

## AMSTERDAM ENTREPRENEURSHIP CASES:



### The development of Optics11 during the life cycle of the firm<sup>1</sup>

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### Introduction

In 2016 Optics11 was one of the most innovative small and medium-sized enterprises (SMEs) in the Netherlands. In that year the firm ranked 7<sup>th</sup> in the Netherlands and 2<sup>nd</sup> in Amsterdam on the list of the most innovative SMEs compiled by the Dutch Chamber of Commerce and the leading Dutch newspaper *De Financiële Telegraaf*. Optics11 has its origins in the academic world, but is now a serious player in the commercial market as well, and the firm is still an example of how the academic world and the private sector may intertwine, with the help of the

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<sup>1</sup> Before this case was even initiated, there already existed two related cases: one on Optics11 and one on its founder Davide Iannuzzi. The first related case is called the “Davina Case”, which was developed by Davide Iannuzzi himself as an educational exercise. The second related case is called “Scientist or university spin-off?” (developed by Enno Masurel), and has been used in academic education since 2016 (both in lectures and exams). The final version of the latter case will also be presented in the forthcoming book *The Entrepreneurial Dilemma in the Development of the Small Firm: Towards the Next Step in the Life cycle* by Enno Masurel (expected to be published in 2018). It should also be noted that the author of this case is very familiar with Optics11, even from its very start. He has worked together with Davide Iannuzzi on a number of projects.

public sector. This intertwining makes Optics11 an interesting case for (among others) scholars, students, policymakers and (nascent) entrepreneurs who are interested in knowledge-driven entrepreneurship.

In this academic educational case, the development of Optics11 during the life cycle of the firm is both described and analyzed. The case uses information found on websites and information provided during the interviews with the major players within Optics11. The analysis of the gathered information is partly open-ended, as Optics11 was still successfully operating in the market when this academic educational case was first finalized (October 2017). Therefore, this case focuses on two lines of enquiry: 1) lessons learned from the past development of Optics11 (2011-2017); and 2) the next steps in the future development of Optics11 (from 2017). Both these practical aspects are compared with the theory of the life cycle of the firm, as testing this theory is also part of this case. Updates of this academic educational case will be made regularly available in the coming years, as it is expected that Optics11 will develop further during the life cycle of the firm.

As this is an academic educational case, first it is necessary to explain the theory on the life cycle of the firm. Appendix 1 contains a brief overview of this theory, and a short reading list is provided in Appendix 2. Although the theory of the life cycle of the firm does not have a predictive value, it is nevertheless a good basis to recognize patterns in the development of firms (especially start-ups and scale-ups). Next, it is necessary to gather knowledge on the exit strategies of the firm, as the choice for an exit strategy is likely to shape the future development of the firm. Appendix 3 gives a brief overview of the various exit strategies, and Appendix 4 has a short reading list on the subject of exit strategies. Finally, the different roles that an entrepreneur may play during the different stages of the life cycle of the firm is also important: so Appendix 5 gives a brief overview of the various entrepreneurial roles is presented. As an annex to Appendix 5, Appendix 6 provides a short reading list on the subject of entrepreneurial roles.

Optics11 will be presented in the four sections of this case: (1) the firm in a nutshell; (2) the development of the firm; (3) the major players within the firm; and (4) the governance structure of the firm. The sources of these four sections are the websites that were accessed and the interviews that were conducted. Then, to assist students, ten questions about this academic educational case are listed. For the lecturers who use this case in their course, lecture notes on these ten questions have been made available separately, in order to support them in the explanation of the case to their students. Finally, there follow eight Appendices, the first of six were mentioned in the previous paragraph. Appendix 7 lists the four websites that were accessed for this case. Finally, Appendix 8 lists the eight interviews with the major players within Optics11 in 2017 that were arranged for the creation of this academic educational case.

## 1. Optics11 in a nutshell

Optics11 was founded in April 2011 (and registered with the Chamber of Commerce in that same month) by the scientist Davide Iannuzzi and the serial entrepreneur Hans Brouwer. The firm was, and still is, based in Amsterdam, the capital of the Netherlands, and more specifically the firm is located at the campus of the Vrije Universiteit Amsterdam (VU).<sup>2</sup> The firm was founded in the form of a private limited liability company (often, for short, referred to as Limited company or, simply, Ltd), and this is still the legal form of the firm. Hans and Davide met for the first time in 2010, when they were introduced to each other by the then Director of the Technology Transfer Office VU & VUmc<sup>3</sup>. At the time of the foundation of Optics11, Davide was an assistant professor (he is now a full professor at the VU, since 2013) who saw a good opportunity for the valorization of his academic knowledge together with Hans. At that time, Hans was (and still is) a serial entrepreneur who saw a good business opportunity in starting Optics 11 together with with Davide. The two had an instant sense of mutual trust, despite the fact that Davide is clearly more academically-oriented than business-oriented, and that Hans is clearly more business-oriented than academically-oriented.

