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Dutch Artificial Intelligence Startups

A Case Study Analysis of Twenty-Four Dutch Artificial Intelligence New Ventures Characteristics and Financing

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Dutch Artificial Intelligence Startups. A Case Study Analysis of Twenty-Four Dutch Artificial Intelligence New Ventures Characteristics and Financing.

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Contents

Abstract:

Despite the growing popularity of artificial intelligence technology and an increasing number of artificial intelligence startups, the research on artificial intelligence startups' characteristics and financing is almost non-existent. To close the research gap, this study focuses on Dutch artificial intelligence startups' features and funding. The main goal of the study is to find out; what are unique Dutch AI startups' characteristics? The study focus will be placed on the financing aspect of startups. To answer research question, a case study approach was adopted (Morland, Feagin, Orum, & Sjoberg, 1992; Thomas, 2011; Yin, 2009). Twenty-four Dutch artificial intelligence startups were analyzed. Also, they were compared with 90 software startups, which were deemed an appropriate non-AI startups control group. The study results show that Dutch AI startups are mostly business to business, core technology-focused startups. Results revealed that there are two clear patterns for AI startups. First, they attract more investors than software startups. Second, different types of investors are interested in funding artificial intelligence new ventures -mainly accelerators, business angels, and government. The quality of research was ensured by using multiple sources of evidence, performing pattern matching, building explanation, using theory, and developing a research database (Johnson & Stake, 1996; Tellis, 1997; Yin, 2009). This research can be used in the future by researchers, investors, and AI-driven companies to gain a better understanding of Dutch AI startups' characteristics and their financing.

List of Abbreviations:

AI - Artificial Intelligence

AINED - AI Voor Nederland Report

BA - Business Angel

B2B – Business to Business

B2C – Business to Customer

B2G – Business to Government

FFF - Friends Family Fools

CVC - Corporate Venture Capitalist

VC - Venture Capitalist

CHAPTER 1: Introduction

The term artificial intelligence was first used in 1956; however, nowadays, with increasing data volumes and advanced algorithms, artificial intelligence startups are created more often than ever before. Artificial intelligence can be defined as a collection of technologies that together enable human-like intelligence (Accenture, 2017). Governments around the world notice the potential value of AI and encourage startups, and mature companies to implement it.

In 2018 the Dutch Ministry of Economic Affairs and Climate published the first draft of a Dutch National AI strategy – AI Voor Nederland (AINED) (Lagendijk et al., 2018). AINED recognized the potential for artificial intelligence development in health, agriculture, and mobility industries. According to Lagendijk et al., (2018) the majority of Dutch companies recognize possible advantages coming from the use of AI for their business (Figure 1). Many Dutch companies are testing AI technology (45%) to use it in day-to-day tasks. In comparison, only 39% of European Union companies are in the testing phase. However, the report highlights the massive discrepancy in the percentage of companies planning to use AI technology in the future, as the percentage is lower for Dutch ventures (9%) in comparison to European Union ventures (22%). As stated by Lagendijk et al. (2018) artificial intelligence use and implementation should be the new Dutch national priority. Therefore, not only existing companies should implement AI, but also new startups should be guided towards the use of AI as a core technology.

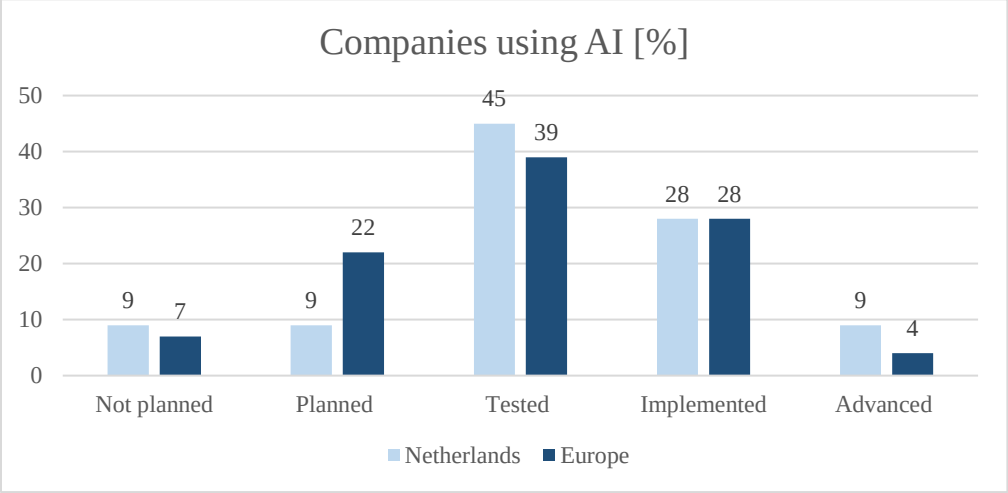

Figure 1: Bar chart. The figure illustrates the percentage of companies using AI in the Netherlands and Europe. Data retrieved from AI Voor Nederland (2018)

Artificial intelligence startups are relatively popular in the Netherlands. In 2018 there were approximately two hundred Dutch active AI startups in different industries. Those startups were often supported by Dutch accelerators such as Startupbootcamp, Startup Delta, and Yes! Delft. However, despite constant government effort, it is difficult for Dutch AI startups to grow into international level companies. Only 0.4% of Dutch startups succeed (Dutch BASECAMP, 2018), which means that only 1 in 200 startups becomes successful and grows to become known worldwide. The question arises: why Dutch AI startups rarely grow into international level companies? There is no single answer to this question. However, Lagendijk et al. (2018) recognizes a low level of investment in AI startups in comparison to neighboring countries as one of the reasons for a small number of succeeding startups.

Furthermore, according to research by CB Insights (Appendix B), the No. 2 reason for startups failure, noted in 29% of cases was running out of cash. It is essential to realize that at the beginning, startups are burning through cash fast and often they do not earn any revenue. Therefore, raising additional funding is necessary to keep a startup alive. To increase company valuation and get additional funding, companies need to achieve certain milestones (Skok, 2012). For high tech companies (including AI startups), those are, for example; hiring a team of experts, performing a product beta test, eliminating product/market issues, proving the business model, and showing that the business is scalable. Failing to achieve these milestones leads to the company running out of cash, achieving lower valuation, and not being able to raise the necessary amount of funds (Skok, 2012). Thus, CB Insights (2019), and Lagendijk et al. (2018) highlight the importance of startups financing as a factor allowing to succeed in the market. Almost non-existent research about AI startups and their financing challenges future researchers to focus on this area.

This thesis investigates the financing of artificial intelligence startups located in the Netherlands. It will focus on researching Dutch AI startups' characteristics, and the comparison of AI and non-AI startups financing. The main goal of this research is to answer the question: What are unique Dutch AI startups' characteristics? To answer this question case study approach will be adopted (Morland, Feagin, Orum, & Sjoberg, 1992; Thomas, 2011; Yin, 2009). The study will be focused on 24 units of analysis – Dutch artificial intelligence startups. It is Type 4 embedded-multiple cases design (Baxter & Jack, 2008; Eisenhardt, 1989a; Gerring, 2004; Siggelkow, 2007; Tellis, 1997; Yin, 2009). The data for this study was retrieved from numerous websites to ensure multiple sources of evidence and as a result ensure internal and external validity. The data collected includes information about 24 Dutch AI startups, Dutch AI startups investors, 95 Dutch software startups, and software startups investors. Software startups were deemed an appropriate non-AI startups control group, therefore the data on Dutch software startups was collected. AI startups and software startups will be compared to determine unique characteristics of AI startups financing. In addition, pattern matching will be performed to determine whether there are certain patterns occurring for AI startups (Trochim, 1989; Yin, 2009). The quality of research can be judged by four characteristics: construct validity, internal validity, external validity, and reliability (Levy, 1988; Tellis, 1997). All of them will be ensured in this research by using multiple sources of evidence, performing pattern matching, building explanation, using theory, and developing research database (Johnson & Stake, 1996; Tellis, 1997; Yin, 2009). This research can be used in the future by researchers, investors, and AI-driven companies to gain a better understanding of Dutch AI startups characteristics and their financing.

CHAPTER 2: Literature review

2.1 Artificial Intelligence Startups

According to Investopedia, a startup is a new venture founded by entrepreneurs with a challenge to prove the validity of concept to potential investors. Startups support the development of a nation by creating jobs that add value to the economy (Salamzadeh et al., 2015). It is in line with research that proves that startups create, on average, three million jobs annually (Reedy & Strom, 2012). This study is focused on startups using relatively new technology – artificial intelligence. It is essential to investigate AI startups since emerging AI is making indelible marks in different industries (Seoh, 2018). AI technology has an impact on productivity, can automate processes, change existing labor force, and increase consumer demand. Besides, it is estimated that AI companies will add $15 trillion (Appendix B) to the world economy by 2030 (Holmes, 2019). Hence, startups using AI have tremendous potential to affect the global economy and understanding them can help maximize a positive impact on building the nation.

Artificial intelligence technology is a disruptive innovation that exhibits intelligent behavior (Kelnar, 2019). It can be defined as a system that possesses human-like intelligence and learning capabilities or as a collection of technologies that together enable human-like intelligence (Accenture, 2017). Furthermore, AI systems can outperform humans by learning through constant practice. This means that human capabilities are undertaken efficiently, inexpensively and at scale (Kelnar, 2019). Table 1 illustrates the classification of artificial intelligence into technologies and applications. Both technologies and applications can be divided into three capability groups: sense, comprehend, and act.

Table 1. Classification of artificial intelligence into technologies and applications.

	Sense	**Comprehend**	**Act**
Technologies	Computer Vision	Natural Language Processing	Inference
	Audio Processing	Machine Learning	Expert Systems
	Sensor Processing	Speech to Text	
Applications	Gesture Recognition	Video Analytics	Bots
	Image Recognition	Text Analytics	Robotic Process Automation
	Biometrics Identity	Semantics	Virtual Assistants
	Context-Aware Computing	Recommendation Systems	Augmented Reality
		System Optimization	

For this research, it is essential to define artificial intelligence startups. High-tech startups (including AI startups) are recognized as high impact firms that produce disruptive innovations diffused across society (Taji, Tsuyuki, Kazumi, Shindo & Igarashi, 2010). A startup can be classified as an AI startup when it is using artificial intelligence technologies or applications from Table 1. All startups investigated in this study were classified as AI startups.

Furthermore, a detailed classification of AI startups can help in understanding their specific features. According to Kelnar (2019), artificial intelligence startups can be divided into three categories: business function-oriented, need-oriented, and core case-oriented.

Business function-oriented AI startups are created for businesses (B2B) to solve existing problems. On the contrary, need-oriented AI startups are focused on individual consumer needs and problems (B2C). As stated by Levine (2017), B2B AI startups face more significant challenges than B2C AI startups. There are many stakeholders involved in B2B; therefore, there is a large amount of data necessary to train models properly (Levine, 2017). As it is widely known the data availability is uncertain, especially for new ventures. Therefore, it is more challenging to create B2B startup than B2C. This could suggest that B2B AI startups should be more difficult to create and are therefore less popular than B2C AI startups. Nevertheless, according to the Kelnar (2019), 90% of AI startups are B2B. To determine which statement is valid in the Netherlands, the following hypothesis will be tested in this case study:

H1: 90% of AI startups are B2B.

The third category of core-case oriented ventures includes startups using AI technology to improve the most important sectors and, as a result, grow the economy. MMC Ventures determined eight core sectors and thirty core use cases:

1) Asset Management (Investment Strategy, Portfolio Construction, Risk Management, Client Service)
2) Healthcare (Diagnostic, Drug Discovery, Monitoring)
3) Insurance (Risk Assessment, Claims Processing, Fraud Detection, Customer Service)
4) Law & Compliance (Case law, Discovery and Due Diligence, Litigation Strategy, Compliance)
5) Manufacturing (Predictive Maintenance, Asset Performance, Utility Optimization)
6) Retail (Customer Segmentation, Content Personalization, Price Optimization, Churn Prediction)
7) Transport (Autonomous Vehicles, Infrastructure Optimization, Fleet Management, Control Applications)
8) Utilities (Supply Management, Demand Optimizations, Security, Customer Experience)

According to the research by MMC Ventures, out of 1600 AI startups, only 10% of startups focusses on core technology. Nine out of ten startups are focusing on problem-solving in specific business functions or are addressing already existing needs in the sector. Since core technology has the potential to grow the economy, this claim will be investigated in this case study.

H2:10% of AI startups focuses on core technology.

2.2 AI Startups Financing and Investors

"The 21st Century is one of Managing for Stakeholders. The task of executives is to create as much value as possible for stakeholders without resorting to tradeoffs. Great companies endure because they manage to get stakeholder interests aligned in the same direction." (Freeman, 2015, p.1). According to the stakeholder theory, relationship with stakeholders places a vital role in the organiation and is the key to success (Freeman, 2015). It is a top priority for startups to attract stakeholder's attention and engage with them (Ter Halle, Beekhof & Ruel, 2018). Stakeholders can be categorized in three ways (Minning, 2019). First, there are internal stakeholders who are part of the company, and external stakeholders without a direct affiliation. Secondly, there are primary stakeholders whom are affected by the company outcome, and secondary stakeholders whom are not affected by the company results. Finally, there are direct stakeholders

involved in the day-to-day activities, and indirect stakeholders involved in a general overview of projects. In this research primary focus is placed on investors. Investors are external, primary, and direct shareholders, and they help grow startup businesses by contributing ideas, networks, and financial aid. To understand the financing of AI companies, it is essential to understand who the main AI startups investors are.

2.2.1 "Friends, Family and Fools"

Bootstrapping is avoiding the use of long term external finance from debt holders by collecting money from different sources (Winborg & Landström, 2001). Usually, the first people investing in new businesses are the entrepreneurs themselves. Often entrepreneurs rely on their family and friends to collect the necessary amount of funds to lunch a new business (Alemany & Andreoli, 2018). Many researchers investigated the role of financial bootstrapping in the high tech industry, concluding that it was used for both product and business development (Freear & Wetzel, 1990; Harrison, Mason, & Girling, 2004). Besides, research proved that specific characteristics affect the bootstrapping strategy; those are, for example, the firms' current stage in the lifecycle, social networks (Jones & Jayawarna, 2010), and performance (Ebben, 2009). Nevertheless, often bootstrapping investments are not documented – therefore, the data is not easily available. Bootstrapping is suitable for businesses in which excessive funding is not necessary at the beginning. Artificial Intelligence-powered companies often need more than a small investment to develop AI technology or to hire top talent (Kelnar, 2019). Hence, FFF is rarely used for AI startups.

