming from Western Europe. TrackIT has identified key areas where the technology can be used indoors and create sustainable customer benefits:

Point-of-Sale Advertising: "Location-based applications are extremely interesting for brands and retailers in that they allow those companies to direct consumers to outlets in their vicinity while simultaneously providing information about the products on offer." - Gartner Inc.

Office Management: More accurate indoor positioning can help employers keep operations smooth by allowing employees in large buildings find an open meeting room or find a colleague. Employers can also track data patterns and behavior of employees to improve the working condition and optimize space.

Airport Management: Airline operators can give passenger notifications and manage crowds and staff during chaotic times. Passengers can receive advertisements for food and shopping depending on their location in the airport.

Check-in Applications: Companies like Foursquare, Gowalla and Facebook places can move from manual to automated check-ins. That is both more user-friendly and provides a new window of opportunity to expand on location-based targeting, servicing dynamic offers based on for instance which section you are in at Walmart.

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TECHNOLOGICAL DIFFERENTIATION

	Technological Infrastructures		
	GPS	Wifi	BSB
Accuracy			
Availability			
Battery life			

Legend: high / medium / low

GPS modules embedded in every smartphone today consume a fair amount of battery power. When turned on, the GPS module on any given mobile phone drains the battery power on an average of five hours, even if no other function of the phone is being used such as calling, texting or playing music. GPS requires line-of-sight to satellites and thus does not work indoors.

A current alternative to GPS is the traditional network based positioning by base station based (BSB) triangulation. BSB triangulation is a matter of intersection of three signals and uses signal strength as a distance measure, which has proved to be inaccurate.

A third infrastructure for mobile based positioning is Wifi. Due to the uncertainty of Wifi-station locations, accuracy and availability levels are worse than GPS, however the accuracy levels are better than BSB technologies. Battery life using Wifi based positioning is better than GPS but worse than BSB.

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COMPETITION

Currently there are several companies engaging in similar research, such as Skyhook (Boston, USA), arguably the most prominent player in the indoor positioning market. Skyhook's Core Engine is a software-only location system that quickly determines device location with 10 to 20 meter accuracy. To arrive at accurate location results, the Core Engine collects raw data from Wifi access points, GPS satellites and cell towers with advanced hybrid positioning algorithms. Skyhook has deployed drivers to survey streets, highways, and alleys in tens of thousands of cities and towns worldwide, scanning for Wifi access points and cell towers plotting their precise geographic locations. Skyhook's coverage area includes most major metro areas in North America, Europe, Asia, and Australia.

GloPos, a spin-off of 4TS Corporation with offices in Dubai and the USA, promises to show the precise position of any cell phone outdoors, indoors, even underground as long as the phone is on the network through a data connection. GloPos independent tests claim accuracy of 7.7 to 12.5 meters indoors or in urban settings and 10-40 meters in suburban geographies. It is based on the cell phone collecting signal information from multiple base stations, then forwarding that information to the GloPos server.

Qubulus (Sweden) and Ekahau (USA) use radio based finger printing technology. With fingerprinting the mobile device is listens radio signals from surrounding networks. The measured signal strength patterns are then used to identify a specific spot indoors. Building up a grid of those spots linking it to a map creates the positioning. Accuracy is supposed to be at least 5-15 meters.

COMPETITION VS. TRACK IT

	qubulus ekahau	SKYHOOK°	GloPos	track it accurate mobile positioning
Accuracy	5-15m	7.7 - 12.5m	10-40m	5-10m
Indoor positioning	✅	✅	✅	✅
Server & Mapping independency	❌	❌	❌	✅
Maintenance costs	🟡	🟡	🟡	FREE

TrackIT's technology has strong advantages compared to its competitors. Companies like Skyhook and Qubulus offer applications for the end consumer that rely on external servers for operation. This can lead to unreliable service should those servers fail. However, TrackIT will aim to integrate its technology into the processor chip of the mobile phone, giving OEMs more control over the final product/service. Moreover, the expected accuracy level of 5-10m outdoors and indoors is the most accurate non GPS based technology on the market. Since our technology is built upon a triangulation positioning algorithm that only requires two available base station signals, TrackIT does not require any server or database for information on Wifi station location, GPS signals or wireless base station signals to operate. This server independency allows for no maintenance costs after the algorithm is embedded in the chip and makes it easier to integrate for potential customers. In order to get an overview of the full competitive landscape please see *Appendix 2: Full Competition Comparison*.

PART 4:
BUSINESS SYSTEM & ORGANIZATION

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POTENTIAL COLLABORATION PARTNERS

We aim to become part of MHBC and the Teknopol network. Through MHBC we have access to various consultants with many years of industry experience. Also, with this collaboration we will be able to introduce our technology to big players in the industry such as Sony Ericsson and ST Ericsson. TrackIT also has full support from Lund University, LU Innovation, and the Entrepreneurship program.

ORGANIZATION

For our organizational structure we choose a traditional approach. The management team and research team will work hand in hand on this joint effort. Each with their competencies at the core of their respective competence within the organization. The board will meet on a regular basis with the management team to assume its supervisory and advisory role. Keeping an eye on the future, all board members as well as those of the research team are expected to be stationary in Lund for the next 2-5 years, at least.

As for the management team: At the time it was composed, the possibility of one or more members leaving by the end of June '11 was taken into account. It was agreed upon, that in any case, Eric Graf and Maximilian Hoene will remain in Lund as the core of the management team beyond the conclusion of their masters degree in Entrepreneurship if the feasibility of the business continues to remain high and adequate funding is secured.

The composition of the board is in accord with the rules and regulations of LU Innovation. One representative from the University and LU Innovation each will be in it, as well as Fredrik Tufvesson himself. The fourth member, as required by LU Innovation, will be an external business adviser, a highly experienced person, both from a technical as well as a management side, from the cellular industry.

We believe that this set-up will guarantee a flexible yet highly sustainable internal structure which reduces the stress on the need for external funding due to the minimization of labour costs.