Davide had already been thinking seriously about starting his own firm for a long time, before 2011. The main theme in this continuous consideration was the pursuit of personal happiness, predominantly based on the combination of the following considerations: a sense of accomplishment to show the world about the impact of his knowledge; an expectation that starting his own firm would help to speed up further his scientific career; the possibility to make money for himself; and last but not least just curiosity about where starting this firm would lead him. As well as all that, he nevertheless acknowledged that his great academic interest and his predominantly risk-averse attitude might not be conducive for the start and the development of his own firm. However, these drawbacks were greatly reduced by the collaboration with Hans, who clearly had the entrepreneurial talent to overcome them. Looking back, Davide acknowledges that the pre-start-up process was somewhat trial and error, and even somewhat a leap in the dark.

The business model of Optics11 is grounded in one of Davide's major scientific inventions, which allows scientists to assess the mechanical properties of cells and tissues with an easy, fast, and reproducible approach. Thanks to Optics11's instruments, researchers all over the world have been able to perform novel experiments that have contributed to a better understanding of the role of mechanics especially in the life sciences. Optics11 aims to build

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<sup>2</sup> De Boelelaan 1081, 1081 HV Amsterdam, The Netherlands. In the first half of 2017, Optics11 moved from its in-house location within the Faculty of Science to the incubator of the VU, called Amsterdam Venture Studios. Both premises are located on the campus of the VU.

<sup>3</sup> Since November 2014 Technology Transfer Office VU & VUmc (TTO) has been part of the new valorization center Innovation Exchange Amsterdam (IXA), together with the technology transfer offices of the University of Amsterdam (UvA), the Academic Medical Center (AMC) and the Amsterdam University of Applied Sciences (HvA). See [www.ixa.nl](http://www.ixa.nl).

optical fiber-sensing systems that are best in class, and also easy and flexible to use, by building on its core technologies, viz. fiber interferometry and micro-manufacturing. One of the major strengths of Optics11 is fast and lean product development, which is enabled by its broad range of engineering skills, mainly fiber optics, analog and digital electronics, software, micro-manufacturing, mechanics and mechatronics.

The strategy of Optics11 has always been to develop products in fast and lean iterations, strongly based on user feedback as well. Optics11 makes sure that it knows the needs of the users, and it steers development in this direction. For Optics11, optical fiber sensing provides a unique solution for many applications that involve precise measurements in challenging environments. Because light can travel unperturbed inside the fiber, and typically only glass or silicon is required for the sensing element, in fact any environmental challenge can be tackled, like low or high temperature, liquids, electrical or magnetic fields, and remote locations.

Interferometry is key to Optics11, as it is believed to be the only fiber-sensing technology that provides the best sensitivity, highest bandwidth, and highest dynamic range. “Interferometry means to directly measure the phase of light, which Optics11 is able to do with a precision that enters into what is called “femto-domain” (in popular terminology this means extreme precision). The design of the sensing element determines which physical parameter is translated into the precise optical phase, like acoustics, accelerations, pressure, and temperature; even gas concentration is possible. Optics11 designs and realizes the sensing elements with a broad range of micro-manufacturing technologies, such as photolithography, laser ablation, or precision cutting. The combination of optical fiber interferometry and micro-manufactured sensing elements provide Optics11 with unique solutions for precise measurements in challenging environments. Therefore, Optics11 is also called a “nanosensor start-up”.

Currently, there are two patents that are relevant for Optics11 (see Table 1). These two patents are now owned by the VU, and they are licensed by the VU exclusively to Optics11 (which in short means that Optics11 has the monopoly position to use the knowledge that is protected by these patents for a certain period of time). These license agreements include the obligation for Optics11 to maintain the patents and to report back to the license holder (the VU) about the use of the protected knowledge by the licensee.

Table 1. The patents that are licensed by the VU exclusively to Optics11

<p>Iannuzzi, Deladi, Elwenspoek: Optical device comprising a cantilever and method of fabrication thereof, Granted: US2009002714, CA2631179; EP1963816. Filed in 2006.</p> <p>DESCRIPTION: This patent describes the idea and several methods for the fabrication of micromachined devices on the tip of an optical fiber.</p>
<p>Iannuzzi, Petrusis, Rector: Align-and-shine system and method for series production of photolithography patterns on optical fiber, Granted: US201201464; EP2368153 . Filed in 2010.</p> <p>DESCRIPTION: This patent describes a method to make photolithography patterns on the tip of an optical fiber. This method enables, in principle, the easy, reproducible, and low-cost fabrication of miniaturized devices on the tip of an optical fiber.</p>

Davide's general vision on filing patents is "if you can do it, do it", because of the personal branding that may result from the filing of the patent (it is important for your personal track record; and it is also interesting for your stakeholders), and because it offers at least some form of protection for your innovation. On the other hand, strong patents may be expensive, as they have to be defended as well, and often it is just hoped for that other organizations will cooperate with you as the patentee, instead of imitate you or even sue you for infringement of another patent that is owned by (one of) these other organizations.