2.2.2 Incubators and Accelerators

Incubators are non-profit companies protecting vulnerable young startups before they become independent (Cohen, 2013). Incubators often select non-competitive companies and provide office space and minimal mentorship. The majority of incubators is publicly owned and does not have investment funds, which means that the incentive of incubators is not to earn money but to help companies grow. Often incubators are created at universities, and are usually helping AI startups to become independent.

Accelerators are companies supporting startups in the early stage of growth. The goal of accelerators is to accelerate startups' growth and speed up the market interactions (Alemany & Andreoli, 2018). There are four unique criteria differentiating accelerators from incubators: fixed-term, cohort-based, mentorship-driven, and graduation at the end of the program (Cremades, 2019). Fixed-term accelerators force startups to grow and complete all activities in a short period, which means that startups need to adapt to the market selection mechanisms before graduation (Cohen, 2013). Furthermore, cohort group creation stimulates startups at their motivation level. Mentorship provided by accelerators helps startup teams to accelerate and find their market. This way, startups can build their own network of specialists, which can be useful in the future. The business model of accelerators is focused on taking an equity stake in the startups participating in the program. This means that the main incentive is to select the most promising startups and lead their growth to a profitable exit (Cohen, 2013). Rockstart is an example of Dutch accelerator with an AI focused program (https://www.rockstart.com/emerging-tech/ai/). The AI program allows AI startups with deep expertise and knowledge in the AI domain to grow and develop core proprietary deep-tech solutions. Rockstart focuses on AI applications such as: algorithms, autonomous robots, autonomous vehicles, virtual assistants, document search, analytics, image and video analysis, AI-optimized hardware, visual inspection, and predictive analysis.

2.2.3 Crowdfunding

Crowdfunding is a method of financing companies by drawing small amounts of funds from a large number of people (Mollick, 2014). Crowdfunding covers many disciplines, and every startup can decide to collect funds with crowdfunding. Entrepreneurs choose crowdfunding with different goals in mind. It not only allows entrepreneurs to collect the necessary initial funds to start the company, but also makes the product or service visible to potential customers and it provides market testing (Mollick, 2014). In addition, there are different motivations for the investors- voluntarily donations (donation model), lend money with a low rate of return (lending model), reward when the company becomes successful (reward-based), or receiving equity (equity model). Nevertheless, high-tech companies with technologies such as artificial intelligence are rarely financed with the use of crowdfunding (Corea, 2017).

2.2.4 Business Angels and Venture Capitalists

Business angels are often a second option for companies after bootstrapping and before venture capitalists (Prowse, 1998; Ramadani, 2009). Business angels are wealthy individuals providing capital to startups. Often a business angels' role is to provide not only money but also skills, expertise, knowledge, and an extensive network of specialists to the startup (Mitter & Kraus, 2011). Business angels expect a return rate of 20-30% from their investments; however, the return is not their primary motivation to invest in startups. They might expect a profit, want to support and teach young entrepreneurs, help to contribute to local economic development, or show social responsibility (Ramadani, 2009). Furthermore, business angels prefer to invest in small companies in their seed or startup stage – on average companies are ten months old when they receive the first investment from a business angel (Mitter & Kraus, 2011). This is in line with Ramadani (2009) who proves that business angels often choose companies in early stages to have an active role in their development. Artificial intelligence companies offer high risk and high return investments; therefore, they are often chosen by business angels.

The difference between business angels and venture capitalists is that the former one are individuals investing their own money while the latter are institutional capital providers (Mitter & Kraus, 2011). Venture Capital firms can be public, private, or created inside of a company – Corporate Venture Capital (CVC). Venture capitalists create a portfolio of companies to invest and provide monitoring, advice, and support. Their ownership is temporary- often a venture capitalist exits after ten years when the company value increased and return on investment is achieved. Venture capitalists are focused on looking for innovative, technology-oriented companies with novel products or services– the imitating companies are of minor interest (Mitter & Kraus, 2011). Imitating companies are ventures which use already existing concept. Nowadays, artificial intelligence startups are becoming very popular among venture capitalists. Venture capital companies with portfolios focusing on AI companies were able to raise more new capital than funds focusing on non-AI related areas (Walch, 2020). According to Kelnar (2019), the most popular types of investors investing in AI companies are venture capital investors and business angels (Appendix C). Therefore, this study investigates the following hypothesis:

H3: More than 50% of the artificial intelligence startups is financed by venture capital investors and business angels.

2.2.5 Public Government

Next to funding from business angels or venture capitalists, startups often seek development funding from governments and universities (Nagaoka, 2009). The government can help startups by making it easier to start a new company- creating tax exemption for startups or giving startups loans without interests. In the USA, the federal government provides a significant contribution of 25% of all funds to early-stage technology development of startups (Nagaoka, 2009). Government help can be seen in each stage of the startup development and in each type of round. In addition, the Dutch government's goal (https://www.government.nl/topics/enterprise-and-innovation/the-government-supports-entrepreneurs) is to support innovative enterprises, increase financing, promote cooperation between researchers and the private sectors, develop IT tools for entrepreneurs, and help them access networks.

Furthermore, in 2019 the Dutch Government presented the Strategic Action Plan AI (SAPAI) that focuses on investment in artificial intelligence – the government formed a coalition with 65 companies focused on looking for opportunities in AI (Appeven, 2019; Vermeer, 2019). Moreover, according to the Lagendijk et al. (2018), it is the priority of the Dutch government to invest in AI companies – therefore, the following hypothesis arises:

H4: Government investment is more often in AI startups than in non-AI (software) startups.

2.2.6 Bank finance

Entrepreneurial companies often choose the bank as a source of finance (Winton & Yerramilli, 2008). The most common is a loan with interest – in this way, entrepreneurs do not have to share company ownership and avoid dilution and loss of control. Usually, banks need collateral in order to assure that the debtor will pay off the credit. It is challenging to provide collateral for startups – therefore, often, banks choose startups that imitate already existing companies (Mitter & Kraus, 2011). Since AI startups are using new technology and creating new applications, the chance of getting debt finance decreases.

2.3 AI startups hype.

Artificial Intelligence is a technology that became largely popular during the last two decades. According to a recent study on 15,798 investments in AI startups, an average investment reached approximately $8,600,000 (Global Index Report, 2019). Besides, global investment in Artificial Intelligence companies increased at an average annual growth rate of 48%; from $1.3 billion in 2010 to $40.5 billion in 2018 (Brynjolfsson et al., 2019).

Often startups decide to claim the use of AI technology to raise larger investment rounds (Olson, 2019). According to Forbes, out of 2,830 European startups claiming to be “AI startups,” only 55% (1580) were using AI technology. Kelnar (2019) supports this finding as in his research on 2,830 AI startups, 40% of them wrongly claimed to use artificial intelligence technology. The hype around artificial intelligence causes this behavior, as AI startups attract 15% - 50% more funding rounds than other types of startups (Olson, 2019).

In addition, more investors are interested in AI technology; they believe that it will be successful, and it will bring profits – which leads to a more significant number of investors investing in AI companies (Kelnar, 2019). Certain types of investors who are either risk-lovers (often business angels) or expect a high return on investment (venture capitalist) will be more inclined to invest in AI startups than other non-AI startups. This was proven by Kelnar (2019), who compared investment in AI startups with investment in

software startups. Furthermore, according to MMC Ventures report the median funding of AI companies increased over the years. From 2015 AI startups raised more capital than traditional software companies. Thus, two hypotheses arise:

H5: The number of investors is smaller for AI startups than for non-AI (software) startups.

H6: The proportion of investor types investing in AI startups and non-AI (software) startups differs.

2.4 AI startups investment rounds.

According to the MMC Ventures report (2019), AI companies raise, on average more capital than traditional software companies (Appendix D). Interestingly AI companies require more investment because of high salaries for AI professionals, the longer time span necessary to develop a minimum viable product, and because of overall complexity involved in AI development (Kelnar, 2019). Therefore, the AI premium over software is higher. This difference can be seen in all stages: seed, series A, series B, and series C funding. This leads to the hypothesis:

H7: AI startups raise smaller investment rounds than non-AI (software) startups at all stages of maturity.

Furthermore, according to Corea (2017), AI startups rarely achieve round C or higher. There are two reasons for this phenomenon. Firstly, AI startups encounter difficulties in delivering promised solutions or products that ultimately leads to failure. Secondly, AI startups are often acquired by larger companies with sufficient funds (Corea, 2017). Those companies want to implement AI startups solutions in their operations and technology base. In this case study, there is not enough data available to investigate if AI startup achieve round C or higher.

CHAPTER 3: Methodology

3.1 The methodology

Choosing an appropriate research method to analyze the data is one of the most challenging parts of the research (Harper, 2011). There are different research methods and conditions based on which the best approach can be chosen (Yin, 2009). One of the methods is case study, which became largely popular among researchers to comprehensively analyze the data (Thomas, 2011). It should be chosen when the research question has a specific form (how?; why?; what?), a researcher has no behavioral control over the events, the focus is placed on contemporary events, and in-depth investigation is necessary (Morland et al., 1992; Yin, 2009). For the purpose of this research, a case study approach was adopted to investigate the characteristics and financing of AI startups. This method was chosen because the research questions are explanatory how and what questions, and there is no control over companies analyzed – thus, all the conditions of the case study approach are met.

3.2 Case study components

The case study form is reflected in decisions about three principal components (Yin, 2009).

3.2.1 Research question and hypothesis

This case study deals with characteristics of Dutch AI startups with the focus on financing. The research question is: What are unique Dutch AI startups' characteristics? In the study, seven hypotheses were created. Hypotheses H1, H2, H3 are focused on unique AI startups features. Hypotheses H4, H5, H6, H7 are focused on characteristics of AI startups financing in comparison to non-AI startups financing. It is to be noted that there is a difference between the financing of AI and non-AI business ventures, so it is crucial to understand what the unique characteristics of AI startups and its financing are.

3.2.2Units of analysis

Every case study should have clearly defined units of analysis. In this case study, the focus will be placed on twenty-four units of analysis – startups using Artificial Intelligence as a central part of their technology. The artificial intelligence technology is defined in Chapter 2, section 2.1. Organizations can be seen as a specific unit of analysis that would rightfully serve as the subject of a case study (Sjoberg, Williams, Vaughan, 1991; Yin, 2009).

3.2.3Data and hypothesis linking

Data and hypothesis linking is creating a logical relation between hypothesis and data available (Yin, 2009). A successful analysis can only be made, making a reasonable and trustworthy relationship between the dependent and independent parameters of a research (Scriven, 1996). Linking data to hypothesis can be done with the use of five different techniques. First of them is *pattern matching* – it is a type of logic, comparing the predicted pattern with empirical, matching patterns to ensure internal validity, and reliability (Trochim, 1989; Yin, 2009). Outcomes can be predicted to be "affected by" variables or to "not be affected by" variables. Nevertheless, there are no quantitative criteria of the comparison, therefore the interpretation is dependent on researcher discretion (Tellis, 1997). The second technique is *explanation building*- an analytic technique that assures that the research explains a phenomenon and connects the explanation with the literature. Similarly, the *logic model* is based on matching theoretical models with empirical outcomes using conventional logic (Scriven, 1996). The fourth technique is *time series analysis* - a technique focused

on performing time series analysis of data to understand patterns. Finally, *cross-case synthesis* technique allows comparison of findings in different cases. The results of the analysis of each case are compared with other cases and conclusions are drawn.

In this research four data and hypothesis linking techniques were used. Explanation building and logic models were applied to explain literature and its logical connection with data. Cross-case synthesis was used for data analysis to compare findings in different companies. Finally, pattern matching was used to answer the question: What patterns are emerging for AI startups financing? Time series analysis was not considered because of its limitation - large number of unit analysis is necessary to perform it. Therefore, this technique was not used in the present research

3.3 Case study type, design and quality of the research

According to Yin (1993) are three types of case studies: *exploratory, descriptive and explanatory*. This classification was broaden by Johnson and Stake (1996) by adding *intrinsic, instrumental* and *collective* case study types. As reported by Yin (1993) if the phenomenon is existing the study can be classified as exploratory, if the investigation is casual it is explanatory, and if the theory exists the case study is descriptive. As stated in Johnson and Stake (1996) research, intrinsic case studies are those in which researcher is intrinsically focused on the research, collective are performed when the phenomenon is obvious to researcher and instrumental when phenomenon is obvious but in-depth understanding is necessary. This study can be classified as exploratory intrinsic study because the researcher was intrinsically interested in exploring AI startups characteristics.

Furthermore, there are four types of case study designs: *holistic single case design, embedded single-case design, holistic multiple-cases design,* and *embedded multiple-cases design* (Levy, 1988; Yin, 2009). For this study, multiple cases design was chosen because it allows to understand similarities and differences between cases, and is more robust than a single-case design (Baxter & Jack, 2008; Yin, 2009). Therefore, this research can be classified as a Type 4 embedded multiple-cases design. It is "multiple cases" because twenty-four companies were investigated, and each of them had unique attributes. Analysis of those companies and their attributes allows to show contrasting and similar characteristics (Eisenhardt, 1989b). It is "embedded" because separate quantitative and qualitative data of each company was collected. There are few disadvantages of multiple cases design: it is time consuming (Baxter & Jack, 2008), complex to analyze (Siggelkow, 2007), and sometimes has low representativeness (Gerring, 2004). On the other hand, multiple cases study enable investigation within and across situations (Tellis, 1997; Yin, 2009), provides strong and reliable evidence (Baxter & Jack, 2008), and allow wider explanation of research question to create more convincing theories (Eisenhardt & Graebner, 2007). Despite all disadvantages, the embedded-multiple cases design was the best case study type for this research.

Empirical research design quality can be judged with four tests: *construct validity, internal validity, external validity, and reliability* (Levy, 1988; Tellis, 1997). The construct validity of the research is critical. To ensure the construct validity of the study researcher should use multiple sources of evidence and establish a chain of evidence. The internal validity of the research can be ensured by doing pattern matching, explanation building, addressing rival explanations, and using logic models. In the third test, the external validity of the research can be ensured with the use of theory in single case studies and using replication logic in multiple case studies. Last but not least, reliability can be ensured by using a case study protocol and developing a research database (Johnson & Stake, 1996; Yin, 2009). The quality of the research design

will be ensured in this study with all above mentioned tests – multiple sources of evidence will be considered, explanation building implemented, external validity and replicability ensured.

3.4 Study data and data collection principles

There are three principles of data collection (Yin, 2009). Following those principles ensures that the appropriate data will be collected what means that the internal and external validity of the research will be ensured, and as a result, the study has the potential to be used for further investigation.