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ORGANIZATIONAL STRUCTURE

BOARD OF DIRECTORS

CTO

CEO

MARKETING

BUSINESS DEVELOPMENT

FINANCE & LEGAL
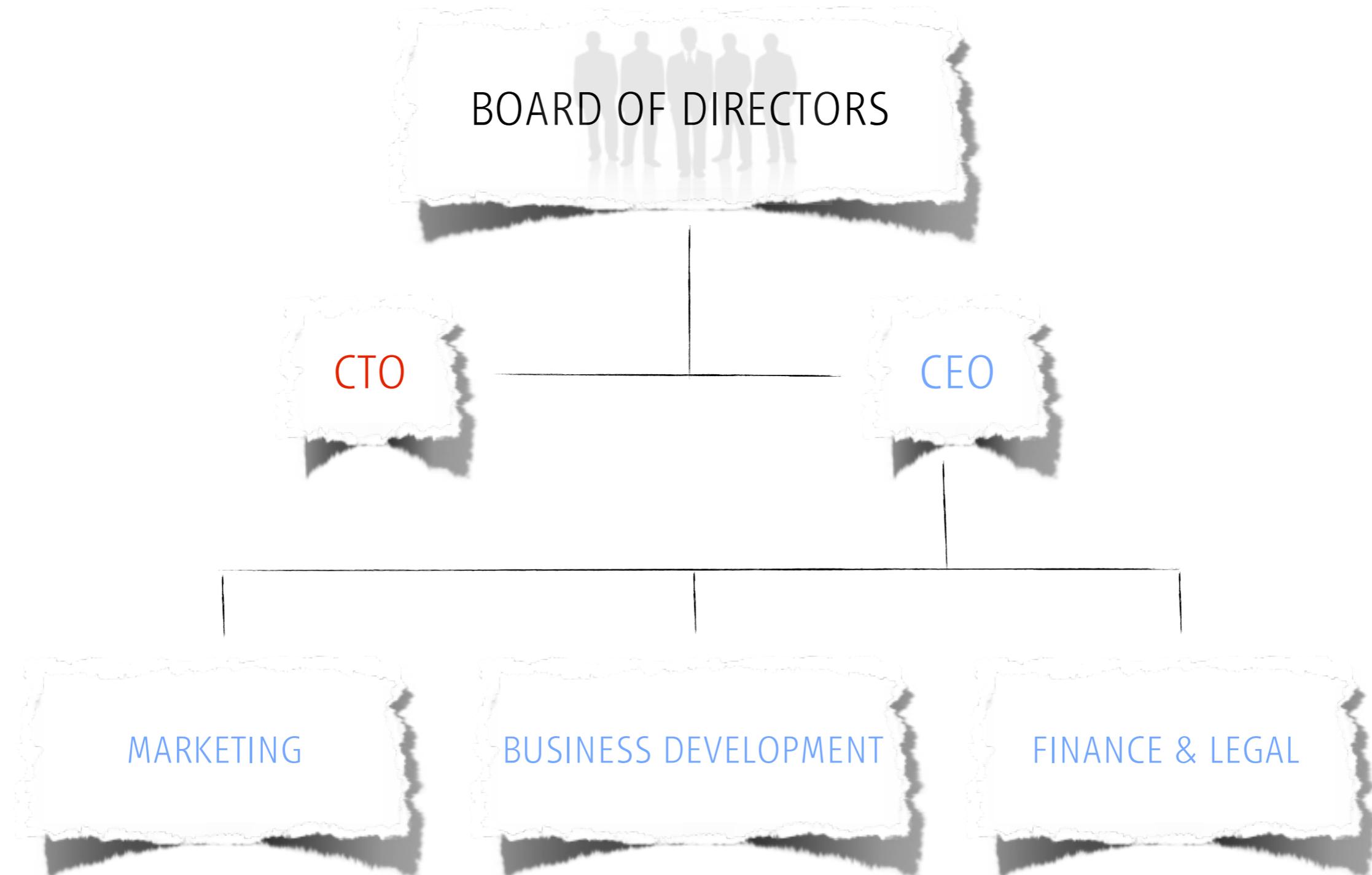
The individual roles will be determined after the first board meeting.

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PART 5:
IMPLEMENTATION

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PART 6:
PROFITABILITY & FINANCING

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PART 7:
RISK ANALYSIS

OPPORTUNITY
AHEAD

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FROM RISK TO OPPORTUNITY

The evaluation of weaknesses and the resulting assessment of associated risks is a task which requires honesty on the most fundamental level, honesty towards yourself, your business idea and most importantly stakeholders. The results of the SWOT - analysis (see *Appendix 6: SWOT - analysis*) show that there are certain risks present within the organization and the competitive environment, which need to be taken into account when considering the feasibility of the proposed business model. Nevertheless, we believe that with high risk, comes great opportunities with high rewards.
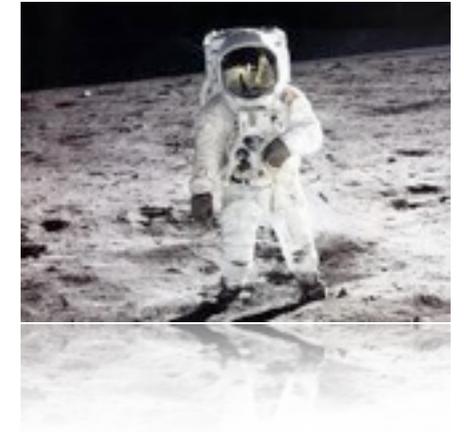
INTERNAL RISKS

The core of the technology has been developed and its patent is still pending. Also, presentable real-life test results are still very limited. This reduces bargaining power on our side when it comes to engaging mobile phone manufacturers. With the current conduction of further tests and the realistic assumption to be able to run the technology on a TEMS phone by ASCOM* in the upcoming weeks, we are confident to increase the strength of our case subsequently.

The issue of initial funding exists; however, researchers as well as the management team are either financed by the university or by other sources at least until the end of the current academic year. As office space is the only resource required in early stages, the financial pressure and therefore risk of financial shortcomings is minimized.

*Ascom is an international provider of communication solutions. Its TEMS Portfolio is a complete set of trusted solutions for drive testing, benchmarking, monitoring, and analyzing network performance.

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EXTERNAL RISKS

When looking at the relevant, existing market, a handful of competitors have been identified. Companies like Nokia and Google are making efforts in areas close to our target market. However, it is not just those big players that pose risks to our endeavor. As identified above, Skyhook and GloPos contribute to external threats.