Ever since the registration of his first patent, Davide has been a nascent entrepreneur, but he just waited for the right moment to start his own company. First, he thought about selling the patent to an interested organization, but along the way he started to realize more and more that he could go further with the patent than just sell it. He began to think it could be also interesting to start his own firm with this patent as well, and that starting his own firm might also offer him a good opportunity to pursue his own personal goals in life.

According to Davide and Hans, the support of the VU, and especially the support of its valorization office IXA (see footnote 3), has been indispensable for the start and the development of Optics11. They consider the VU as the major stakeholder of Optics11. Further, support for scientific research by NWO (the Netherlands Organisation for Scientific Research) and three (semi-)public funding agencies has been important. These three (semi-)public funding agencies are: the Foundation for Fundamental Research on Matter (FOM; terminated and then divided over other (semi-)public funding agencies in 2017); STW (that connects people and resources to develop technology with added economic value that contributes to solving societal problems); and ERC (that encourages the highest quality research in Europe through competitive funding and supports investigator-driven frontier research).<sup>4</sup>

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<sup>4</sup> See: [www.nwo.nl](http://www.nwo.nl), [www.fom.nl](http://www.fom.nl), [www.stw.nl](http://www.stw.nl) and [www.erc.edu](http://www.erc.edu).

Optics11 currently consists of two business units, each with its own Research and Development (R&D) group, and with its own sales team. The business unit “Life sciences” is the oldest of the two and also the most developed. The business unit “Remote sensing” is the youngest and is still developing more than the first business unit. The user and buyer markets for the two business units differ strongly, and the technology used by both business units overlaps only partially. One typical example of “Life sciences” is a table-top measurement instrument, and one typical project in “Remote sensing” is a feasibility study.

## **2. The development of Optics11**

The first row in Table 2 shows the development of Optics11 in terms of its number of employees. It is clearly shown that, after a cautious start, the growth curve of Optics 11 becomes much more steeper. The same situation applies to the level of sales (see Table 2, second row): again, after a cautious start, the growth curve of Optics11 becomes much steeper. The level of labor productivity (the level of sales divided by the number of employees: see Table 2, third row) also increased strongly after a cautious start but in recent years its development has more or less flattened down. 2016 was the first year in the period 2011-2017 when there was a significant level of profit (followed by 2017). It is plausible to expect that the value of Optics11 has also increased, but it is not known (or not made public) by how much. Note that the current value of the firm can also be perceived differently by different people and/or organizations, as it also depends on the future value generated by the business model of Optics11.

As mentioned earlier, Optics11 currently consist of two business units. Now, in 2017, the share of “Life sciences” in total sales is about two-thirds, and the share of “Remote sensing” is about one-third. In 2016, the estimated shares were 80% and 20%, respectively. Optics11 started with 100% of its sales from “Life sciences” and no sales from “Remote sensing”. This development of the two business units symbolizes an increasing diversification in the sales composition of Optics11. Today, in 2017, about 40% of the sales comes from clients in Europe, about 40% from clients in North America, and about 20% from clients in China. Examples of these clients are universities, firms from the private sector, a Ministry of Defense, and a space agency.

The current total number of Optics11’s employees in 2017 is 18.0 (full-time equivalents) in 2017. Note that this number excludes the members of the Supervisory Board and the Advisory Board, who also spend time in Optics11, and will continue to do so in the future). The share of technical employees is about two-thirds of Optics11’s total employment (consisting of about 80% development staff and 20% production staff). Today, in 2017, less than 25% of Optics11’s employees are working as sales staff, and about 10% work as support staff. The main development in the employment of Optics11 over the years has been the growth in the share of the support staff. It should be noted that in the start-up years the shareholders were (almost) the only employees in the firm.<sup>5</sup>

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<sup>5</sup> Employed people can be employees and employed owners. Strictly speaking, employed owners are not the same as employees because they do not have a labor contract with the firm.