3.4.1 Principle 1: Multiple sources of evidence

One of the most significant advantages of case studies is the possibility of using multiple data sources. To avoid adverse effects of using more than one data source, it is essential to validate the collected data. Triangulation is an approach to data collection which allows careful validation. Triangulation can occur in data, theories and methodologies (Morland et al., 1992; Tellis, 1997). It is critical to comply with four rules of triangulation, mainly data triangulation, investigator triangulation, theory triangulation, and methodological triangulation (Davies, 2018; Patton, 2002). Thus, it is essential to collect data from multiple data sources, evaluate the data carefully, try different perspectives to the same dataset, and choose a few methods to analyze data (Yin, 2009).

One of the characteristics of the study unit – artificial intelligence startups - is opaqueness, which means that it is difficult to acquire information about their financing and capitalization structures (Cassar, 2004). To overcome the opaqueness of startups, the data was collected from multiple sources. According to Yin (2009), there are six sources of evidence that can be used in the study case. Those are *documentation, archival records, interviews, direct observations, participant observation, physical artifacts*. In this research, documentation evidence was collected. The weakness of documentation evidence is that it can be incomplete and biased. Reporting bias may occur, and therefore it is essential to validate the data.

The data validation was performed by collecting data from multiple sources. First, data was collected from Crunchbase, a platform for finding information about aspects of company founding. Collected data included organization name, operating status, closed date, founded date, number of founders, names of founders, total funding amount, funding status, number of funding rounds, number of investors, last funding type, last funding amount, top five investors, organization URL, description, website, twitter, LinkedIn, Facebook, contact email, full description. Furthermore, the data was verified with Owler.com, Zoominfo.com, and specific information about each company was verified on Facebook, LinkedIn, Twitter, and company website. In addition, the data about the investors and specific data about each investment was collected from Crunchbase. This data included investor name, investor type, investment amount, and location.

3.4.2 Principle 2: Create a case study database

To make the research replicable, it is essential to create a study database that can be later on used as a source of secondary analysis or independent analysis on a different topic. This database should include the case study data, documents, and all gathered materials (Tellis, 1997; Yin, 2014).

In this study, two databases were created. The first database included 169 Dutch Artificial Intelligence companies. However, because of database limitations, not all companies were investigated. Out of 169 companies, 144 were disqualified because of missing data. Missing data presents various problems, including reduced statistical power, the bias in the estimation of parameters, and reduced

representativeness of the samples (Kang, 2013). The best method of handling the missing data is to minimize the amount of it in the research (Kang, 2013). In this study, the adopted rule was that if the total funding amount, the last funding type, the number of investors, the number of founders, or the funding status was missing, then likewise deletion was performed (Skarga-Bandurova, Biloborodova, & Dyachenko, 2018). Likewise deletion is removing unit of analysis from the data. Above mentioned variables were necessary for further research; therefore, lack of them in the data disqualified those companies. Thus, appropriate mechanisms for the missing data were used to conduct statistically valid analysis. Furthermore, Crunchbase data was validated by comparing it to the company data available on different websites such as Facebook, LinkedIn, Twitter, company website. The specific data validation rule was adapted. If in two other data sources, the data was different, it was also changed in the new database. In this way, cross-checking of consistency was performed to ensure the correctness of the data (Johnson & Stake, 1996).

To define characteristics unique for AI startups, a control group of companies needs to be compared with AI startups. Software startups were deemed as appropriate control group in research led by Kelnar (2019), on AI startups characteristics. Software startups can be defined as startups that do not claim to use artificial intelligence. Thus, for this research, the second database created included non-AI software startups. The data on 175 software startups was collected on crunchbase.com, 95 of those companies were eligible for analysis and 80 companies were disqualified because of missing essential data (variables: number of investors, number of funding rounds, last funding type or total funding amount). In this case, complete company deletion was performed (Skarga-Bandurova et al., 2018).

3.4.3. Principle 3: Maintain Chain of Evidence

The last data collection principle is maintaining a chain of evidence that assures the reliability of the case study information. This principle allows replication of the research in future by following the initial research report, database, and protocol. The goal is to create a chain of evidence that can be followed by a random person wanting to recreate research. In this study, the chain of evidence was established to ensure research replicability. Therefore, a case study database was created to gather the collected evidence. In this database, two separate sections for investors and companies were created. An extensive study of those ventures was performed to get a better understanding of what are the Dutch AI startups unique characteristic, and what is the difference between AI and software startups financing. In addition, all plots and calculations were added in additional workbooks. The design of the study was created to maximize construct validity by using multiple sources of evidence, establishing a chain of evidence, internal validity, external validity, and reliability (Johnson & Stake, 1996; Morland et al., 1992; Tellis, 1997; Yin, 2009).

CHAPTER 4: Analysis of data

4.1 Descriptive Statistics of twenty-four Dutch AI startups.

In this study, twenty-four Dutch artificial intelligence companies were investigated in detail to understand their characteristics and how they are financed. In the following sections, the total investment amount, funding rounds, and investors will be studied in more detail.

4.1.1 Analysis of the total investment amount

Figure 2 illustrates the total amount of financing gathered by investigated companies during their lifetime.

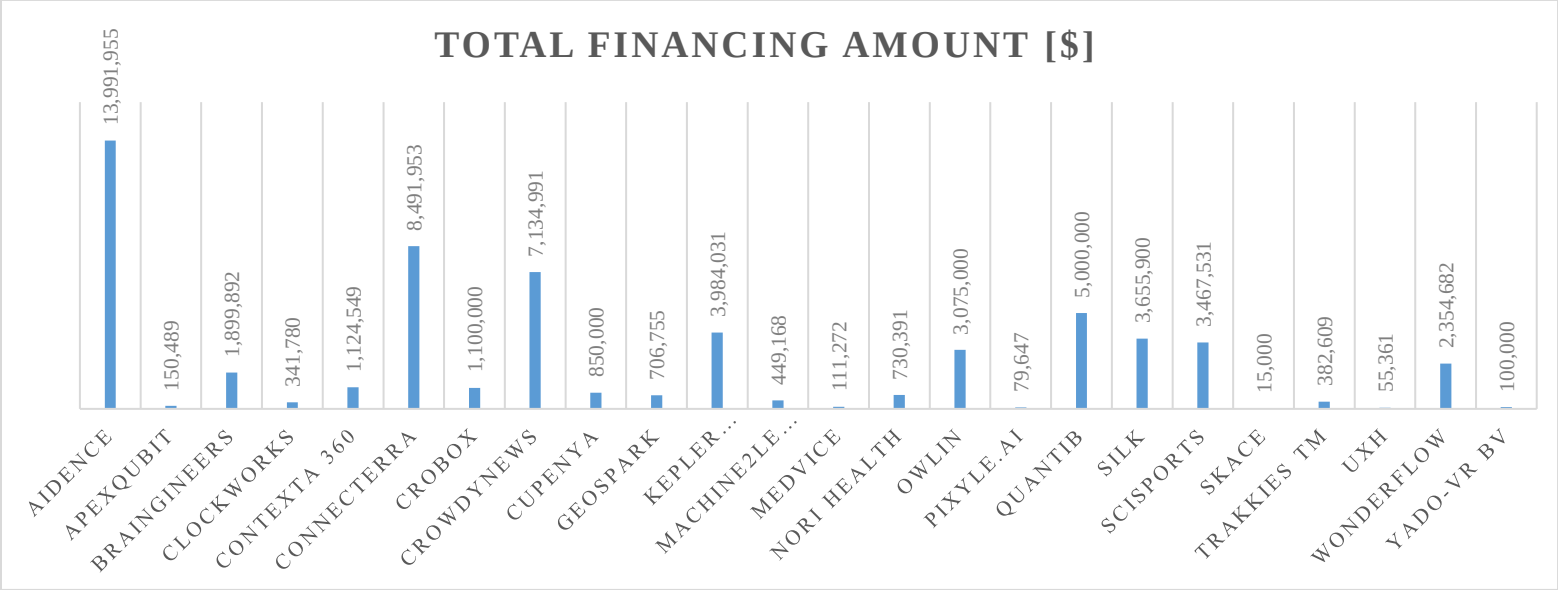

Figure 2. Bar chart. Figure illustrates total financing amount in dollars for each investigated company.

As can be concluded from the data (Figure 2), the investment companies varied from approximately $15,000 to $14,000,000. The mean financing amount was $2,602,763.79. There are three companies which secured substantial investments (above $7,000,000): Aidence, Crowdynews and Connecterra.

4.1.2 Analysis of round type

In the group of 24 AI startups, six-round types were differentiated: pre-seed, seed, series A, series B, debt, and grant. Some of the AI startups had more than one financing round; therefore, in total, there were fifty-five financing rounds. The most popular was seed round, which was at least once in every company and in total twenty-seven times in the sample. The amount of money collected during all seed rounds reached $15.763,690 in total, with a mean of $583.840 Furthermore, very popular were also pre-seed round, and Series A. Former one occurred twelve times with $2,038,171 collected in total and mean of $169.847 and the latter occurred seven times with $20,300,000 in total and mean of $3,383,333. Less popular were debt, grant, and series B rounds. Only two companies decided to take a loan ($1,253,000 in total; M=$625,500), five companies received grants (total = $2,663,000; M= $532,600) and one company reached series B (total= $1,800,000) (Appendix E). To conclude, the highest amount of funds was collected during round A despite it only occurring seven times. This is in line with the literature, since series A is occurring in later stages of a company and more funds are usually collected.

Furthermore, it is essential to analyze the financing rounds pattern for each company. Figure 3 illustrates the total financing amount with a visual representation of all financing rounds. The limitation of this figure is that it is difficult to read how much money was invested during each financing round. Nevertheless, the overall distribution of money invested in consecutive rounds can be read from this figure. According to Figure 3, in almost all cases, the second financing round was higher than the first financing round. This is in line with the literature since the company is often raising more money in the second round because it is successful.

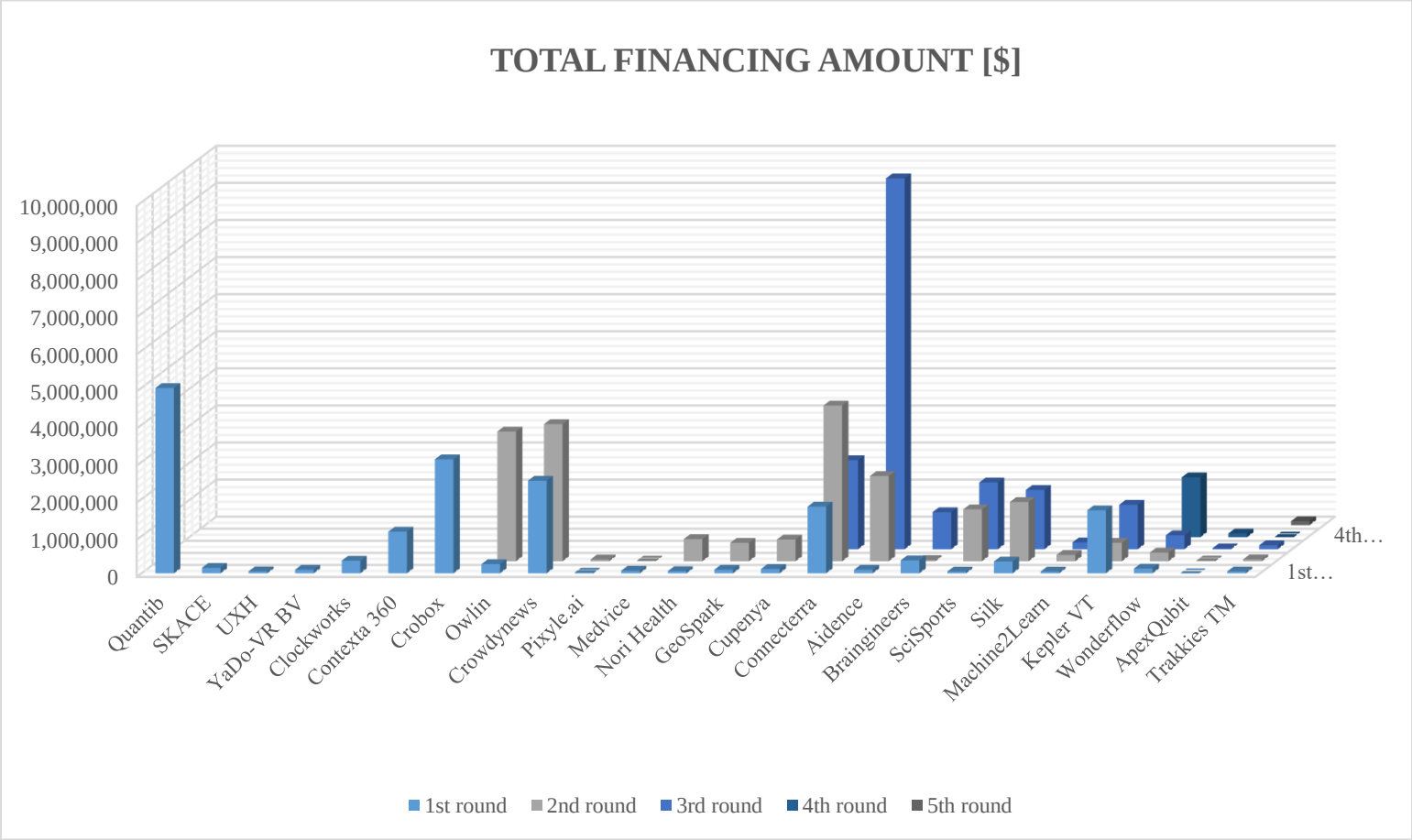

Figure 3: Bar chart. Figure illustrates total financing amount in dollars of all investigated companies divided into rounds

Furthermore, companies with more financing rounds (four or five) not always collected more money than companies with less financing rounds. For example, companies with four and five financing rounds (Machine2Learn, Kepler Vision Technology, Wonderflow, ApexQubit, and Trakkies TM) together collected less money than Quantib in one round. Therefore, it can be concluded from the data that the higher number of financing rounds does not necessarily mean more money collected for the company.

Three companies with unique financing patterns are Kepler Vision Technology, Braingineers, and Conecterra. The first two of them are companies that collected more money in the first round than in the second financing round. Furthermore, Conecterra collected more money in the second round than in the first round; however, in the third round, less money was collected. Another interesting company is Aidence, which collected a relatively small amount of money in the first and second round but managed to secure a considerable investment in the third round. The third-round investment is an outlier since it is approximately

$9,000,000 which is more than total investment in 15 companies from this study case (Skace, UXH, YaDo VR BV, Contexta360, Crobox, Pixyle.ai, Medvice, Nori Health, Geospark, Cupnya, Braingineers, Machine2Learn, Wonderflow, ApexQubit, TrakkiesTM).