The bottom line is that the technology developed by the research team at Lund University is not the only one of its kind. However, none of the competitors have successfully entered the market we aim at on a large scale because the proposed solutions are still in development and require many resources and have high costs. The risk of a competitor entering the market before us is off-set by the opportunity of creating strategic partnerships with these companies.

Another external risk associated with this technology is the short life-cycle of software in general. New developments in technology could change the market beyond our ability to adapt and a large competitor could wipe out our market position through just a small change in their focus. Additionally, we are aware of the fact that the cellphone manufacturing industry is prone to be subject to complicated and time extensive product development cycles, which also translate into relatively slow-moving bureaucratic organizational structures.

PART 8:
APPENDICES

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APPENDIX 1: VALUE CHAIN – MOBILE PHONE MARKET

| Chip | OS | OEMs | CSPs | LBS | Consumer |
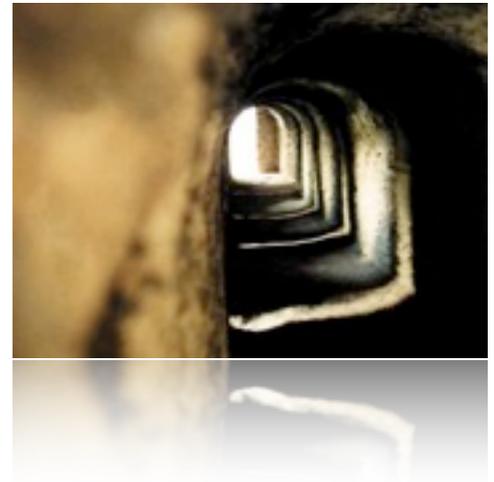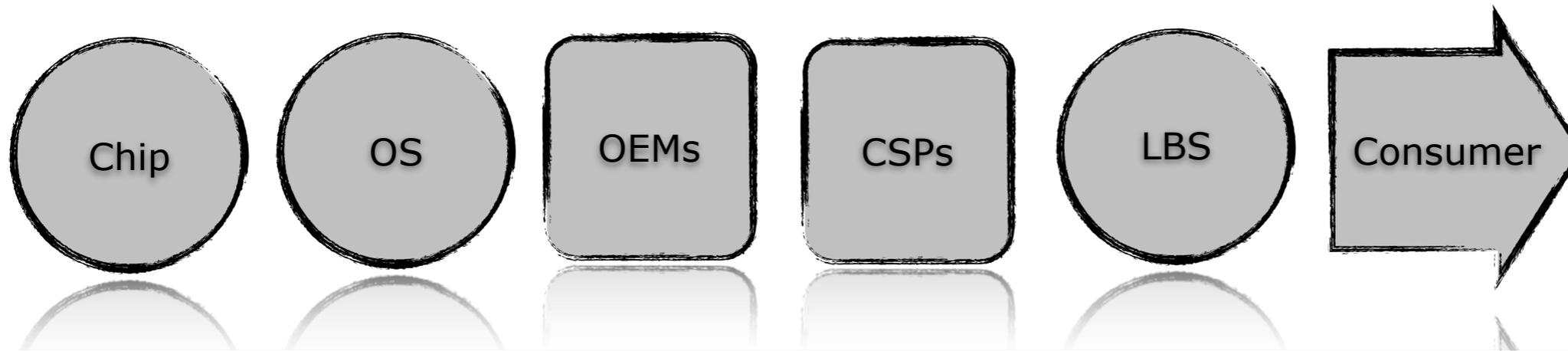
Chip	Chip manufacturers, e. g. ST Ericsson, produce the processing unit that is embedded in a mobile phone.
OS	Operating Systems (OS), e. g. Android, consist of programs and data that act as intermediaries between application programs and computer hardware.
OEMs	Original Equipment Manufacturers (OEMs), e. g. Sony Ericsson, produce mobile devices for the end consumer.
CSP	Carrier Service Providers (CSPs), e. g. Telia, are telephone companies that provide services for mobile phone subscribers. Together with the OEMs they have the most control over the mobile phone market.
LBS	Location based services (LBS) like Android or iPhone applications, provide services for the end-user.
Consumer	Mobile phone users are the end of the value chain.

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APPENDIX 2: FULL COMPETITION COMPARISON

	Infrastructures			Applications			
	GPS	Wifi	BSB	SKYHOOK°	GloPos	qubulus ekahau	track it accurate mobile positioning
Accuracy	u: 5-100m / su: 1-30m	u: 20-50m / su: 20-50m	u: 100-500m / su: 300-1000m	7.7 - 12.5m	10-40m	5-15m	5-10m
Indoor positioning	❌	✅	✅	✅	✅	✅	✅
Mapping independency	✅	✅	✅	❌	❌	❌	✅
Server independency	✅	✅	✅	❌	❌	❌	✅
Availability	medium	low	high	high	high	low	medium
Battery life	low	medium	high	high	high	high	high

🔋 high   u: urban areas
🔋 medium   su: suburban areas
🔋 low

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APPENDIX 3: SWOT - ANALYSIS

STRENGTHS

_core product development completed
_time already invested (3-4 years)
_internal willingness and ability to showcase product
_ability to respond very quickly
_make compatible to all OS
_strong network:
Lund University, LU Innovation,
Mobile Heights Business Center,Teknopol

OPPORTUNITIES

growing market for mobile devices and relevant application_
location based services is a booming market_
strong geographical proximity to industry players_
competitors may be slow to adapt new technology_
separate revenue streams for software embedment of original
product (manufacturers) and software-based service
applications_

WEAKNESSES

_no market presence or reputation
_small staff
_unreliable cash flow in early stages
_patent pending
_demonstrator not yet ready
_unresolved structure of ownership

THREATS

new developments in technology could change the market
beyond our ability to adapt_
interdependency of applications and fundamental software
(algorithm)_
a large competitor could wipe out our market position
through just a small change in their focus_
slow decision process within OEM structure may hinder/
delay market entry_

III. REFERENCES

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Theoretical Reflections: Entrepreneurial Teams

In Partial Fulfillment of the Requirements for the Degree of Master in Entrepreneurship

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May 30, 2011

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1 Introduction

"Coming together is a beginning. Keeping together is progress. Working together is success." Henry Ford

Entrepreneurship is often perceived as a one-man show with extroverted personalities that work individually and isolated. Thinking of successful entrepreneurs, names like Steve Jobs, Bill Gates or Richard Branson come to mind. There is no doubt that these individuals had a memorable impact on the field of entrepreneurship and economy in general, but it is often overseen that the success of a new venture is the result of effective and efficient teamwork. The John Donne quote "no man is an island" underlines that no matter how skilled and dedicated an individual is, they will always be limited to their own perceptions and opinions.