Table 2. Development of the employment of Optics11 (2011-2017)

Year	2011	2012	2013	2014	2015	2016	2017 (estimate)
Number of Employees (full-time equivalents)	0	1	2.5	4.7	5.9	11.7	18.0
Sales (€1000)	0	67	185	297	487	1.043	1.600
Labor Productivity (Sales/Employees; €1000)	NA	67	74	63	83	89	89

Optics11 still operates from one outlet, where all the employees are active, apart from working from other locations, like home and the Faculty of Sciences of the VU that is based in the same building. Recently, Optics11 moved from in-house at the Faculty to the new incubator at the VU (see also footnote 2) that was founded in the last quarter of 2016 but really made a start in the spring of 2017.

In the first years of Optics11 in April 2011, Hans and Davide were the only two shareholders. Between these two shareholders, a number of share exchanges took place, especially to secure Optics11's cash position. From the beginning, a certain number of the shares were kept in stock, through what is called a trust office construction. In a later stage, Niek Rijnveld (the current Chief Executive Officer (CEO), see the next section) also acquired part of the shares in Optics11, and some other employees have some shares as well. With the entrance of the investor (Value Creation Capital (VCC), in 2016) 25% more shares were issued by the Ltd company, which meant that the value of the existing shares partially diluted. VCC represents the TechNano Fund, which is supported by the Dutch Ministry of Economic Affairs, through what is called the SEED-Capital Regulation. In this way the Dutch government injects capital into venture capital funds in order to invest in "tech and creative startups".

### **3. The major players within Optics 11**

There are five major players within Optics11:

- Davide Iannuzzi, founder, shareholder and member of the Advisory Board of Optics11, VU University Research Chair, and Full Professor in Experimental Physics at the VU.
- Hans Brouwer, founder, shareholder and Chairman of the Supervisory Board of Optics11, serial entrepreneur.
- Niek Rijnveld, Chief Executive Officer and shareholders of Optics11.
- Willem van den Berg, managing partner of VCC and member of the Supervisory Board of Optics11.
- Jos Bourgonje, managing partner of VCC and member of the Advisory Board and observer on the Supervisory Board.

### **4. Governance of Optics11**

The current formal governance structure of Optics 11 is shown in Figure 1. At its core is the combination of the Supervisory Board, the Chief Executive Officer (CEO), the two business units “Life Science” and “Remote Sensing”, and the Shareholders’ Meeting. The Supervisory Board consists of two people: Hans and a representative of VCC (Willem van den Berg, at the time of developing this case; note that Willem is not a personal shareholder, like Davide, Hans and Niek, but represents the shareholder VCC). Niek, the CEO of Optics11, supervises the two business units, and reports directly to the Supervisory Board. At the Shareholders’ Meeting, the four main shareholders participate: Davide, Hans, Niek and VCC (the latter is represented by Willem). The Shareholders’ Meeting appoints the members of the Supervisory Board and delegates activities and decisions to the Supervisory Board. Currently, the Supervisory Board consists of two people (Hans and Willem), but there is also a place for a third member. The delegation from the Shareholders’ Meeting to the Supervisory Board is a dynamic process, and it can be expected that the Supervisory Board will succeed in getting more activities and decisions delegated from the Shareholders’ Meeting in the future.

This governmental structure was largely installed after VCC came in as a shareholder (June 2016). Before VCC came in, the internal organization was less formal in its character. Also before that moment, Hans was the CEO of Optics11, Davide was the CTO (Chief Technology Officer) of Optics11 and Niek was employed as a Development Manager.

In this current formal governance structure of Optics, there is also a prominent place for two permanent advisors: Davide and Jos. It is called an “Advisory Board” here to give it a more or less formal place in the organization chart, but in practice it can also be called “The Advisors” or something like that. The Advisory Board is not an official forum within the internal organization but it is undoubtedly of crucial importance for Optics11. As one of the founders of the firm, the academic one, Davide is to a great extent the face of Optics11 for the stakeholders, and is available to answer all kinds of questions. Jos is also available for this purpose, and is also the observer at the meetings of the Supervisory Board.