Furthermore, for this study, companies were divided into five categories based on the number of financing rounds (Appendix A). Category 1 includes seven companies with one financing round (Appendix F). The total amount of money collected by companies with one financing round is equal $7,736,690, with a mean of $1,105,241. However, there is a discrepancy in category one; funding amounts are varying from $15,000 collected by SKACE to $5,000,000 collected by Quantib. Six out of seven companies with one financing round had seed round type, only one was Series A round.

Category 2 includes seven companies with two financing rounds (Appendix G). The companies managed to collect $12,688,056 in total, with a mean of $1,812,579. All companies managed to secure a more substantial second round, the average amount collected in round one was $446,000, and in round, two $1,279,571. In addition, the most popular was a seed round – it appeared eight times – only two companies (Crowdynews, Nori Health) did not have a seed round. On the contrary, pre-seed, grant, and Series A rounds were not popular; they appeared one, two, and three times respectively.

Category 3 includes seven companies with three financing rounds (Appendix H). The companies collected $35,940,430 with an average of $5,134,347. Furthermore, similarly to companies with two financing rounds, AI startups collected more money in every consecutive round (round one M= $624,000; round two M = $1,458,285; round three M= $2,597,857).

Category 4 includes two companies with four financing rounds and one company with five financing rounds (Appendix I). The companies with four financing rounds collected $962,593 on average and $2,887,780 in total. In addition, they collected on average $65,835; $128,750; $201,000; $857,000 in first second third and fourth-round retrospectively. The company, with five financing rounds, collected $382,609. This is counterintuitive since it seems like companies with more financing rounds should collect more money. Furthermore, Trakkies™ collected the same amount of money in the first and second rounds ($53,000) and in third and fifth ($107,000). However, in round four, the company collected only $16,000. This is also counterintuitive since, in comparison to all companies in the dataset, each consecutive round was bigger. Therefore, Trakkies™ is a unique case of a company which regardless of the large number of rounds, collected a relatively small amount of funds, and the amount of money collected in each consecutive round was not growing.

4.1.3 Analysis of the number of investors

Eighty investments were made in the sample of 24 Dutch AI startups, with 54 investment rounds (Appendix J). In those eighty investors, fifty-two (Appendix K) were unique, which means that some investors invested in more than one company from the dataset or invested in more than one round in the company. The most popular investors were venture capital investors (24), business angels (17), and accelerators (11). Thirteen investors were unknown. Furthermore, considering only unique investors venture capitalists invested eighteen times, business angels fourteen times and government offices seven times. In many cases, investors decided to invest in consecutive rounds (Crowdynews – INKEF Capital; Cupneya – Rockstart Accelerator; Conecterra – Elias Tabet, Breed Reply; Aidence- henQ; Silk -Atomico). Investors often get pre-emptive rights, and they can invest in consecutive rounds to maintain their current ownership of a company. Nevertheless, this information is not publicly available; therefore, it is not possible to check whether this was a reason for the follow-up investment.

4.2 Framework: AI startups using core technologies

According to the MMC Ventures Report (2019), there are eight core AI sectors: Asset Management, Healthcare, Insurance, Law & Compliance, Manufacturing, Retail, Transport and Utilities. As can be seen in Table 2. fourteen out of twenty-four (58.3%) AI startups were classified as core technology AI startups. Ten out of twenty-four companies in the sample (UXH, SKACE, YaDo-VR, Crowdynews, Cupneya, Conecterra, SciSport, Silk, Wonderflow, Trakkies) did not focus on core technologies. The classification was created by fitting identified core sectors (Kelnar, 2019) to the 24 AI startups description. The results can be found in Table 2.

Table 2: AI startups using core technologies.

Company	Description of core use	Core use case	Sector
Clockworks	Clockworks product is Blicker, an intelligent meter readout assistant that digitalizes gas, electricity, and water meters from photos. The product goal is to increase customer satisfaction and achieve higher customer response rates.	Customer Experience	Utilities
Quantib	Quantib provides groundbreaking technologies for patient diagnosis in the radiology field. Quantib developed accurate medical image analysis software whose primary function is to detect abnormalities	Diagnostic	Healthcare
Crobox	Crobox provides online retailers with insights on consumer psychology to help them understand consumers better and optimize personalized online buyer journeys.	Content Personalization	Retail
Contexta360	Contexta360 analyzes voice calls and turns them into data useful for the organization. Speech intelligence insights are used to categorize and label customer service and sales calls.	Customer segmentation	Retail
Owlin	Owlin developed a tool that helps finance professionals monitor their finance portfolio proactively and in real-time. It helps recognize emerging risks, opportunities, and trends.	Investment strategy	Asset Management
Medvice	Medvice created a tool to automate clinical processes for emergencies. The software is improving patient-doctor interactions and allowing tele-diagnostics.	Diagnostic	Healthcare
Pixyle.ai™	Pixyle.ai™ created recognition software detecting fashion items. Customers can visually search for products and get relevant similar product recommendations on their e-commerce platforms. This way, content is personalized and customer engagement is increased.	Content personalization	Retail
Nori Health™	Nori created a chatbot coach for people that live with Crohn's disease or Colitis. The digital coach helps discover, monitor, and change the lifestyle factors that impact patient well-being.	Monitoring	Healthcare
GeoSpark	GeoSpark created AI location tracking technology with the use of a combination of location sensors like GPS, Assisted GPS, and Network. Geospark can predict the user's mode of transportation and therefore optimize infrastructure.	Infrastructure optimization	Transport
Aidence	Aidence created a tool to improve reporting in the treatment of lung cancer. It helps radiologists by detecting, quantifying, and reporting on lung nodules present on CT- scans.	Diagnostic	Healthcare
Braingineers	Braingineers' goal is to reform customer experience research. It is a neuro-usability platform analyzing users' emotions.	Customer experience	Utilities
Machine2Learn	Machine2Learn allows control or automating local tasks in a production line and to monitor and manage the quality of production.	Asset performance	Manufacturing

Kepler Vision Technology	Kepler Vision Technologies created a tool for elderly care at night. The software investigates live streams and can recognize when a patient needs care.	Monitoring	healthcare
Apex Qubit	ApexQubit created a platform for drug design that allows customer to save 20% income by boosting the drug discovery phase.	Drug design	Healthcare

4.3 Analysis of hypotheses

This study hypotheses can be divided into two groups. The first group includes hypotheses focused on validating claims from the literature on characteristics of the AI startups (H1, H2, H3). The second group includes hypotheses focused on the comparison of AI startups and software startups financing characteristics (H4, H5, H6, H7). All hypotheses together aim to answer the question: What are unique Dutch AI startups' characteristics?

H_1: 90% of AI startups are B2B.

H_{1o} : p=.90 90% of AI startups are B2B
H_{1a} : p<.90 Less than 90% of AI startups are B2B

According to Kelnar (2019), 90% of AI startups are B2B. To investigate this hypothesis classification of twenty-four Dutch AI startups was performed. Dutch AI startups were divided into three groups: business to business (B2B), business to consumer (B2C), and business to government (B2G). B2B are AI startups creating products for businesses, B2C are creating products for customers, and B2G are creating products for government agencies. As a result of classification, 18 Dutch AI startups were classified as B2B and only six startups (Clockworks, YaDo-VR, Owlin, Nori health, Silk, and Trakkies) were assigned to B2C category. What is interesting there were no B2G Dutch AI startups in the sample. To validate the hypothesis H_{1o}.z-test for a proportion was performed. The proportion of B2B AI startups differs from 0.9, as indicated by a z-test: z= 2.4, p =0.0072. Therefore, the H_{1o} can be rejected, and thus it can be concluded that less than 90% of Dutch AI startups are B2B. This finding contradicts Kelnar (2019) statement that 90% of AI startups are B2B. However, it is in line with Levine (2017), since because of data availability, it is less difficult for AI startups to focus on B2C than on B2B. Therefore, it is easier to create B2C AI startup. This finding indicates that in the Netherlands approximately 25% of startups focus on B2C while 75% of startups on B2B.

H_2: 10% of AI startups focus on core technology

H_{2o} : p=.10 One in ten AI startups focuses on core technology
H_{2a} : p>.10 More than one in ten AI startups focus on core technology

According to Kelnar (2019), out of 1600 AI startups, only one in ten startups focus on core technology and as a result has the potential to grow the economy significantly. To validate this hypothesis, first startups were classified into core and non-core technology startups (Table 2). The classification was created according to the MMC Report – The State of Divergence 2019 (Kelnar, 2019). In present study fourteen out of twenty-four (58.3%) Dutch AI startups were classified as core technology AI startups. Only ten companies in the sample (UXH, SKACE, YaDo-VR, Crowdynews, Cupneya, Conecterra, SciSport, Silk, Wonderflow, Trakkies) did not focus on core technologies.

To validate the hypothesis H_{2o}, a z-test statistic for a proportion was performed. The proportion of AI startups focusing on core technology differed from 0.1, as indicated by a z-test: z= -7.548, p =0.00001.

Therefore, the H_{2o} can be rejected, and thus it can be concluded that more than 10% of Dutch AI startups focus on core technology. This result is very interesting since it is contrary to the claim made by Kelnar (2019). It is of considerable importance to understand why the percentage of core technology startups is much higher in this research than in Kelnar (2019) research. There are multiple explanations of this discrepancy. The first of them is that the sample is too small, and there is a hidden bias that led to a higher percentage of core technology Dutch AI startups in the sample. Secondly, startups might be wrongly classified by MMC Ventures or by the researcher in this study. However, it might also be the case that the country in which AI startups were created might affect their focus on core technology. Kelnar (2019) research focused on AI startups worldwide. However, this study is focused on Dutch AI startups. Therefore, questions arise: Are Dutch AI startups more often focused on core technology? If the core technology focus is indeed dependent on country in which AI startup was created, it can indicate that Dutch AI startups have huge potential to grow the economy significantly. However, further investigation is necessary to prove it.

H_3: More than 50% of the artificial intelligence startups is financed by venture capital investors and business angels

H_{3o} : $p<.50$ Less than 50% of AI startups are financed by VC & BA.
H_{3a} : $p>.50$ More than 50% of AI startups are financed by VC & BA.

According to Kelnar (2019), venture capitalists and business angels are the most common AI investors. For business angels, it is a high risk and high return investment (Ramadani, 2009). For venture capitalists, a portfolio focused on AI startups allows to collect more capital, and therefore AI startups are of primary focus. Hence, this study investigated whether more than 50% of AI startups is financed by venture capitalists and business angels. The analysis was performed on twenty-four Dutch AI startup companies, which were financed by sixty-seven investors in total (excluding thirteen unknown investors). The sample consists of twenty-four venture capital investors (36%), six private equity investors (9%), nine government investors (14%), seventeen business angels (25%), and eleven accelerators (16%). Therefore together, business angel investors and venture capitalists constituted 61% of all investors investing in AI startups. Hypothesis H_{3o} was constructed in such a way to make it possible to disprove it. However, a z-test showed that the result was not statistically significant, $z=(-1.0769)$, $p=0.14007$. Therefore, the H_{3o} cannot be rejected what means that it cannot be concluded that business angels and venture capitalists finance that majority of AI startups. This suggest that in the Netherlands not only business angels and venture capitalists are leading investors, but also other investors often fund AI startups.

H_4: Government investment is less often in AI startups than in non-AI (software) startups.

Another investor studied in this research was the government office. According to the literature, the government provides a significant contribution of 25% of all funds to high-tech startups (Nagaoka, 2009). Furthermore, the Dutch national strategy is to focus on AI development to increase economic growth by looking for opportunities and investing in artificial intelligence technology (Appeven, 2019; Lagendijk et al., 2018; Vermeer, 2019). Therefore, the hype connected with AI technology and AI startups, leads to assumption that government investment in AI startups should be more often than investment in software startups. Out of twenty-four Dutch AI startups in the sample, seven (29%) were partially or fully financed by the government (government agencies: UNIIQ, Innovation Fund Macedonia, European Union, EASME – EU Agency for SMEs, SBRI Healthcare, University of Amsterdam, Ministry of Economic Affairs). For software companies, only five startups out of ninety-seven (0.5%) were financed by government agencies (UNIIQ, European Investment Bank (Luxemburg) EASME (Belgium), and BOM Brabant Venture).

Furthermore, according to Table 3., government investors constituted 11.25% of all AI startups investments while for software investments, the percentage was only 0.017% of all investments. To compare both groups, a z-test for two population proportions was performed. It can be concluded at a 95% confidence level that hypothesis H_4 can be rejected (z-score=3.9168, p=0.00008), and that the proportion of government investors in both types of startups differ. Thus, it can be concluded that government investors are more likely to invest in AI startups than in software startups. Present study results are in line with the literature suggesting that government investors are more likely to invest in AI startups than in software startups (Appeven, 2019; Nagaoka, 2009; Vermeer, 2019). This phenomenon is very interesting, especially considering the hype around AI startups and the fact that research proves 40-50% of AI startups wrongly claiming use of AI technology (Kelnar, 2019). This study result can be used to further investigate why government invest in the AI startups. Is it based on the hype around artificial intelligence? Or is it because the government recognized potential for high economic growth coming from the AI startups? Answering those questions can provide deep understanding of government funding strategy for AI startups.

H_5: The number of investors is smaller for AI startups than for non-AI (software) startups

According to the research, there is a hype around artificial intelligence technology, which leads to an increase in the number of investors willing to invest in AI startups (Kelnar, 2019; Olson, 2019). This study investigated whether AI startups have greater investor numbers. To validate H_5 two-sample t-test was performed. An independent t-test allows to compare the number of investors for Dutch AI startups and Dutch software startups. At a 95% confidence level, there was a significant difference in the number of investors for Dutch AI startups (M=2.56, SD=2.25) and Dutch software startups (M=2.30, SD=1.73). These results suggest that the number of investors in Dutch AI startups is, on average, approximately three, while the number of investors in software startups is, on average, approximately two. Therefore, the H_5 can be rejected, and it can be concluded that the number of investors is larger for AI startups than for non-AI startups. What suggest that Dutch AI startups are more likely to attract larger number of investors than non-AI startups and is in line with research by Kelnar (2019) and Olson (2019).

H_6: The proportion of investor types investing in AI startups and non-AI (software) startups differ

Furthermore, the proportion of investors investing in AI startups and non-AI startups was investigated. Some investors types might be inclined to invest in AI startups more often than in software startups. In this study, the sample of software startups is larger than the sample of AI startups, and the number of investor types in both types of startups differs (Table 3). Therefore, the proportions of investors were studied.

Table 3: Number of Investors for AI startups and software startups.