At the start of my entrepreneurship master program at Lund University, my expectations were to gain as much entrepreneurial experience as possible. I grew up in my father's business and worked in several other institutions and companies through various industries and business fields. What I was lacking was the experience of starting my own venture in a realistic environment. Through the first theoretical and practical courses within the entrepreneurship masters program at Lund University, I realized quickly that the picture of the individual one-man-show entrepreneur is outdated and discloses disadvantages when it comes to managing a successful new venture. Various empirical studies document that companies that start by entrepreneurial teams are on average more successful than those founded by individuals (Cooper and Bruno, 1977; Mayer et al., 1989; Bird, 1989; Timmons, 1990; Kamm et al., 1990; Vyakarnam et al., 1997).

The first time I experienced the positive influence of entrepreneurial team activities was the start up challenge, which took place within the first weeks of our masters program. Entrepreneurial activities and strategizing in order to gain as much profit as possible within a limited time period required smart team-oriented decision making, and challenged us to work together in an effective and efficient way with people we hardly knew. Through more assigned team activities throughout the program, the emphasis on entrepreneurial teams became clearer and inspired me to reflect on my team experiences in this thesis and relate it to adoptable theories within the field of entrepreneurial teams. The focus of my thesis will lie on the entrepreneurial team of TrackIT, which was my main project throughout the master of

entrepreneurship at Lund University. The analysis of team members and other participants will be held anonymously in this thesis and is not meant to be judgmental towards any individual. It solely analyses the outcome and success factors of the composition and interaction of entrepreneurial teams by means of the TrackIT project.

1.1 Problem formulation

As I have already stated above, various studies prove that entrepreneurial teams are on average more successful than individuals. In addition to that, Gartner states, "*High technology industries might require more skills than an individual would be likely to have, necessitating that individuals combine their abilities in teams in order to start an organization successfully.*" (Gartner, 1985, p. 703). Regarding this statement I want to shortly explain the core project my team members and I worked on throughout the masters program:

→ TrackIT is the name of a cutting-edge technology, which will enable mobile phones to determine their geographical location. At the core of the technology is a unique algorithm, which is to be embedded into the phone's signal processing unit. The technique dramatically increases accuracy compared to current solutions without the need for additional hardware. Our team consists of seven professionals whose skills complement each other to give TrackIT a balance of business and science. The management team consists of four Masters in Entrepreneurship students and the research team is composed of three PhD Scientists from Lund University.

Finding the right people to work with is one of the most crucial aspects of the start up process of a new venture. The search for people with complementing skill-sets and competencies is as important as finding people who are trustworthy and share the same vision and idea of creating and managing a new venture. In order to benefit from the composition of an entrepreneurial team, it is necessary to have a combination of people with diverse personalities, characteristics, knowledge, skills and abilities (Vesper, 1990; Vyakarnam et al., 1997). In addition, stressful situations can be decreased by the trust and support the entrepreneurial team members give each other (Boyd and Gumpert, 1983). Furthermore, the examination of the teams' interactions is necessary to evaluate its performance.

1.2 Purpose

The purpose of this thesis is to evaluate and highlight the success factors of entrepreneurial team composition and interaction by means of the TrackIT project. The thesis aims to examine the entrepreneurial management team of TrackIT with its individuals throughout the experiences of the master project and gives insides of my personal perceptions of entrepreneurial teams and learning outcomes within this field. The thesis looks into two determinants of entrepreneurial team venture success: the entrepreneurial learning theory of individual team members as well as social interaction within the entrepreneurial team.

1.3 Question

• How did the composition of, and interaction within, the TrackIT management team influence the project's performance?

1.4 Restriction

The main restriction concerning this thesis is the limited use and analysis of TrackIT as an example to discuss the topic of entrepreneurial team composition and interaction. I will only focus my study on the management team of TrackIT. The limitation is due to the lack of time to conduct an empirical study with a larger variety of entrepreneurial teams and/or team members. My research will be primarily based on, but not solely limited to, literature from the master program of entrepreneurship. In order to examine the social interactions within the TrackIT team, I will only use certain components of Hoegl's model of social interaction within innovation teams (Hoegl, 1998). Its adaptability to entrepreneurial teams has successfully been proven by Tomas Lechner's article "Social Interaction: A Determinant of Entrepreneurial" (Lechner, 2001)

2   Theory

Two different theoretical methods will be used in this thesis in order to examine the entrepreneurial management team of TrackIT and thus evaluate success factors of the composition and interaction of entrepreneurial teams. First I will examine the team members' individual learning styles by means of the Honey & Mumford learning styles system (Honey & Mumford, 1982) to identify similarities or dissimilarities of learning styles within the TrackIT management team. Second I chose Hoegl's model of social interaction within

innovation teams in order to examine and document the quality of social interactions within the team.