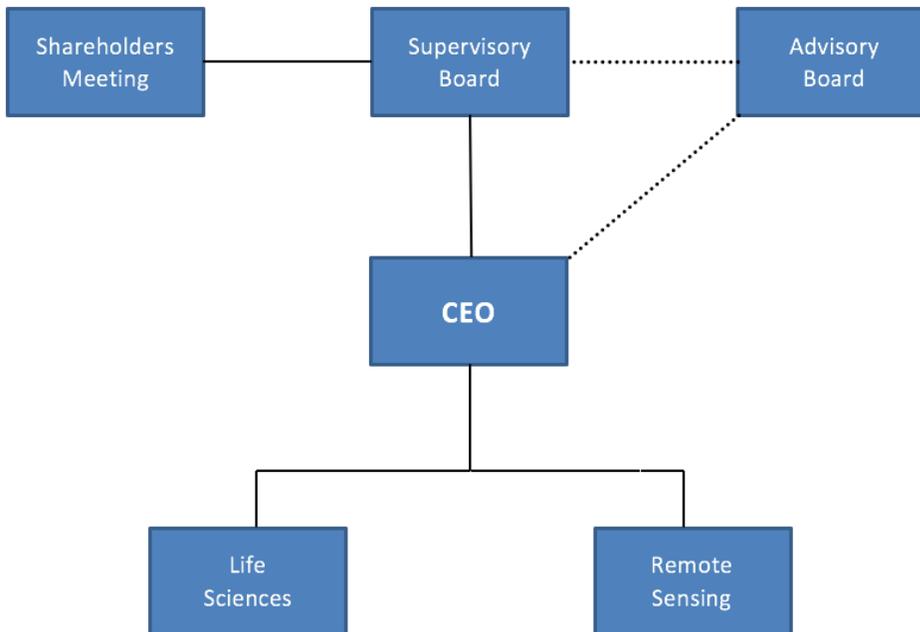


Figure 1. Formal Governance Structure of Optics11

### Questions for the students

1. Where do you picture Optics11 now in the lifecycle of the firm?
2. How did Optics11 survive in previous years while they were only making losses and/or having cash flow problems?
3. What do you learn from Optic11's equity approach?
4. In the literature, it is suggested that the entrepreneur predominantly takes the role of the professional in the start-up stage of the firm, and should take the role of leader and manager in the growth-stage and the maturity stage of the firm. How did Davide solve this potential problem for himself?
5. Elaborating on the three entrepreneurial roles mentioned in the previous question, and considering the report by Masurel and Van der Lugt (2016): What is the logic behind the career path of Davide within Optics11?
6. What do you see as the most plausible growth path for Optics11 for the immediate future, in terms of achieving size?
7. What are the most important obstacles to overcome in order to achieve this size?
8. How would you overcome these obstacles?
9. What do you see as the most plausible growth path for Optics11 for the long-term future, in terms of achieving size?
10. Which long-term strategy do you recommend for Optics11 for the long term? Why? The possibilities are: 1) Continuity; 2) Squeeze; 3) Liquidate; 4) Sell; 5) Bankruptcy; 6) Re-orientation; 7) IPO. The argumentations should not only be concern Optics11 as a whole, but also the different shareholders.

## Appendix 1. The life cycle of the firm<sup>6</sup>

A firm is not a static phenomenon but a dynamic phenomenon that develops to a lesser or a greater extent in the course of time, and thus has different shapes and sizes over the course of time. This development of the firm consists of a number of different stages. These stages may be expressed in terms of firm size (quantitative aspects), but they also may be expressed in terms of the form of the firm (qualitative aspects). First, we take a look at the general development of the firm in terms of size.

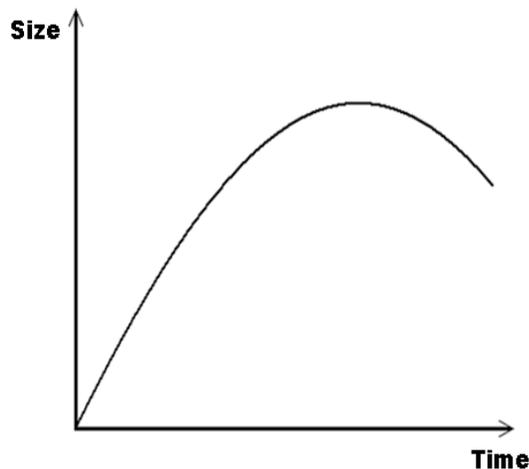


Figure 2. The life Cycle of the firm

The general concept of the life cycle of the firm is helpful here (see Figure 2). This concept is partly based on the product life cycle concept that is often used in marketing research in order to analyze the rise and fall of products; here the product life cycle is in fact applied to the development of a small business, viz. the life cycle of the firm. The horizontal axis of the figure represents the dimension “time” is presented. Time is the irreversible succession of the past through the present to the future. One of the most obvious criteria in this context is “years”, but other measures are also possible, e.g. “months” or “sunset and sunrise”. The vertical axis represents the dimension “firm size”. One of the most common features to express the size of a small business is its employment, i.e. its number of employed people. However, there are also other good quantitative measures, like sales and assets.