Investor type	AI STARTUPS (N=80)	SOFTWARE STARTUPS (N=286)
Venture Capital	24	151
Business Angels	17	26
Government	9	5
Private Equity Firm	6	32
Accelerator	17	24
Others	13 (unknown)	28 (unknown) 20 (other)

Since the sample size is relatively small for both groups, the z-score test was used to validate this hypothesis. Z-score test is the most suitable method for random sample population groups with categorical variables such as investor type. The proportions between the two groups were calculated for venture capitalists, private equity firms, business angels, and accelerators. Government was investigated in H_4. Therefore, sub-hypotheses were created

$H_{6.1}$: The proportion of venture capital investors for AI startups and software startups is equal

According to the data, venture capitalists constitute 30% of AI startups investors and 52% of software startup investors (Table 3). The results of analysis (z = -3.6084, p=0.0003) indicated that the proportion of venture capital investors differ for software startups and AI startups.

$H_{6.2}$: The proportion of business angels' investors for AI startups and software startups is equal

Reading from Table 2, business angels constitute 21% and 9% of investors for AI startups and software startups retrospectively. Furthermore, the result of z test is significant (z =2.9856, p=0.00278). Hence the $H_{6.2}$ is rejected, and it can be concluded that both types of startups differ in the proportion of business angel investors.

$H_{6.3}$: The proportion of private equity investors for AI startups and software startups is equal

The result of z test leads the conclusion that at a 95% confidence level the null hypothesis $H_{6.3.}$ cannot be rejected for private equity investors (z = -0.9562, p=0.33706). Therefore, it can be concluded that the proportion of private equity investors in both AI startups and software startups is equal.

$H_{6.4}$: The proportion of accelerators investors for AI startups and software startups is equal

According to the Table 2. 21% of AI startups and 8% of software startups are financed by accelerators. The proportion of accelerators investing in AI and startups differ, as indicated by z-test: z=-3.2235, p=0.00128 Therefore, $H_{6.4}$ is rejected and it can be concluded that the proportion of accelerator investors differ for software startups and AI startups.

Thus, present study shows that the proportion of investor types for AI startups and software startups differ. Venture capitalists are more inclined to invest in software startups while business angels and accelerators prefer to invest in AI startups. There was no difference between the sample proportion for private equity firms, which means that they are likely to invest in both types of startup.

H_7: AI startups raise smaller investment rounds than non-AI (software) startups at all stages of maturity.

According to the MMC Ventures report (2019), AI companies raise, on average more capital than traditional software companies. This difference can be seen in all stages: seed, series A, series B, and series C funding. Therefore, the investment amount in both types of startups will be investigated in this research for seed, series A rounds. To compare both groups, two-sample t-test was performed.

$H_{7.1}$: Mean investment in seed round for AI startups and software startups is equal

The 13 AI startups seed rounds (M=$ 664,941, SD= $640,472) compared to 44 software seed rounds (M= $1,310,199, SD= $1,600,459) demonstrated little or no difference in mean investment t(55)=1.4132, p=0.1632. Therefore $H_{7.1.}$ cannot be rejected and therefore it can be concluded that the mean investment in the seed round for AI startups and software startups is equal.

$H_{7.2}$: Mean investment in series A round for AI startups and software startups is equal

The 18 software startups series A rounds (M=5,260,049, SD=6,451,012) compared to 4 AI startups series A rounds (M=6,243,855, SD= 3,555,362) demonstrated no statistically significant difference in mean investment amount for both groups t(20)=0.2915, p=0.7736. By conventional criteria, this difference is not statistically significant, therefore $H_{7.2}$ cannot be rejected which means that the mean investment in the series A round for both types of startups is equal.

The present study proved that the mean investment in seed and series A rounds for both AI and software startups are approximately equal. In conclusion, considering data available in this study, it can be stated that there is no statistical significance in the difference in mean investment for seed and series A rounds for AI and software startups. This result might suggest that "hype" around AI technology might not affect amount of money collected in financing rounds. This is in line with literature showing that the AI industry hype is slowly coming to an end because people recognize that the machines cannot match human flexibility in some tasks (Mehra, 2019). Nevertheless, some researchers claim that the AI hype cycle will not end anytime soon, since AI can speed up calculations significantly, and there are endless possibilities that are not yet discovered (Hovhannes Avoyan, 2017). Therefore, the effect of the AI hype on financing and funding rounds should be further investigated in future research with a larger data set.

4.5 Pattern matching

Pattern matching is a hypothesis and data linking technique which ensure internal validity, and reliability of a case study (Trochim, 1989; Yin, 2009). Pattern matching was performed on hypotheses focused on comparison of AI startups and non-AI (software) startups. It was performed to answer question: *What patterns are emerging for AI startups financing?* Empirically based patterns indicated that:

> *Pattern 1:* Investor number is affected by the type of startup – more investors decide to fund AI startups than non-AI startups (H5).
>
> *Pattern 2:* Investor types are affected by the type of startup – venture capitalists, business angels and government offices are more inclined to invest in AI startup (H4; H6).
>
> *Pattern 3:* Rounds are affected by the type of startup – AI startups raise more capital than non-AI startups in all round types including Seed and Series A (H7).

This study shows that there are two patterns emerging for Dutch AI startups financing. First of them is that Dutch artificial intelligence startups attract larger number of investors than software startups. Second is that some investor types are more inclined to invest in AI startups. It is a case for business angels, venture capitalists and more importantly government office. Government office pattern is very interesting since the difference between both groups (AI startups and non-AI startups) was astonishing – 30% of AI startups were at least once financed by government while for software startups only 1% was funded by government. Last but not least, pattern matching of H7 reflected that there is no specific pattern in investments in seed and series A rounds for both AI and software startups.

CHAPTER 5: Concluding Remarks and Suggestions

Few interesting findings were made in this research. Descriptive statistics suggest that in few Dutch AI startups cases, the amount of money collected in consecutive rounds was not always higher. However, similarly to other startups, the mean amount of money collected in consecutive rounds was growing. In addition, in the sample companies with higher number of rounds not always collected more money than companies with lower number of rounds. Furthermore, Dutch AI startups characteristics were studied. It was proven, that majority of Dutch AI startups focus on core technology. This focus implies that they can bring value to the economy what is in line with Dutch national artificial intelligence strategy. Secondly, 75% of AI startups are B2B. This finding is important since B2B companies are more stable than B2C companies in case of crisis. For example, with the COVID-19 pandemic the drop in the demand for B2B companies was approximately 10% smaller than for B2C businesses (Rogers, 2020). Furthermore, significant differences between AI startups and non-AI startups were found. First of them is difference in the number of investors, which is larger for AI startups. Hence, it can be concluded that investors more often choose AI startups. Furthermore, descriptive statistics suggest that certain investor types such as business angels, and accelerators are more inclined to invest in AI startups. This was confirmed in the study by finding out that proportion of investor types for AI startups and software startups differ. Present study shows that business angels and accelerators are more inclined to invest in AI startups while venture capitalists prefer software startups. In addition, government investments in AI startups are significantly more often than in non-AI startups. Therefore, there are two clear patterns for AI startups – they attract larger number of investors and three types of investors: government, business angels and accelerators. Thus, it can be concluded that Dutch AI startups unique characteristics are: core technology focus, relatively large number of investors and unique proportion of investor types.

5.1 Limitations

There are two main limitations of this research. The first of them relates to literature on the topic. Artificial intelligence technology and artificial intelligence startups are relatively new. Therefore, there is little research available, and the literature is often in the form of reports. This makes the research challenging but very valuable for future researchers. The second limitation of this research is the small sample size. The data on AI startups collected in this study included 169 Dutch AI startups. Nevertheless, out of 169 companies, 144 were disqualified because of missing data. Missing data presents various problems, including reduced statistical power, the bias in the estimation of parameters, and reduced representativeness of the samples (Kang, 2013). Therefore, only 24 companies were investigated in detail and compared with software startups. Also, the comparison of the two groups carries a particular risk as well. Although software startups were chosen as the best comparison group for AI startups (Kelnar, 2019) there is still a possibility that another group would better represent the uniqueness of AI startup characteristics. Finally, this research value would increase if there would be a possibility of an interview with the owners or employees of investigated companies. That would allow to collect more information and validate information available online. This research is limited to the data which was entered manually on the Crunchbase website and on other company websites. Nevertheless, the interview would allow gaining more insight into companies financing and therefore investigate it in more depth.

5.2 Suggestions for further research

Dutch artificial intelligence startups have unique characteristics that can be investigated in more detail. The first interesting finding from this study, which can be further investigated, is the focus of AI startups. According to the study, more than 50% of Dutch AI startups focus on core technology. Nevertheless, according to the literature, only 10% of AI startups focus on core technology. This discrepancy should be investigated to understand whether this phenomenon is unique only for the Netherlands or is it standard for other countries as well. The result of this study could be used to understand AI startups better and use them for more substantial economic growth in the Netherlands. The second interesting finding which could be investigated in more detail is a statistically significant investment of government offices in Dutch AI startups in comparison to software startups. Future research can be used to investigate further why the government invests in AI startups. Is it based on the hype around artificial intelligence? Or is it because the government recognized the potential for high economic growth coming from the AI startups? Understanding government motives can lead to gaining a deeper understanding of those investors. Finally, this study results leads to the question: is the artificial intelligence hype affecting AI startups financing? This can be investigated in future research by contacting investors and learning about their approach to the AI hype. This can add more value to the understanding of AI startups and their financing.

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Appendices:

Appendix A: AI startups divided into tables by number of financing rounds.

Table 4. Table shows companies with one financing round

Organization Name	Founded Date	Operating Status	Total Funding Amount	Round number	Round Type	Year	Approximate amount ($)	Financing companies	Investor Type	Location
Quantib	1/1/2012	Active	$5,000,000.00	1	Series A	2017	$5,000,000.00	Holland Venture	Private Equity Firm	Netherlands
SKACE	9/22/2015	Active	$15,000.00	1	Seed	2015	$15,000.00	Startupbootcamp	Accelerator	United Kingdom
UXH	7/1/2016	Closed	$55,361.00	1	Seed	2016	$55,361.00	Luxury Hospitality Group	Private Equity Firm	Netherlands
YaDo-VR BV	6/30/2016	Active	$100,000.00	1	Seed	2016	$100,000.00	TMI Investments BV	Private Equity Firm	Netherlands
Clockworks	4/29/2017	Active	$341,780.00	1	Seed	2018	$341,780.00	UNIIQ	Government Office	Netherlands
Contexta360	1/1/2016	Active	$1,124,549.00	1	Seed	2019	$1,124,549.00	Venture Builders Capital	Venture Capital	Netherlands
Crobox	8/19/2014	Active	$1,100,000.00	1	Seed	2016	$1,100,000.00	Keadyn	Venture Capital	Netherlands
								Ventech	Venture Capital	France

Table 5. Table shows companies with two financing rounds

Organization Name	Founded Date	Operating Status	Total Funding Amount	Round number	Round Type	Year	Approximate amount ($)	Financing companies	Investor Type	Location
Owlin	6/23/2012	Active	$3,075,000.00	1	Seed	2012	$250,000.00	Rockstart Accelerator	Accelerator	Netherlands
								Noro Venture Capital	Private Equity Firm	Netherlands
				2	Series A	2019	$3,500,000.00	Velocity Capital Private Equity	Venture Capital	Netherlands
Crowdynews	1/1/2010	Active	$7,134,991.00	1	Series A	2015	$2,500,000.00	INKEF Capital	Venture Capital	Netherlands

				2	Series A	2016	$3,700,000.00	INKEF Capital	Venture Capital	Netherlands
Pixyle.ai	1/17/2018	Active	$79,647.00	1	Seed	2018	$20,000.00	Rockstart AI	Accelerator	Netherlands
				2	Grant	2019	$50,000.00	Innovation Fund Macedonia	Government Office	Macedonia
Medvice	1/1/2016	Active	$111,272.00	1	Seed	2018	$73,000.00	Igor van Eck	Business Angel	Netherlands
								Henry Rouquairol	Business Angel	United Kingdom
								Ahmed Abushanab	Business Angel	Netherlands
				2	Seed	2018	$20,000.00	Rockstart AI	Accelerator	Netherlands
Nori Health	10/1/2017	Active	$730,391.00	1	Grant	2017	$60,000.00	European Union	Government Office	Netherlands
				2	Pre Seed	2019	$600,000.00	Unknown	Business Angel	Netherlands
GeoSpark	9/1/2017	Active	$706,755.00	1	Seed	2017	$100,000.00	Steven van Houwelingen	Business Angel	Netherlands
				2	Seed	2018	$500,000.00	Airbridge Equity Partners	Venture Capital	Netherlands
Cupenya	3/1/2013	Active	$850,000.00	1	Seed	2013	$119,000.00	Rockstart Accelerator,	Accelerator	Netherlands
								Steven van Houwelingen	Business Angel	Netherlands
				2	Seed	2015	$587,000.00	Rockstart Accelerator	Accelerator	Netherlands

Table 6. Table shows companies with three financing rounds

Organization Name	Founded Date	Operating Status	Total Funding Amount	Round number	Round Type	Year	Approximate amount ($)	Financing companies	Investor Type	Location
Connecterra	11/1/2014	Active	$8,491,953.00	1	Seed	2016	$1,800,000.00	MVI (MENA Venture Investments)	Venture Capital	United Arab Emirates
								Elias Tabet	Business Angel	United Kingdom
								DeNA	Private Equity Firm	Japan
								Breed Reply	Accelerator	United Kingdom
				2	Series A	2018	$4,200,000.00	Sistema_VC	Venture Capital	Russia
								MENA Ventures	Venture Capital	Ireland
								Elias Tabet	Business Angel	United Kingdom
								Breed Reply	Accelerator	United Kingdom
								AgFunder	Venture Capital	United States of America
								Acequia Capital	Venture Capital	United States of America
				3	Grant	2019	$2,400,000.00	EASME- EU Executive Agency for SMEs	Government Office	Belgium
Aidence	1/1/2015	Active	$13,991,955.00	1	Grant	2017	$100,000.00	SBRI Healthcare	Government Office	United Kingdom
				2	Seed	2017	$2,300,000.00	henQ	Venture Capital	Netherlands
				3		2019	$10,000,000.00	INKEF Capital	Venture Capital	Netherlands
					Series A			Rabo Ventures	Venture Capital	Netherlands
								henQ	Venture Capital	Netherlands
								Northzone	Venture Capital	Sweden
								Healthinnovations	Private Equity Firm	United Kingdom
Braingineers	11/16/2015	Active	$1,899,892.00	1	Pre-Seed	2015	$350,000.00	Unknown	Unknown	Unknown
				2	Pre-Seed	2017	$35,000.00	Unknown	Unknown	Unknown