2.1 The Honey & Mumford learning styles system

The Honey & Mumford learning styles system is developed from Peter Honey and Alan Mumford as a variation on David. A. Kolb's concept of experiential learning (Kolb, 1984) while working on a project for management development in a UK corporation in the 1970's. Kolb as well as Honey & Mumford use the learning cycle model (Figure 1: *Kolb's Experiential Learning Cycle*), which identifies four different learning styles and describes the four stages of the learning cycle.
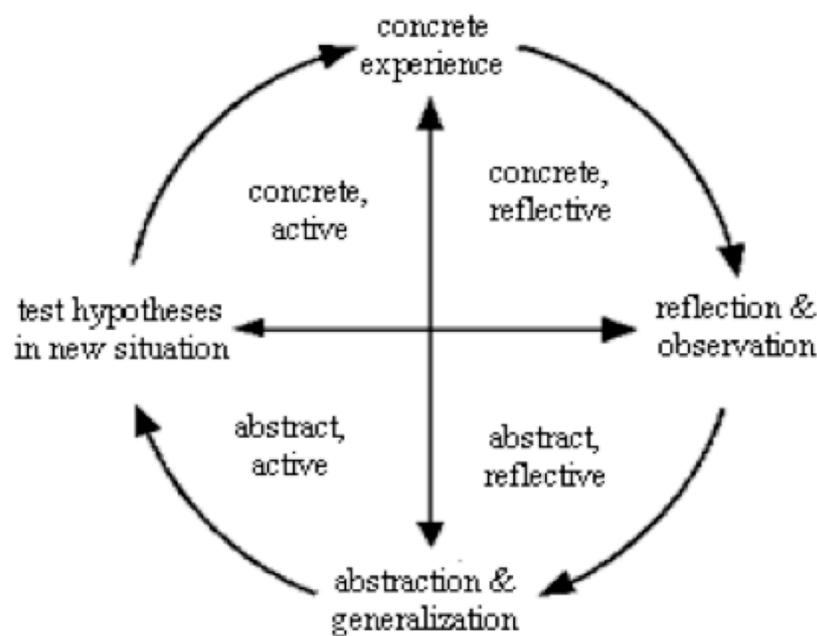
Figure 1: Kolb's Experiential Learning Cycle

The Honey & Mumford's learning stages: concrete experience, reflection & observation, abstraction & generalization and test hypothesis in new situation can be seen on the outer rim of the learning cycle model. The inner section showcases the attributes of concrete/reflective, abstract/reflective, abstract/active and concrete/active to supplement the learning cycle.

The four learning styles: **Activist**, **Reflector**, **Theorist and Pragmatist** are directly aligned to the stages. More information about the four different learning styles will be given in Chapter 4.1: *Results of the Honey and Mumford questionnaire* and Chapter 5: *Analysis*.

The data will be collected through the Honey & Mumford Learning Styles Questionnaire (Honey & Mumford, 2006), which is a self-development tool. The subjects complete a checklist of work-related behaviors without directly sharing information on how they learn. The questionnaire identifies the subject's preferred learning styles and encourages them to improve neglected learning styles. The purpose of Honey & Mumford's questionnaire is to identify the stage(s) at which learning is most effective, i.e. the preferred learning style for an individual person.

For the purpose of this thesis the Honey & Mumford learning styles system will solely be used to identify the learning styles of the TrackIT management team members and evaluate the benefits of similarities or dissimilarities.

2.2 Hoegl's model of social interaction

In order to measure the social interaction in the TrackIT management team I will use Hoegl's model of social interaction of innovation teams. Figure 2 shows an extended framework for the success factors of entrepreneurial teams. It can be stated that social interactions, which are part of the team interactions in general, are an important component of the identification of success factors of entrepreneurial teams.
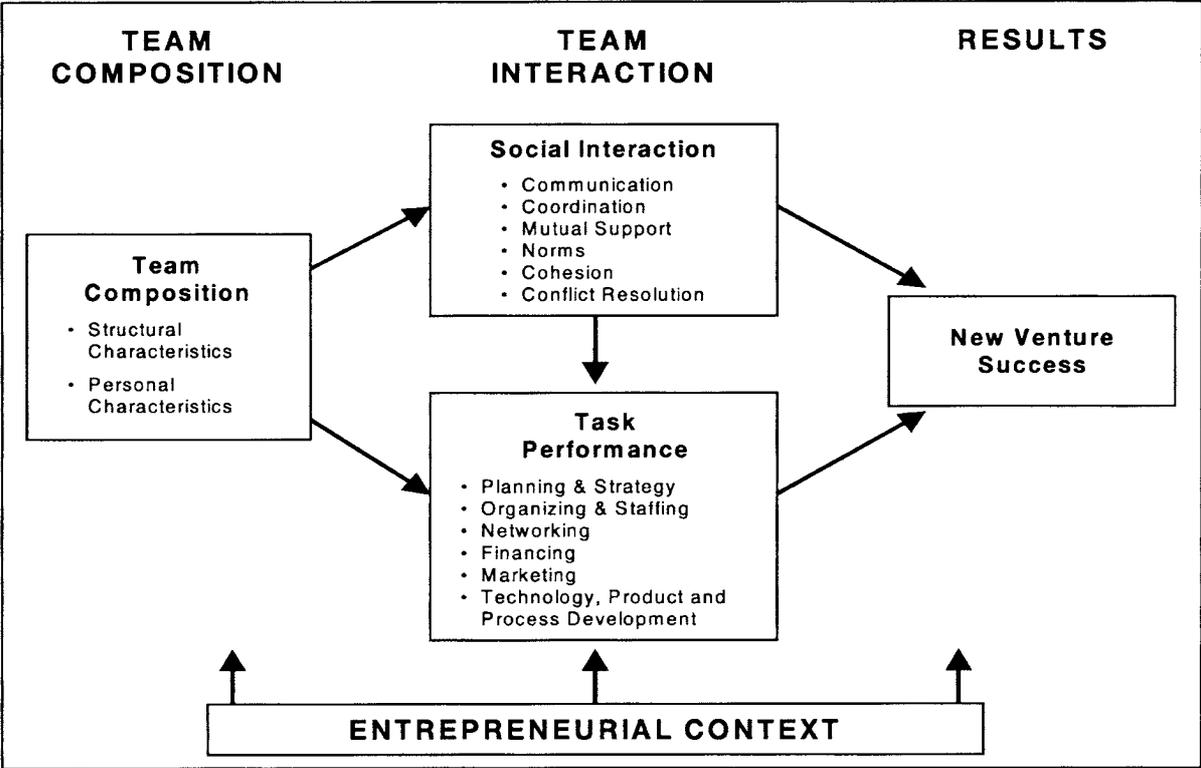

Figure 2: Extended framework for the success factors of entrepreneurial teams

6

Hoegl's model contains six components: (1) communication, (2) cohesion, (3) work norms, (4) mutual support (5) coordination and (6) the balance of member contributions. For the purpose of my study, I will substitute balance of member contributions to conflict resolution. The six components will be further explained below:

(1) *Communication:* Information exchange among team members is the result of good communication with in an entrepreneurial team. (Pinto and Pinto, 1990). Its quality can be measured and is dependent on frequency, formalization, structure and openness of the information exchange (Hoegl, 1998).