Elaborating on the previous paragraph, the stages in the development of a firm can be seen as combinations of intervals of time, on the one hand, and firm size, on the other. In principle, the life cycle of the firm consists of four stages: 1) start-up stage; 2) growth stage; 3) maturity stage; 4) decline stage. The *start-up* stage reflects the initial steps of the firm immediately after its founding; in this stage, the firm represents a combination of small size and young age. In the

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<sup>6</sup> This section is largely based on the section “The Life Cycle of the Firm” in the forthcoming book *The Entrepreneurial Dilemma in the Development of the Small Firms: Towards the Next Step in the Life Cycle* (see also footnote 1).

second stage, the *growth stage*, the firm takes off after its initial steps; in this stage, the firm employs more people than in the initial stage, after existing for a number of years, so further in time as well. In the *maturity stage*, the third stage, the firm finds itself after a number of years in a more or less stable situation in terms of the number of employed people. Finally, in the *decline stage*, or in the last years of its existence, the firm cuts back in terms of employed people and prepares for the end in its existence.

Although the life cycle model of the firm is an illustrative one, it is only a conceptual model: the model is basically meant to help understand what may happen with a firm in the course of time. The life cycle model of the firm is not a normative model, in that it does not state what the firm should do, in order to develop further. Neither is the life cycle model a predictive model, in that it would predict what the firm will inevitably do, in terms of its further development. One illustration of the model conceptual character is the following. Instead of entering the growth stage, which follows the start-up stage in the life cycle model, the entrepreneur may choose to stabilize the firm in terms of the number of employed people, and not to grow any further, e.g. because the entrepreneur does not want others to have any interference in the control of the firm. In fact, here the start-up firm progresses straight into a mature firm, without any intermediate stage of growth. However, it is also possible that the start-up firm goes into a decline stage immediately after its start-up stage, e.g. because its product does not appeal to the market, and moves towards the end of its existence immediately after its start-up stage. Given the fact that the majority of start-ups die prematurely and do not survive the “five-year itch” gives substance to this example of the life cycle of the firm. Next, it is also possible that, after the growth stage, the firm may re-invent itself, and, for example, come up with innovative products, and thus in fact enters a new start-up stage, after which a new growth stage may follow. In this example, the firm has not (yet) progressed into a mature firm. In another example: the firm may, after the growth stage, move into the decline stage prematurely, for example, (again) because its product does not appeal to the market, and thus face the end of its existence, without ever having been in the maturity stage. Finally, It is also possible that, after the maturity stage, the firm may re-invent itself and move into a new start-up stage or into a new growth stage, and, for example, come up with innovative products, instead of entering the expected decline stage. So, there are a number of practical applications of the conceptual model of the life cycle of the firm, and it is not a strict pathway for the firm to follow.

## **Appendix 2. Suggested reading on the life cycle of the firm**

Churchill, N.C., and V.L. Lewis (1983) The five stages of small business growth, *Harvard Business Review*, May-June, 30-50.

Greiner, L. (1972) Evolution and revolution as organizations grow, *Harvard Business Review*, July-August, 37-46.

Ismail, S., M.S. Malone and Y. van Geest (2014) *Exponential organizations: Why new organizations are ten times better, faster, and cheaper than yours (and what to do about it)*, Diversions Books.

Jones, O., A. MacPherson and D. Jayawarna (2014) *Resourcing the start-up business: Creating dynamic entrepreneurial learning capabilities*, New York: Routledge.

Masurel, E., and K. van Montfort (2006) Life Cycle Characteristics of Small Professional Service Firms, *Journal of Small Business Management*, 44 (3), 461-473.

Olaison, L., and B.M. Sørensen (2014) The abject of entrepreneurship: Failure, fiasco, fraud. *International Journal of Entrepreneurial Behavior & Research*, 20 (2), 193-211.

Shepherd, D.A., and J. Wiklund (2013) Are we comparing apples with apples or apples with oranges? Appropriateness of knowledge accumulation across growth studies, in: P. Davidson and J. Wiklund (eds) *New perspectives on firm growth*, Routledge, 115-138.

### **Appendix 3. Exit strategy<sup>7</sup>**

In the previous Appendix, it was already explained that the life cycle of the firm is not a predictive model, in which the firm automatically develops and declines in a predefined way along a number of stages. In principle, the decline stage may start anywhere in the life cycle, even immediately after the start of the firm, and even before the very start of the firm (so before the start-up threshold). Therefore, the entrepreneur should continuously think about an exit strategy (also called entrepreneurial exit), briefly described as a deliberate choice to stop the development of the firm in its current form, because to carry on with the firm is no longer a viable alternative for the entrepreneur, in a way that serves him best. As the lifecycle contains dynamic aspects, and as the firm is under the continuous influence of an ever-changing environment, the entrepreneur should continuously think about further developing a future exit strategy.

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<sup>7</sup> This section is largely based on the section "Exit strategy", also in the forthcoming book *The Entrepreneurial Dilemma in the Development of the Small Firms: Towards the Next Step in the Lifecycle* (see also footnote 1).