				3	Seed	2019	$1,000,000.00	JOA Ventures	Venture Capital	Netherlands
SciSports	9/1/2012	Active	$3,467,531.00	1	Seed	2013	$50,000.00	LLX2 Investments	Business Angel	Netherlands
				2	Series A	2016	$1,400,000.00	Unknown	Unknown	Unknown
				3	Series B	2017	$1,800,000.00	Unknown	Unknown	Unknown
Silk	1/1/2010	Closed	$3,655,900.00	1	Seed	2011	$320,000.00	Mark de Lange	Business Angel	Netherlands
								Hans Poul Veldhuyzen van Zanten	Business Angel	Netherlands
								Han de Groot	Business Angel	Netherlands
								Floris Rost van Tonningen	Business Angel	Netherlands
								Atomico	Venture Capital	United Kingdom
				2		2012	$1,600,000.00	New Enterprise Associates	Venture Capital	United States of America
								Atomico	Venture Capital	United Kingdom
								Philippe Cases	Business Angel	United States of America
								Jens Christensen	Business Angel	United States of America
								Anil Hansjee	Business Angel	Netherlands
				3	Seed	2013	$1,600,000.00	New Enterprise Associates	Venture Capital	United States of America
Machine2Learn	8/29/2017	Active	$449,168.00	1	Pre-Seed	2017	$48,000.00	Unknown	Unknown	Unknown
				2	Seed	2017	$173,000.00	European Union	Government Office	Netherlands
				3	Seed	2017	$185,000.00	European Union	Government Office	Netherlands
Kepler Vision Technologies	2/1/2018	Active	$3,984,031.00	1	Seed	2018	$1,700,000.00	University of Amsterdam Ventures	Government Office	Netherlands
				2	Seed	2019	$500,000.00	Unknown	Unknown	Unknown
				3	Debt	2019	$1,200,000.00	Ministry of Economic Affairs (Innovation Credit)	Government Office	Netherlands

Table 7. Table shows companies with four financing rounds

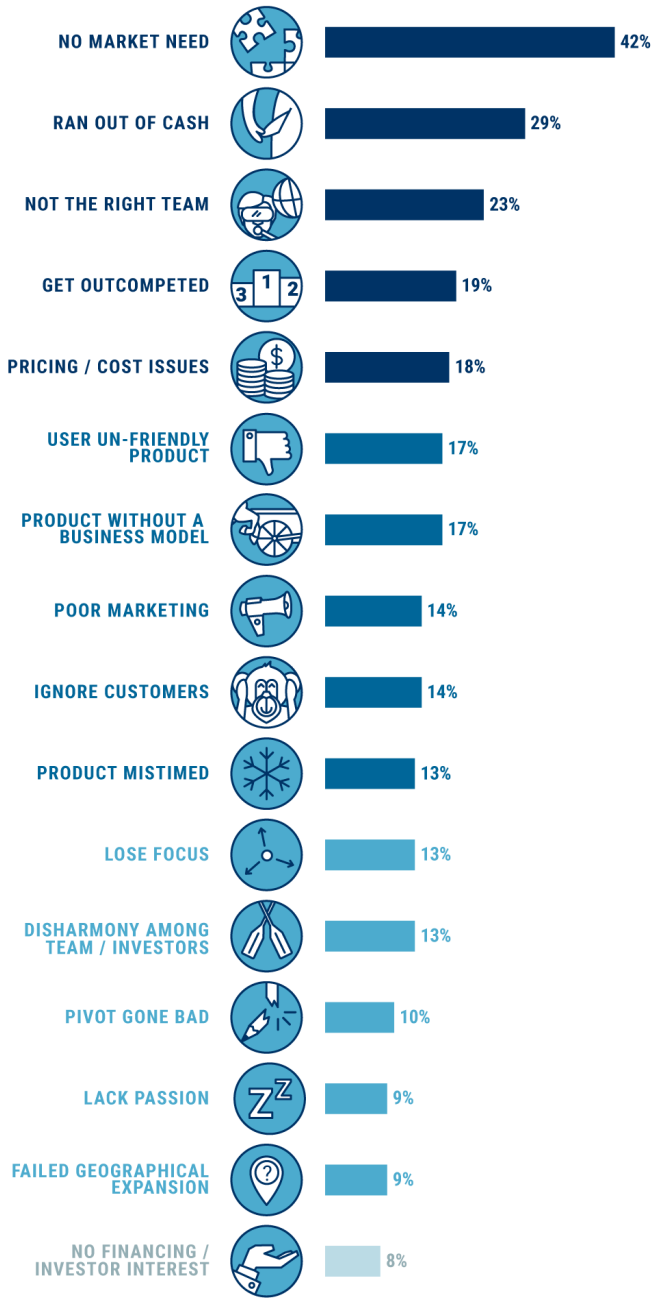
Organization Name	Founded Date	Operating Status	Total Funding Amount	Round number	Round Type	Year	Approximate amount ($)	Financing companies	Investor Type	Location
Wonderflow	10/15/2013	Active	$2,354,682.00	1	Pre-Seed	2014	$128,682.00	Rockstart Accelerator	Accelerator	Netherlands
				2	Pre-Seed	2015	$236,000.00	Unknown	Unknown	Unknown
				3	Pre-Seed	2016	$376,000.00	Jeroen Morrenhof	Business Angel	Netherlands
				4	Seed	2018	$1,614,000.00	P101	Venture Capital	Italy
ApexQubit	11/15/2018	Active	$150,489.00	1	Pre-Seed	2018	$2,989.00	Unknown	Unknown	Unknown
				2	Pre-Seed	2019	$21,500.00	Overkill Ventures	Venture Capital	Denmark
				3	Pre-Seed	2020	$26,000.00	HealthInc	Accelerator	Netherlands
				4	Seed	2020	$100,000.00	Unknown	Unknown	Unknown

Table 8. Table shows company with five financing rounds

Organization Name	Founded Date	Operating Status	Total Funding Amount	Round number	Round Type	Year	Approximate amount ($)	Financing companies	Investor Type	Location
trakkies TM	1/23/2010	Closed	$382,609.00	1	Grant	2012	$53,000.00	Unknown	Unknown	Unknown
				2	Debt	2012	$53,000.00	Unknown	Unknown	Unknown
				3	Pre-Seed	2015	$107,000.00	Unknown	Unknown	Unknown
				4	Seed	2015	$16,000.00	Startupbootcamp Smart City & IoT Amsterdam	Accelerator	Accelerator
				5	Pre-Seed	2015	$107,000.00	Unknown	Unknown	Unknown

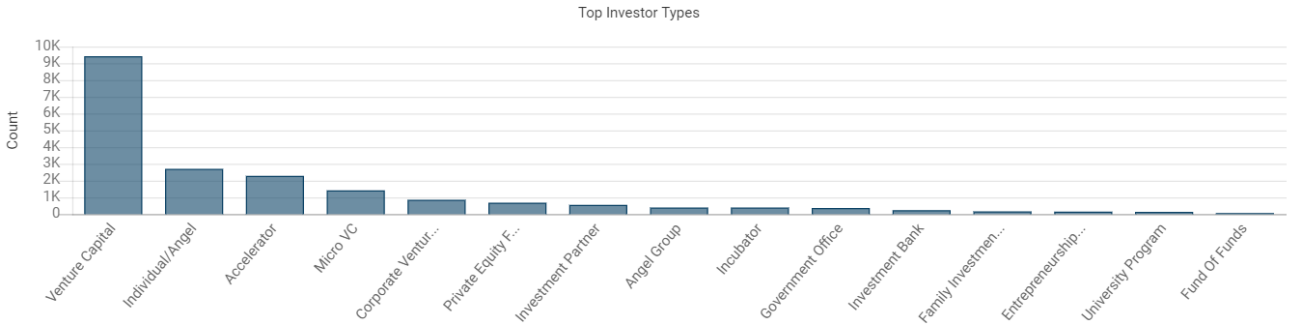
Appendix B: Infographic "why startups fail"

Retrieved from: https://www.cbinsights.com/research/startup-failure-reasons-top/.



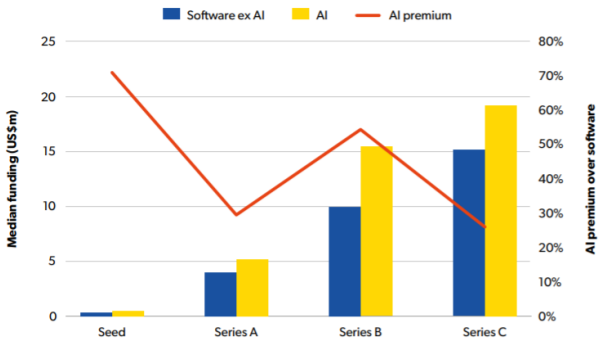
Appendix C: Top investor types investing in AI.

Retrieved from: https://www.crunchbase.com/hub/artificial-intelligence-startups#section-investors-that-invested-in-companies-in-this-hub

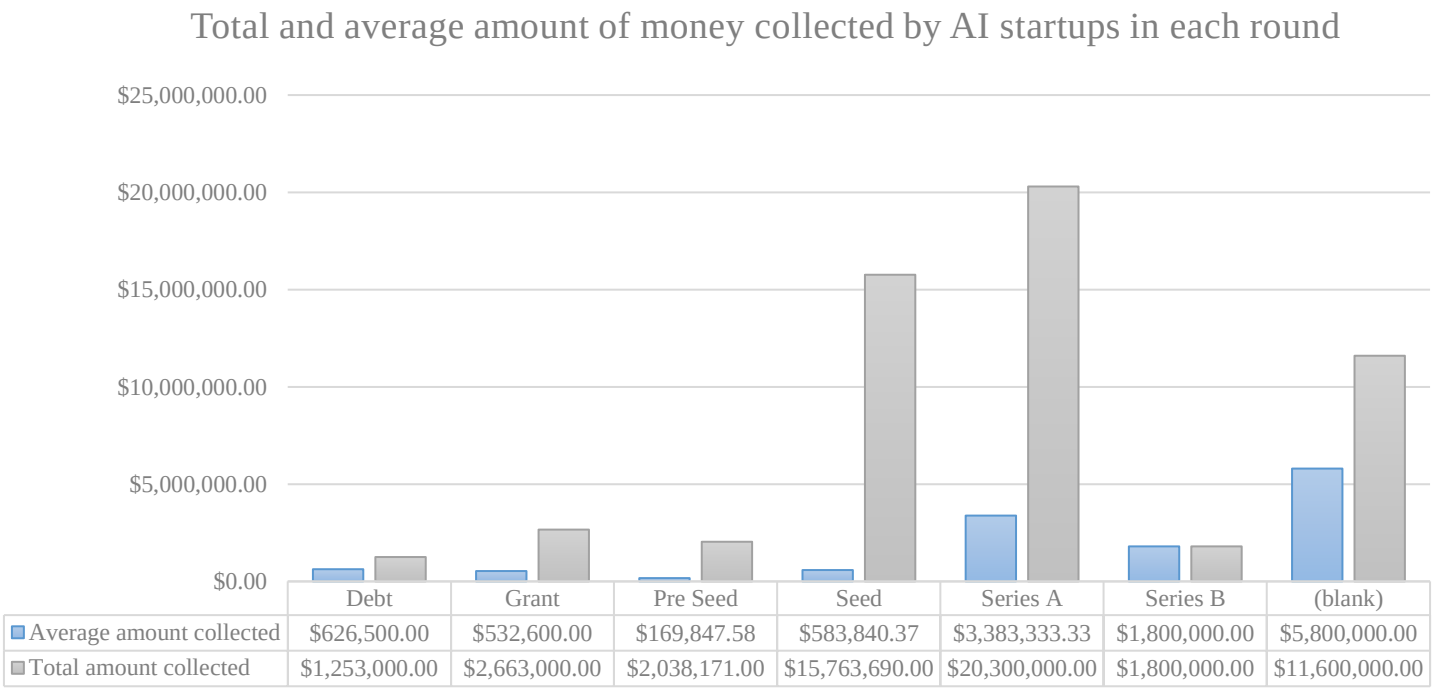


Appendix D: Rounds of founding for AI startups and software startups.

Retrieved from:https://www.mmcventures.com/wp-content/uploads/2019/02/The-State-of-AI-2019-Divergence.pdf

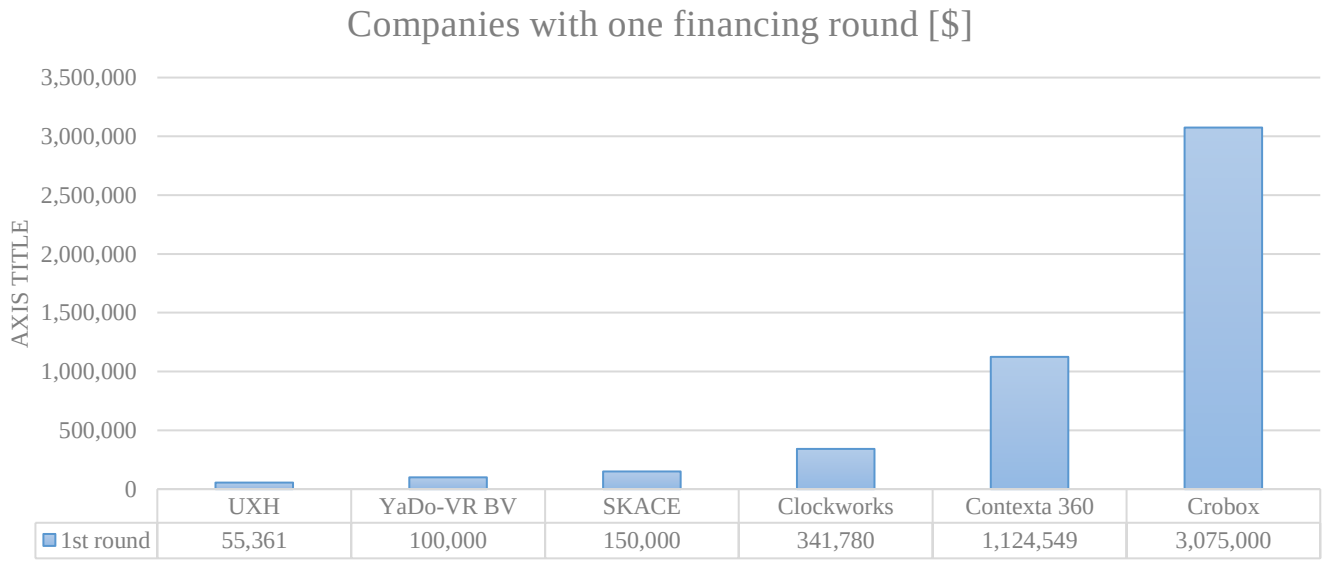


Appendix E: Bar chart with total amount of money collected and average amount of money collected in each round**.**