(2) *Cohesion:* Cohesion illustrates the likelihood of which team members want to continue working in the team. Hoegl states that high team performance is dependent on a sufficient level of team cohesion (Hoegl, 1998). It is, in particular, a crucial component for this thesis because TrackIT as a final project of the master in entrepreneurship comes to an end in June 2011.

(3) *Work norms:* Behavior of team members define the expected norms shared between one another, thus acts as a important factor to ensure successful teamwork (Levine and Moreland, 1990; Goodman et al., 1987).

(4) *Mutual support:* Successful teamwork is strongly related to mutual support (Tjosvold, 1995). Furthermore, the joint effort does not depend on competition; it is rather a result of cooperation (Hoegl, 1998).

(5) *Coordination:* In order to fulfill tasks and deadlines, various responsibilities are delegated within the team allowing team members to work on different topics simultaneously. The way the team coordinates and organizes time frames, budget lines, and deliverables impacts the quality of social interactions.

(6) *Conflict resolution:* Conflicts within an entrepreneurial team in times of high pressure and stress are often unavoidable. Thus, the conflict resolution component should identify how the team solves conflicts before they have a damaging effect on the business performance.

In order to estimate the importance of social interaction, Hoegl's model also takes five dimensions of success into account. (1) economic success, (2) competitive position, (3) efficiency, (4) client satisfaction and (5) personal success. Due to the early stage of the TrackIT project I will differentiate my study method here from Hoegl's model. In order to estimate the importance of social interactions I will outline the achievements we gained with the TrackIT project until now and give an outlook to a possible continuation of the project beyond the master program.

3 Method

Before describing the methods I will use, I want to provide general information about the test subjects of my study (my team members) and a short history of the team's composition in order to evaluate the entrepreneurial management team of TrackIT, Subsequently, I will portray the methods of Honey & Mumford's questionnaire as well as Hoegl's model of social interaction of innovation teams. Due to time restrictions and the convenience of being part of the TrackIT management team myself, the method of personal observation will be used for Hoegl's model.

3.1 TrackIT management team and its composition

Vyakarnam et al. (1997, p. 2) defines an entrepreneurial team as "*the 'top team' of individuals who is responsible for the establishment and management of the business*". In our case, it is composed of four entrepreneurship students who decided to take the master of entrepreneurship at Lund University in the year of 2010/2011. Driven by motivations such as practical learning experience, international study environment, innovation development, as well as free education, the four of us decided to come to Lund for program.

Going through various team assignments with different team members throughout the first half of the program, it was requested to form a team to work with for the final project, in our case TrackIT. All of us were working in different teams before and faced a range of challenges and difficulties with our first projects. Given the imbalances of our previous team projects it was an easy decision when the opportunity rose to form the TrackIT management team.

As I already mentioned in the introduction, the analysis of team members will be held anonymously in this thesis and is not meant to be judgmental towards any individual. Thus I

will only give general information about the test subjects, e.g. the TrackIT management team. We are a group of four male individuals from two different countries. Our ages vary from 24 to 27.

3.2 The Honey & Mumford questionnaire

I chose the Honey & Mumford questionnaire because it gives a great overview of the different learning styles a person uses. Its indirect questioning does not mislead the test person to cheat on his answers. Although it does not take collective learning styles (i.e., that people learn in interaction with others and that learning is influenced by the social context) into account, the Honey & Mumford learning style system differentiates the TrackIT management team members and thus provides a base for the personal observation by means of Hoegl's model of social interaction.

The Learning Style Questionnaire consists of 80 questions of work-related behaviors without directly asking for personal learning style information. The time frame for the questionnaire is 10 – 15 minutes and the accuracy of the results depends on how honest the test person is with his answers. The questions are structured in agree or disagree types, where the test person either puts a tick or a cross whether he agrees or disagrees. After answering all questions, the participants put their results on a scoreboard and picture an illustration of their preferred learning style as depicted in Figure 4 below.

3.3 Personal observation

After the identification of the team member's individual learning styles, it is necessary to link this information to entrepreneurial team interaction with the help of Hoegl's model of social interaction of innovation teams. I chose the method of personal observation because I believe it gives the reader an in-depth insight of the team's interaction and is best accomplished in the limited time period. Although this observational research method is limited to behavioral variables and not cannot be generalized, it gives the opportunity to measure behavior directly and not only intentions.

The personal observation of the TrackIT management team will be based on my personal reflections and experiences in the team and, thus is a reverse approach for an observation method. The observational research method type that describes my approach the best is the **covert observational research approach.** Marshall defines this method as a *"participant*

observation carried out without the explicit awareness and agreement of the social unit being studied.'' (Gordon Marschall, 1998). Thus it was not necessary to get the test subject's support and the subject's behavior was not biased by the presence of the observer.

In the next chapter I will describe the results of my study based on the Honey and Mumford learning styles system as well as Hoegl's model of social interaction of innovation teams.

4 Results

In this chapter, the results of two research methods will be presented. I will present the individual scores of the Honey & Mumford learning style questionnaire and picture an illustration of each member's preferred learning style. Also, I will showcase the findings of my personal observation by means of Hoegl's model of social interaction of innovation teams. I therefore, adopt the six components of social interaction to the case of the TrackIT management team.

4.1 Honey & Mumford learning style questionnaire

As mentioned before in this thesis, Honey & Mumford defines four different learning styles. Before presenting the individual results I want to give and overview and short definition of the four different learning styles, which can be seen in Figure 3.

Learning style	Characteristics
Activist	Prefers doing and experiencing things
Reflector	Likes to observe and reflect
Theorist	Wants to understand underlying reasons, concepts, relationships
Pragmatist	Likes to have a go; to try things to see if they work out

Figure 3: Learning styles with characteristics

The four TrackIT management team members, which include myself as well, will further be mentioned as team member A, B, C and D in order to guarantee anonymity.