Below, six relevant exit strategies for small businesses are presented. In fact, these strategies are all alternatives for the strategy just to carry on with the firm. These six are:

1. *Squeeze the firm*: get as much as possible money out of the firm, e.g. in the form of a salary, a bonus and/or a special class of shares that gives the right to certain dividends. Long-term planning is needed here, because the money should not be taken out of the firm at first when it is really needed in the firm.
2. *Liquidate the firm*: simply called the entrepreneur quits with the firm and closes the business doors. However, in principle, any proceeds from the assets must first be used to repay the creditors of the firm, whereas only the remainder of the value of the assets goes to the owner of the firm or will be divided among the owners of the firm.
3. *Sell the firm*: passing the ownership to another party, who may come from the inside (e.g. employees or family members) or from the outside (e.g. clients, suppliers, or competitors). One advantage of this approach is the preservation of employment of the firm (i.e. securing the jobs of the employees).
4. *Have the firm go bankrupt*: this may prevent the firm from more loss-making and more assaults on the equity of the entrepreneur in the future. The initiative for this exit strategy should come from the outside, mostly from the suppliers, because their bills are not paid by the client firm.
5. *Re-orientate the firm*: change the course of the firm and do it differently than before. One specific move may be to leave the current general market and to go for a specific niche in the market, e.g. directed at a specific target group or with a specific product or service.
6. *Initial Public Offering (IPO)*: although this is only for a small minority of small businesses, and is not feasible for most small business, it should be mentioned as a possibility. In an IPO, part of the equity can be sold the owner(s) to the general public, leading to a strong cash position for the owner(s).

An exit can be a voluntary event, planned even a long time ahead. However, it may also be a forced situation that just happens to the entrepreneur, because this is the best or least-worse alternative. In the latter situation, it may have to do with the personal situation of the entrepreneur, e.g. sickness or divorce, in which situations he may be too disabled to fully run his operations in an optimal way. Anticipation of these forced situations and taking them openly in consideration may be useful, in terms of both probability and of impact.

#### **Appendix 4. Suggested reading on exit strategy**

Detienne, D.R. (2010) Entrepreneurial exit as a critical component of the entrepreneurial process: Theoretical development, *Journal of Business Venturing*, 25 (2), 203-215.

Head, B. (2003) Redefining business success: Distinguishing between closure and failure, *Small Business Economics*, 21 (1), 51-61.

Klein, E., E. Masurel, and K. van Montfort (2012) Emergency situations in SMEs: Are entrepreneurs prepared?, *International Journal of Entrepreneurship and Innovation Management*, 16 (3/4), 159-172.

Robbins, S. (2017) Exit strategies for your business, [www.entrepreneur.com](http://www.entrepreneur.com), accessed November 2017.

#### **Appendix 5 Different roles of the entrepreneur<sup>8</sup>**

Any human being shows a set of behavior, that combined can be seen as the role that the individual plays or the function that the individual fulfills. Likewise, this also applies to the entrepreneur. Basically, the entrepreneur may play three roles in and for his firm: 1) he may play the role as a professional; 2) he may play the role as a leader; and 3) he may play the role as a manager. In practice, the entrepreneur may play a combination of the three roles, with different possible centers of gravity. In the first instance, we will stick to these three separate roles.

As a professional, the entrepreneur works directly on the job and also takes care of the sales, like a painter who is painting the exterior of a house and then gets new orders to paint similar houses. Other areas of interest associated with this role may be quality control (e.g. to use the right sort of paint) and keeping up to date with developments in the profession (e.g. to know about new sorts of paints on the market). As a leader, the entrepreneur gives direction to the development of the firm and formulates the long-term goals of the firm, like a painter who decides to paint only the exterior of houses or factories, and also chooses which set of objects are to be painted. Another important activity of the leader-entrepreneur may be the commitment to a SWOT-analysis of the firm (S = current strengths of the firm; W = current weaknesses of the firm; O = future opportunities to the firm; T = future threats to the firm). As a manager, the entrepreneur has to ensure that the employees of the firm come to work daily

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<sup>8</sup> This section is largely based on the section "Different roles of the entrepreneur", in the forthcoming book *The Entrepreneurial Dilemma in the Development of the Small Firms: Towards the Next Step in the Life Cycle* (see also footnote 1).

and do the right things, like an employer-painter who divides the jobs among the other employee-painters, and takes care that the right paints are used by his employees. Other activities of the entrepreneur in the management role are to control and to solve conflicts, both within the firm and in the relation of the firm with stakeholders, and to create platforms for decision-making at the firm-level. A specific aspect of this management role is financial management: often this subject is undervalued in terms of importance and overvalued in terms of complexity.