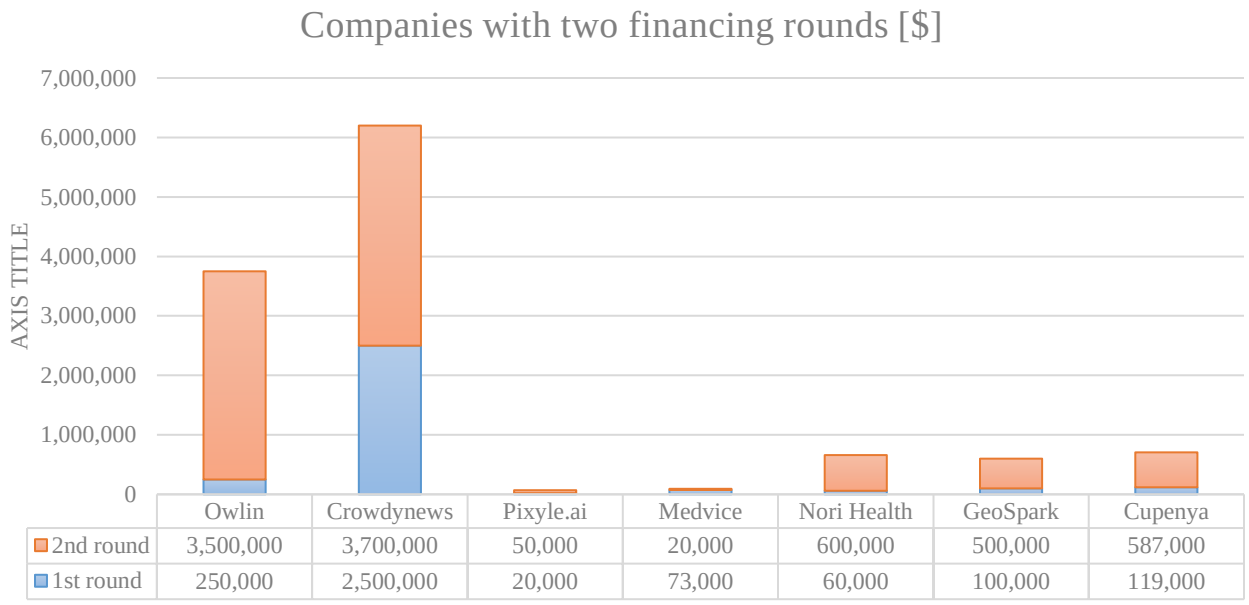
	Debt	Grant	Pre Seed	Seed	Series A	Series B	(blank)
Average amount collected	$626,500.00	$532,600.00	$169,847.58	$583,840.37	$3,383,333.33	$1,800,000.00	$5,800,000.00
Total amount collected	$1,253,000.00	$2,663,000.00	$2,038,171.00	$15,763,690.00	$20,300,000.00	$1,800,000.00	$11,600,000.00

Appendix F: Bar chart illustrating total amount of money collected by companies with one financing round



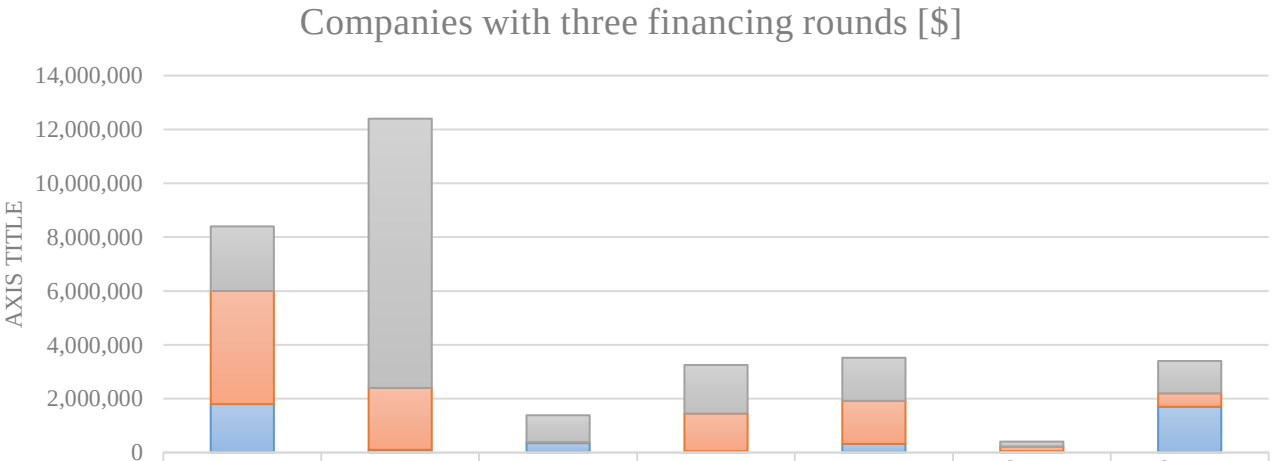
	UXH	YaDo-VR BV	SKACE	Clockworks	Contexta 360	Crobox
1st round	55,361	100,000	150,000	341,780	1,124,549	3,075,000

Appendix G: Bar chart illustrating total amount of money collected by companies with two financing rounds



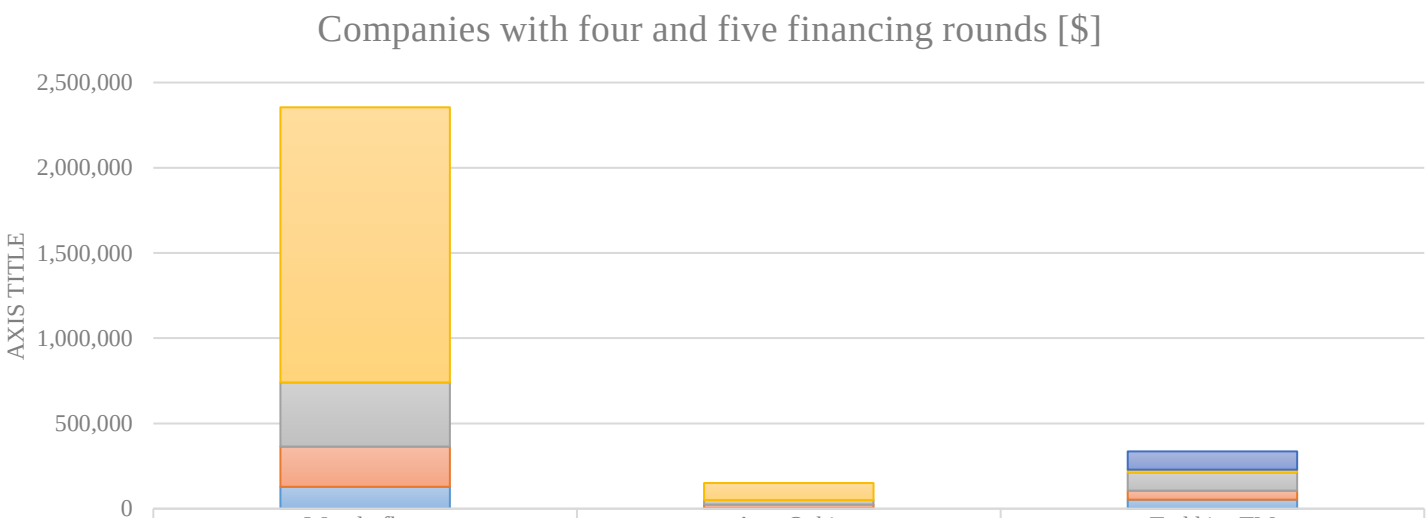
	Owlin	Crowdynews	Pixyle.ai	Medvice	Nori Health	GeoSpark	Cupenya
2nd round	3,500,000	3,700,000	50,000	20,000	600,000	500,000	587,000
1st round	250,000	2,500,000	20,000	73,000	60,000	100,000	119,000

Appendix H: Bar chart illustrating total amount of money collected by companies with three financing rounds



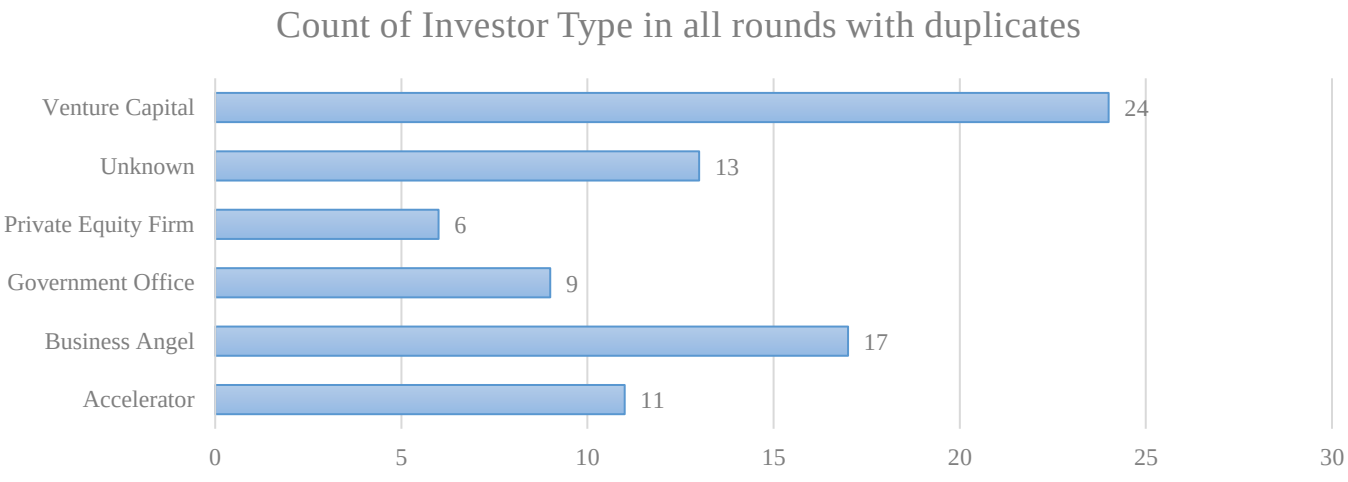
	Connecterra	Aidence	Braingineers	SciSports	Silk	Machine2Learn	Kepler Vision Technologies
Series 3	2,400,000	10,000,000	1,000,000	1,800,000	1,600,000	185,000	1,200,000
Series 2	4,200,000	2,300,000	35,000	1,400,000	1,600,000	173,000	500,000
Series 1	1,800,000	100,000	350,000	50,000	320,000	48,000	1,700,000

Appendix I: Bar chart illustrating total amount of money collected by companies with four and five financing rounds



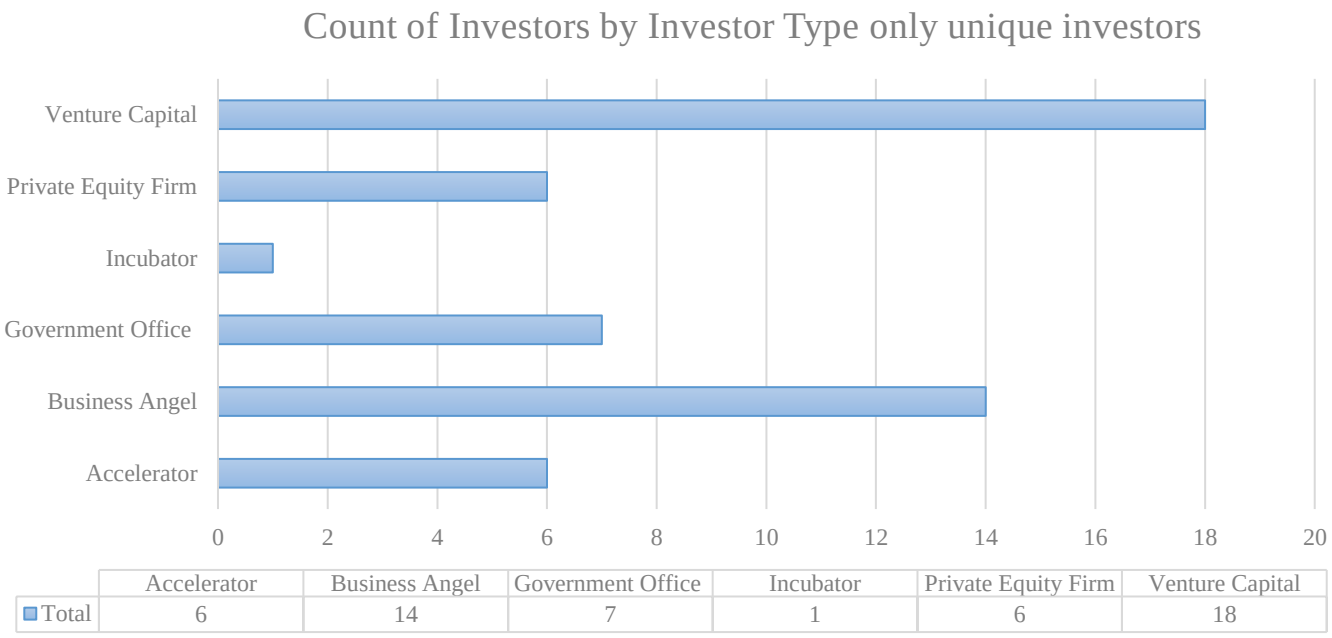
	Wonderflow	ApexQubit	Trakkies TM
5th round			107,000
4th round	1,614,000	100,000	16,000
3rd round	376,000	26,000	107,000
2nd round	236,000	21,500	53,000
1st round	128,682	2,989	53,000

Appendix J: Bar chart illustrating count of investors investing in AI startups in all rounds with duplicates.



	Accelerator	Business Angel	Government Office	Private Equity Firm	Unknown	Venture Capital
Total	11	17	9	6	13	24

Appendix K: Bar chart illustrating count of unique investors investing in AI startups**.**



Appendix L : Description of twenty-four companies in the study

ONE FOUNDING ROUND

Clockworks

Company Profile:
Status: Active
Founded: 2017
Founders: Noalle Fischer, Victor Westerwoudt
Total Funding Amount: $341,780
Brief Description:
Clockworks is a deep learning software Company. The latest product of Clockworks s Blicker, an intelligent meter readout assistant that digitalizes gas, electricity, and water meters from photos. This product goal is to increase customer and employee satisfaction, decrease operational costs, increase customer response rates. The product was created with use of machine learning and artificial intelligence image recognition software.