Figure 4 shows that team member A's learning styles differ essentially from the rest of the group. He has a tendency to observe and reflect (Reflector score: 17) and wants to understand underlying reasons, concepts and relationships before doing and experiencing things. (Theorist score: 16). Team members B, C and D show remarkable similarities in their learning styles. All of them have a preference of doing and experiencing things and like to try things to see if they work rather than observing and reflecting. It can be identified that team member C has the lowest score and preference of the theoretical learning style (Theorist score: 4).
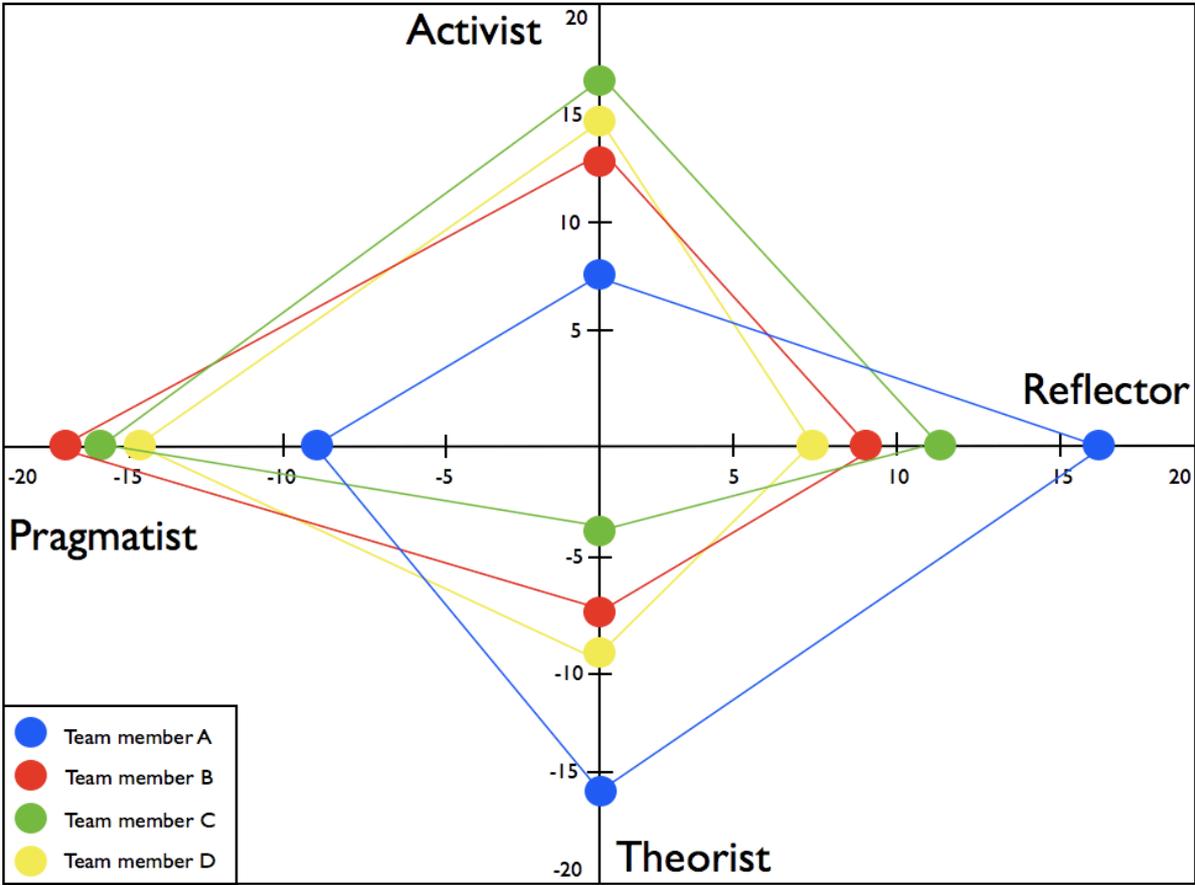
Figure 4: Illustration of the TrackIT management teams' learning styles

How these results influenced the composition of the TrackIT management team and how they are linked to the social interaction outcomes will be evaluated in Chapter 5: *Analysis*.

4.2 Hoegl's model of social interaction

This subchapter will present the results of my personal observation made by means of Hoegl's model of social interactions. As already stated above the model contains six different

components of social interaction and is related to the personal success factors of the TrackIT management team members. First I will showcase the results of each component and subsequently outline the achievements we gained with the TrackIT project until now.

(1) *Communication:*

a) The team members communicate frequently with each other.

b) Informal meetings are held at least three times a week in the provided office space.

c) The communication structure is openly design and ranges from creative brainstorming sessions to formal progress reports.

d) The communication structure occasionally turns into long lasting discussions without valuable results.

(2) *Cohesion:*

a) The team members are proud to be part of the TrackIT project and its achievements.

b) Up to this point in time none of the team members plan to continue with the TrackIT project after the master program.

c) Diverse personal plans impede the continuation of the TrackIT project.

(3) *Work norms:*

a) Each team member invests similar efforts to achieve the projects goals.

b) Every member perceives the same responsibility level for the entrepreneurial goals.

c) The workload is shared equally.

(4) *Mutual support:*

a) The team members' try to complement each other as well as they can.

b) Although working in a cooperative environment the team members occasionally require long time periods to find an agreement in important issues.

c) The team members have occasional differences over strategic goals.

(5) *Coordination:*

a) Regular tasks are assigned to each team member individually.

b) Each team member's strengths and weaknesses are taken into consideration at the task distribution.

c) Each team member has an area of task specification.

(6) *Conflict resolution:*

a) Disagreements are happening frequently but hardly turn into conflicts or fights.

b) When conflicts within the TrackIT management team occur, they are openly discussed and objectively evaluated.

c) Until now the team members always found a conflict solution, although the process is time intensive and involves long discussion sessions.

In order to estimate the importance of TrackIT's social interactions I will now outline the achievements gained with the TrackIT project until now. Besides being evaluated and graded by the master program in entrepreneurship at Lund University (results to be determined) we also took part in the Venture Cup Syd competition. Venture Cup is an organization that helps people to develop their business idea into a business plan and thus take the step towards becoming a sustainable company. The outcomes of this competition were rather deflating. After getting very positive and valuable feedback in the second round of the competition we did not succeed to become one of the ten finalists. Nevertheless, we do not regret the participation and are thankful for most of the feedback. Also, we participated in the Dragons at the University event organized by the master program in entrepreneurship. Despite the loss in Venture Cup, this event where potential investors evaluate the ideas and projects resulted in a more positive note, claiming a second place win.

5 Analysis

The following chapter analyses the results of the Honey & Mumford learning style questionnaire and thus evaluates the composition of the TrackIT management team. Furthermore, the outcomes of Hoegl's model of social interaction will be examined which outlines the success factors of the interaction within the team.