So, on the one hand, in theory, these three entrepreneurial roles can be clearly distinguished from each other. A professional-entrepreneur, as such, is not typically a leader-entrepreneur and neither is the professional-entrepreneur typically a manager-entrepreneur. This is similar to the presumptions that a leader-entrepreneur is neither a professional-entrepreneur nor a manager-entrepreneur, and that a manager-entrepreneur, as such, is neither a professional-entrepreneur nor a leader-entrepreneur. On the other hand, in practice, these three entrepreneurial roles cannot fully be distinguished from each other, because a professional-entrepreneur also has to a certain extent be a leader-entrepreneur and/or a manager-entrepreneur; and a leader-entrepreneur also has to a certain extent be a professional and/or a managers; and an entrepreneur-manager also has to a certain extent ne a professional-entrepreneur and/or a manager-entrepreneur. The compromise between the theoretical aspect and the practical aspect of playing different entrepreneurial roles is that the entrepreneur will predominantly be a professional or a leader or a manager, without fully eliminating out aspects of the other two roles. However, sub-activities named under the headings of the three main roles described the in previous paragraph may not be restricted to the entrepreneur's specific main role: a professional may also give direction to his firm; a leader may also work directly on the job; and a manager may also make a SWOT-analysis of the firm.

It is important, however, to realize that the role of the entrepreneur and the development stages of the firm are interconnected: in other words, the role of the entrepreneur is a dynamic one, not a static one. If we take the artificial character of both the entrepreneurial roles and the firm life cycle as given, then we can defend the following three propositions. First, in the start-up stage, the entrepreneurial role of the professional is most important. In this stage, the owner-manager is often the only employed person in the firm, or one of the few employed persons, but still the daily work has to be done. In the growth stage, the entrepreneurial role of the leader is most important, as, in this stage, the entrepreneur has to make choices about the future direction of his firm's development. Finally, in the maturity stage, as the entrepreneur has attracted a number of employees, the entrepreneurial role of the manager is most important. In this sense, the decline stage is rather indecisive, as it is often a stage in which the firm is seriously in jeopardy and busy closing down. In principle, however, the role of the entrepreneur in this stage is that of the professional, as the entrepreneur is one of the remaining employed persons, or even the only employed person left. In this sense, the decline stage is quite similar to the start-up stage, including in terms of firm size.

Especially in the transfer periods between the stages of development of the firm, the three roles of the entrepreneur may not be as black and white as they were before. So, when anticipating the growth stage, the entrepreneur in the start-up stage, who should be a professional, may already be assuming more the role of a leader, which is the main role of the entrepreneur in the growth stage of the firm. And when anticipating the maturity stage, the entrepreneur in the growth stage, who should be a leader, may already be assuming the role of a manager, which is the main role of the entrepreneur in the maturity stage of the firm. And when anticipating the decline stage of the firm, the entrepreneur in the maturity stage, who should be a manager, may already be assuming more the role of a professional, which is the main role of the entrepreneur in the decline stage of the firm.

### **Appendix 6 Suggested reading with different roles of the entrepreneur**

Grijalva, E., P. D. Harms, D. A. Newman, B. H. Gaddis, and R. Fraley (2015) Narcissism and leadership: A meta-analytic review of linear and non-linear relationships, *Personnel Psychology*, 68 (1), 1.47.

Kwakkel, H., E. Masurel and E. van der Kaaden (2000) *Successful entrepreneuring in the 21<sup>st</sup> Century*, Amstelveen: KPMG. [report in Dutch: Succesvol ondernemen in de 21e eeuw]

Masurel, E., and S. van der Lugt (2016) Changing roles of the entrepreneur during the lifecycle of the firm, ACE Update, May. [report in Dutch: Veranderende rollen van de ondernemer tijdens de levenscyclus van de onderneming]

### **Appendix 7. Websites accessed**

<http://optics11.com/>

<https://www.linkedin.com/company/optics11>

<http://www.mkbinnovatietop100.nl/site/top-100-2016>.

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<https://startupjuncture.com/2016/06/07/nanosensor-startup-optics11-gets-seed-funding-value-creation-capital/>

Note: All these websites were accessed in the first half of 2017,

## **Appendix 8. List of interviews conducted**

22/2/2016 Davide Iannuzzi (with Enno Masurel)

1/3/2017 Davide Iannuzzi (with Etienne Schraven and Enno Masurel)

13/3/2017 Hans Brouwer (with Etienne Schraven and Enno Masurel)

20/3/2017 Hans Brouwer (with Etienne Schraven and Enno Masurel)

7/4/2017 Niek Rijnveld (with Etienne Schraven and Enno Masurel)

25/4/2017 Niek Rijnveld (with Enno Masurel)

24/08/17 Willem van den Berg (with Enno Masurel)

29/08/17 Davide Iannuzzi (with Enno Masurel)