Figure 4 Clockworks Logo (n.d.). Retrieved from: https://www.linkedin.com/company/clockworks-data-innovation/

UXH

Company Profile:
Status: Closed
Founded: 2016
Founders: Daan Akse
Total Funding Amount: $55,361
Brief Description:
Company was focusing on solutions in hospitality field. Main vision was to improve human safety through the careful application of best practice UX design, AI technology and luxury hospitality.

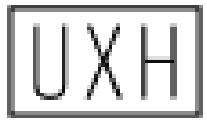


Figure 5. UXH Logo (n.d.). Retrieved from: https://www.crunchbase.com/organization/uxh#section-overview

Quantib

Company Profile:
Status: Active
Founded: 2012
Founders: Arthur Post Uiterweer, Jorrit Glastra, Rudolf Scholte
Total Funding Amount: $5,952,203
Brief Description:
Quantib is a company implementing Artificial Intelligence in healthcare solutions to provide groundbreaking technologies for patient diagnosis. Company focuses on radiology field. It is developing fast, accurate medical image analysis software which main function is to detect abnormalities. Currently company has two main products: Quantib™ ND and Quantib™Brain.

Figure 6. Quantib logo. (n.d.). Retrieved from https://twitter.com/Quantib/photo

SKACE

Company Profile:
Status: Active
Founded: 2015
Founders: Jan Bitter, Jan Musil, Jan Tlustak, Martin Váša, Miroslav Popelka
Total Funding Amount: $16,659
Brief Description:
SKACE (Super Kind Artificial Customer Experience) chatbot using artificial intelligence (AI), machine learning and conversational user interface (UI) to help companies understand their employees and improve their culture of productivity. Main goal of SKACE is to create easy to use performance management application which gives frequent feedback, personalized coaching and actionable analytics.

Figure 7. SKACE logo. (n.d.) Retrieved from https://twitter.com/getskace

YaDo-VR BV

Company Profile:
Status: Active
Founded: 2016
Founders: Anjo De Heus, Pieter van den Tillaart
Total Funding Amount: $100,000
Brief Description:
YADO is a software platform capturing Reality Through automated Light Detection and Ranging. The outcome of the program is DYNAMIC TRUE 3D IMAGERY Computer Vision- giving customers capabilities to experience real life scenarios using cutting edge technology. YADO platform enables recognition, prediction of actions for connected devices, and classification power. Data is processed in real time giving customers capabilities to experience real life scenarios. Company is focusing on four fields: ADAS, Gaming framework, Classification and Street Level Recording.

Figure 8. YaDo-VR BV Logo (n.d.). Retrieved from: https://www.linkedin.com/company/yado-vr-b.v./

Crobox

Company Profile:
Status: Active
Founded Year: 2014
Founders: Leonard Wolters, Rodger Buyvoets, Sjoerd Mulder, Wouter Donkers
Total Funding Amount: $1,253,848
Brief Description:
Company provides online retailers with insights on consumer psychology to help them understand consumers better. It allows companies to deliver optimized online buyer journeys and actionable customer intelligence. Crobox deliver AI-driven persuasive personalization suited to the company to serve the right message and design to reach visitor.

Figure 9 Crobox Logo (n.d.). Retrieved from: https://www.crunchbase.com/organization/sagent

Contexta360

Company Profile:
Status: Active
Founded: 2016
Founders: Marc van der Peet, Prins Jaspal, Tim Harbers
Total Funding Amount: $1,124,549
Brief Description:
Contexta360 uses machine learning and artificial intelligence to analyze voice calls and turn them into data useful for organization. Company goal is to detect trends, tracks, topics, key customers in business, customer satisfaction, impact of customer behavior on revenue. The software looks for key words in calls that indicate successful resolution of the call. Contexta 360 has four applications. First of them is to get insights for sales leaders – it improves performance and act on opportunities. Secondly, it ensures gives actionable insights that help company to adhere to rules and meet metrics. Thirdly, it optimizes business by measuring customer sentiment and detecting customer dissatisfaction. Finally, it automates performance and maintain quality, therefore it helps to create top performing service calls to customers.

Figure 10 Contexa360 Logo (n.d.). Retrieved from: https://www.crunchbase.com/organization/contexta360

TWO FOUNDING ROUNDS:

Owlin

Company Profile:
Status: Active
Founded:
Founders: Bas van Ooyen, Richard Kraaijenhagen, Sjoerd Leemhuis
Total Funding Amount: $3,075,000
Brief Description:
Owlin is a technology company developing real-time data analysis and cutting edge. Main product of Owlin is analytics tool that helps finance professionals monitor their portfolio proactively and in real time. It helps recognize emerging risks, opportunities and trends. Main goal of Owlin is to help companies anticipate opportunities, read market, detect and manage risk, maximize capital efficiency and reach current and upcoming trends.

Figure 11: Owlin Logo (n.d.). Retrieved from: https://www.crunchbase.com/funding_round/owlin-seed--b8c7f193#section-overview

Pixyle.ai

Company Profile:
Status: Active
Founded: 2017
Founders: Svetlana Kordumova
Total Funding Amount: $79,647
Brief Description:
Pixyle.ai™ is image recognition software detecting fashion items in images. The software allow shoppers to visually search for products and get relevant similar product recommendations on their e-commerce platforms, improving both customer engagement and conversion rates. Automatic tagging and business intelligence solutions enable retailers to save time, reduce costs and make smarter decisions.

Figure 13: Pixyle.ai logo. (n.d.). Retrieved from: https://www.linkedin.com/company/pixyleai/about/

Crowdynews

Company Profile:
Status: Active
Founded: 2010
Founders: Edwin Kuipers, Jeroen Zanen
Total Funding Amount: $7,134,991
Brief Description:
Crowdynews is the world largest social media platform delivering content to the news media market worldwide. Crowdynews AI-driven user-generated content curation engine provides a one-stop shop for automating the inclusion of relevant, real-time, and safe content from Twitter, Facebook, Instagram, and more. The company goal is to increase engagement (number of pages per visit, engagement with pages), improve conversion rates and decrease costs with use of fully automated technology across all social platforms.

Figure 12: Crowdynews logo. (n.d.). Retrieved from: https://www.linkedin.com/company/crowdynews/about/

Medvice Digital Help

Company Profile:
Status: Active
Founded: 2016
Founders: Tareq Jaber, Ziyaad Jaber
Total Funding Amount: $111,272
Brief Description:
Medvice creates AI- supported tools to automate clinical processes for emergency and urgent care clinics. Software created by Medvice is machine learning, artificial intelligence supported triage and tele-consultation that improves efficiency in patient-doctor interactions. The main goal of Medvice is to make healthcare more efficient, affordable, and sustainable for everyone.

Figure 14: Medvice logo. (n.d.). Retrieved from: https://www.linkedin.com/company/medvice/

Nori Health

Company Profile:
Status: Active
Founded: 2017
Founders: Roeland Pater
Total Funding Amount: $730,391
Brief Description:
Nori is a chatbot coach for people that live with a Crohn's or Colitis. Digital coach helps discover and change the lifestyle factors that impact patient well-being. Company offers 6-week Nori Health™ program which includes unlimited anonymous conversations. Nori coach focuses on better self-care including improving energy levels, mental strength, and stress reduction. It is powered by artificial intelligence and library of scientifically proven topics.

Figure 15: Nori Logo. (n.d.). Retrieved from: https://www.linkedin.com/company/norihealth/

GeoSpark

Company Profile:
Status: Active
Founded: 2017
Founders: Jothi Priyadharshan, Manoj Adithya
Total Funding Amount: $706,755
Brief Description:
GeoSpark is an AI location tracking technology for app makers that cuts battery drain by 10x, enables endless possibilities and location triggered analytics. GeoSpark uses a combination of location sensors like GPS, Assisted GPS and Network to provide location information and with the help of motion sensors GeoSparks's AI and ML features include Car Location Detection, Frequent places detection, Geo-Grouping, User Behavior prediction and Crowd Sourced Parking network

Figure 16: GeoSpark logo. (n.d.). Retrieved from:https://www.linkedin.com/company/geospark/about/

Cupenya

Company Profile:
Status: Active
Founded: 2013
Founders: Dominik Blattner, Elmar Weber
Total Funding Amount: $850,000
Brief Description:
Cupenya uses Zendesk data to help user deflect tickets, solve issues faster, and deliver superior customer service. It provides companies with a smart self-service board that can be integrated into existing help centers, so companies can provide their customers with answers even before tickets are created. It is providing root-causing troubles with pattern matching technology that looks at successfully resolved incidents and learning from them, real-time smart routing that automatically identifies root cause and best solution.

Figure 17 Cupenya logo (n.d.). Retrieved from: https://www.linkedin.com/company/cupenya/

THREE FOUNDING ROUNDS:

Aidence

Company Profile:
Status: Active
Founded: 2015
Founders: Jeroen van Duffelen, Mark-Jan Harte
Total Funding Amount: $ 13,991,955
Brief Description:
The company goal is to improve their reporting in the treatment of lung cancer. Specially designed program Veye Chest helps radiologists by detecting, quantifying and reporting on lung nodules present on CT- scans. Deep learning integrated in the program reduces radiologists workload. The tool is still improved with the use of feedback received from radiologists and independent validation by scientists.

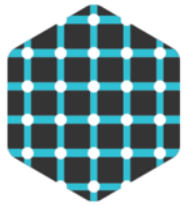


Figure 18: Aidence logo. (n.d.). Retrieved from: https://www.linkedin.com/company/aidence/about/

Connecterra

Company Profile:
Status: Active
Founded: 2014
Founders: Saad Ansari, Yasir Khokhar
Total Funding Amount: $ 9,491,953
Brief Description:
Connecterra provides an AI solution for the agriculture industry. It is a farmer's assistant which helps to run the most efficient farm by identifying farmers issues, recommending solution and streamline operations. It empowers farmers to increase their productivity while reducing impact of farming on the planet.

Figure 19: Connecterra Logo. (n.d.). Retrieved from: https://www.linkedin.com/company/connecterra-bv/about/

Braingineers

Company Profile:
Status: Active
Founded: 2015
Founders: Max van Kaathoven, Roderick Reichenbach
Total Funding Amount: $ 1,899,892
Brief Description:
Company goal is to reform customer experience research. To do that, it is important to look at human brain and analyze how people feel. Braingineers is a neuro-usability platform analyzing users' emotion. Through the use of EEG brain activity is measured and processed by emotion detection algorithms. With these science-based algorithms joy, attention and frustration of customer can be measured. With the use of Braingineers tool companies can create impactful and efficient videos and great customer experience.

Figure 20: Braingineers Logo. (n.d.). Retrieved from:https://www.linkedin.com/company/braingineers/

SciSports

Company Profile:
Status: Active
Founded: 2012
Founders: Alain le Loux MSc. MBA, Anatoliy Babic, Giels Brouwer
Total Funding Amount: $ 3,467,531
Brief Description:
Scisports is a provider of football data intelligence for professional football organizations, football players, media and entertainment. Company goal is to provide dedicated data driven reports about players, clubs', competitors and regions offering unique insights. Moreover, gathered data is analyzed and custom solutions based on custom needs are created. Company goal is to create state of the art data delivery including SciSkill Index, Player Roles, Contributon Ratings and Expected Goals.

Figure 21: SciSports Logo (n.d.). Retrieved from:https://www.linkedin.com/company/scisports/

Silk

Company Profile:
Status: **Closed (2017) M&A**
Founded: 2010
Founders: Lon Boonen, Salar al Khafaji
Total Funding Amount: $ 3,655,900
Brief Description:
Silk was a visualization, analysis, and publishing web platform. It helped users use the data from simple spreadsheets and create powerful and interactive visualizations.

Figure 22. Silk Logo (n.d.). Retrieved from: https://www.crunchbase.com/organization/silk#section-overview

Machine2Learn

Company Profile:
Status: **Active**
Founded: 2017
Founders: Ali Bahramisharif, Tom Heskes
Total Funding Amount: $ 449,168
Brief Description:
There are few applications of Machine2Learn. Level 1- direct control allows for automating local tasks in a production line. Level 2- plant supervisory is the tool to monitor the quality of a production line. Level 3- production control is the tool to manage the quality of a production line, it identifies abnormal behaviors. Level 4- production scheduling is the tool to manage and optimize the production line with respect to the demand. It is possible to buy customized AI solution from Machine2Learn with high precision, high speed, low power.

Figure 23: Machine2Learn Logo (n.d.). Retrieved from:https://www.linkedin.com/company/machine2learn/

Kepler Vision Technologies

Company Profile:
Status: **Active**
Founded: 2018
Founders: Harro Stokman
Total Funding Amount: $ 3,984,031
Brief Description:
Kepler Vision Technologies created a tool for elderly care at night. It is helping nurses by reducing their workload by 40%. Mission of the company is to make the job of nurses less stressful and simultaneously more enjoyable. The software looks into live streams and has the ability to recognize when patient needs care, then it sends message to the nurse on duty. Kepler implemented few solutions. First of them is man down detector which can detect when person is lying down and raise the alarm immediately. Kepler night nurse is a solution looking into live streams at body language and human activities, it can recognize when patient is struggling and have potential problems.

Figure 24. Kepler Logo. (n.d.). Retrieved from: https://www.linkedin.com/company/kepler-vision-technologies/

FOUR FOUNDING ROUNDS:

Wonderflow

Company Profile:
Status: Active
Founded: 2013
Founders: Giovanni Gaglione, Michele Ruini, Riccardo Osti
Total Funding Amount: $ 2,354,682
Brief Description:
Wonderflow is an integrated enterprise solition to complete customer feedback analysis in one go. The compant offer insights from unstructured consumer feedback. The company is collecting data about the customers, analyzing it with the use of AI and Natural Language Processing and create accessible to everyone 24/7 reports.

Figure 25. Wonderflow Logo (n.d.). Retrieved from:https://www.crunchbase.com/organization/wonderflow

ApexQubit

Company Profile:
Status: Active
Founded: 2018
Founders: Denis Farnosov
Total Funding Amount: $150,489
Brief Description:
Company delivers platform for drug design employing quantum computing and artificial intelligence technologies that allows to save 20% income by boosting the drug discovery phase, reduce costs for clinical trials and approval by 2 times and increase income by 10-25% with gaining market share of new drugs and longer time in market.

Figure 26 ApexQubit Logo. (n.d.). Retrieved from: https://www.crunchbase.com/organization/apexqubit

FIVE FOUNDING ROUNDS:

Trakkies™

Company Profile:
Status: Closed
Founded: 2010
Founders: Adrian Blackwood, Steven Wood
Total Funding Amount: $ 382,609
Brief Description:
AI intelligence platform that provides products and services designed for human centered relationships

Figure 27: Trakkies Logo (n.d.). Retrieved from: https://www.crunchbase.com/organization/trakkies-research#section-overview