In order to extend the evaluation of the Honey & Mumford learning style questionnaire, Figure 5 gives an overview and definition of the four different learning style pairs including characteristics and occupations.

The questionnaire results showcased in Figure 4: *Illustration of the TrackIT management teams' learning styles* indentify that team members B, C and D prefer the pragmatist/activist learning styles, whereas team member A has a preference towards the theorist/reflector learning styles. That identifies the team members B, C and D are rather active and action-

orientated people that in general like to use their knowledge in action. This learning style combination is very common for small business owners and entrepreneurs in general. Team member A's learning style classifies him as a rather theoretical person that works independently and analyses problems carefully with a high level of security. Common occupation for these learning styles is academics and accountants.

Learning styles	Characteristics	Occupations
Activist/reflector	Curiosity, feeling, observation and associative ability; learning through discussions; prefers working with practical tasks, in groups	Engineers
Reflector/theorist	Theories, facts, expertise; logical, careful problem analysis; independent work; maximize security	Academics, accountants
Reflector/theorist	Analyses, logical thinking; problem solvers, technical tasks; usefulness	Production managers, R&D
Pragmatist/activist	Active and action oriented, trial and error learning, often find new ways to use their knowledge in action	Small business owners, entrepreneurs

Figure 5: Learning style pairs with characteristics and occupations

Evaluating the team's composition many similarities between the individuals can be identified. All four team members are male and within the age group of 24 – 27. Furthermore, three group members come from the same country. With the identification of the learning styles more similarities can be seen. Three-fourths of the team prefers the pragmatist/activist learning style. That means the majority of the team feels more comfortable with trial and error learning and thus shares values, beliefs and norms. Reuf et al. indentify the mechanisms of group composition in their article "The structure of founding teams: Homophily, strong ties, and isolation among U.S entrepreneurs" (Reuf et al., 2003). One

mechanism of group composition is made up of those with similar characteristics and can be explained through the concept of homophily. These characteristics may refer to social identities that are connected externally to individuals (e.g., ascribed characteristics such as gender, race, or age) or to internal states concerning values, beliefs, or norms (Lazarsfeld and Merton, 1954). Taking all similarities into account it can be concluded that the high level of homophily within the TrackIT management team is the major reason for its composition.

Having more clearance about the teams' composition, the analysis of the social interaction within the TrackIT management team can be further addressed. The outcomes of Hoegl's model of social interaction will be linked to the entrepreneurial achievements gained throughout the project.

I will focus on two particular results that were found while evaluating Hoegl's six components of social interactions by means of the TrackIT management team. First the *communication* component showcases that the team members met frequently and have an open communication design structure that, on the downside, encourages long lasting discussions without valuable results. Secondly, it can be stated that the *mutual support* in the team was given throughout the project and a cooperative environment was created where all team members complemented each other. Nevertheless, the team members occasionally required long time periods to find an agreement on important issues and did not always agreed on strategic goals.

The success of the second place at the Dragon's at the University competition proves that the team is able to interact and perform successfully, and that the quality level of social interactions is sufficient overall. However, it has to be questioned if the performance of the TrackIT management team could have been higher taking into consideration that the teams' business plan was not elected for the final of the Venture Cup Syd competition.

Although the elimination from the competition was based on more than a single reason, it can be said that the teams' focus on the business development process of the TrackIT project has been slowed down due to long lasting discussions and agreement findings for important issues. The team's behavior during that time period does not overall reflect the preferred learning styles of the majority of its individual members. Even though three-fourths of the team prefers the pragmatist/activist learning style, the teams' behavior during the Venture

Cup period was not driven by trial and error learning and action oriented behavior. Due to the early stage of the technology and the lack of a 'proof of concept', the team decided to wait with approaching potential customers and collaboration partners. This rather careful or passive strategy was acknowledged by all team members but faced different opinions about its chances of success within the team.

Two different statements can be made after analyzing the teams' composition as well as social interactions. First, it can be said that although a high communication level has the ability to increase venture performance of an entrepreneurial team (Watson et al., 1995), differences over strategic issues and the disability to solve theses issues within the team can lead to decreased venture performance (West & Meyer, 1998). Second, a homogeneous composition of an entrepreneurial team enables them to better deal with routine tasks (Filley et al., 1976), but for circumstances that contain unique challenges or chaotic environment, heterogeneous team composition has proven to be better in performance. (Filley, House, & Kerr, 1976; Hambrick & Mason, 1984). These statements reflect with the rather disappointing performance at the Venture Cup Syd competition.

6 Discussion/Conclusion

The analysis outcomes of the TrackIT management team should not aim to leave an overall negative impression on the teams' performance. Although the team members had hoped for a better result in the Venture Cup Syd competition, the experience gained from the competition and the entrepreneurship program as a whole outperforms the disappointment. One of the first lessons I learned in the master program in entrepreneurship was, that knowledge gained from "failure" can be used by entrepreneurs to improve their business and personal skill set. A failure can, for example, point out imperfections in the organization that needed to be adjusted in order to keep up an effective and efficient way of doing business. (Politis & Gabrielsson, 2009).

Taking this into account, the TrackIT project was a success for gaining hands on experience within a real business environment and helped its management team members to better understand the industry of the mobile phone market as well as mobile location based services. The team went through ups and downs but eventually found a way to acknowledge each member's skills and competencies in the best way for the project. Overtaking various

challenges and going through disappointments, the team members became friends and developed as a team. Nevertheless, up to this point in time none of the team members plan to continue with the TrackIT project after the master program. The fact that the commercialization process of the TrackIT technology is very long lasting and is still far from market, a possible continuation of the TrackIT project would require a permanent stay in Lund, which can be indentified as the main reason of the projects discontinuation. However, I still believe in the attractiveness of the project and hope that a new management team can be formed in order to commercialize the TrackIT technology. Personally I would feel very proud to see the technology embedded in future mobile phones.

I want to end this thesis with a quote from Cooney and Bygrave (1997): "*For a long time it has been a great myth that entrepreneurship implicitly describes the battle of a lonely hero against economic, governmental and social forces.*" I hope that beyond the evaluation of the TrackIT management team this thesis also underlines that acting within an entrepreneurial team can be a great alternative to the solo attempt entrepreneur.

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