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## QUANTITATIVE VALUATION OF PLATFORM TECHNOLOGY BASED ENTREPRENEURIAL VENTURES

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## Quantitative valuation of platform technology based entrepreneurial ventures

### Abstract:

In the course of raising external equity, e.g. from venture capitalists, a quantitative valuation is usually required for entrepreneurial ventures. This paper examines the challenges of quantitatively valuing platform technology based entrepreneurial ventures. The distinct characteristics of such companies pose specific requirements on the applicability of quantitative valuation methods. The entrepreneur can choose from a wide range of potential commercialization strategies to pursue in the course of company development which is difficult to take account of in a quantitative valuation. By developing and applying a systematic map of valuation requirements in this context, we analyze whether the cost, market, discounted cash flow or real option approach is suitable for platform technology based entrepreneurial ventures. We argue that all three valuation methods have drawbacks. Yet, the discounted cash flow approach is considered to be more suitable for the entrepreneur as well as external equity providers than other quantitative valuation methods.

### Keywords:

Entrepreneurial venture, platform technology, young venture valuation, quantitative company valuation, intangible assets, intellectual property, commercialization strategies, value extraction

## 1 Introduction

Platform technology based entrepreneurial ventures have distinctive characteristics in regard to their company setup and their commercializing strategies because in an early stage of development they already have the possibility to serve different markets with the same core innovation (Kim and Kogut, 1996; Meyer, 1997; Sullivan, 1998; Yang and Jiang, 2006). This leads to specific challenges when quantitatively valuing these companies as both the downside risk and the upside potential arising from the

applicability of the core intellectual property (IP) in different markets needs to be considered in the company value (Pitkethly, 1997; Sullivan and Sullivan, 2000).

A company valuation is often required in the life-cycle of platform technology based entrepreneurial ventures because they are often in need of funding to finance additional R&D activities and company growth (Artley et al., 2003). Due to high company risk, they are usually not able to acquire debt capital and often have to rely on an investment by outside equity investors such as business angels or venture capitalists. In the process of acquiring additional funding, a quantitative company valuation is required to determine the share of ownership the business angel or venture capitalist is to receive for the investment sum. Despite the relevance of quantitative valuation of platform technology based entrepreneurial ventures, the topic has not yet been addressed in academic literature. The aim of this paper is to fill this research gap and to make the following contributions:

First, platform technology based entrepreneurial ventures are described and commercialization strategies for intangible assets in general and platform technologies in particular are introduced. Second, valuation issues that arise from the characteristics of platform technology based entrepreneurial ventures and their commercialization strategies are elaborated and a systematic map of valuation requirements is developed. Third, quantitative valuation methods are discussed and evaluated based on our systematic map of requirements. The cost, market, DCF (discounted cash flow) and real option approaches are included in this analysis.

## **2 Characteristics of platform technology based entrepreneurial ventures**

### **2.1 Business model based on intangible assets**

The business model of entrepreneurial ventures can be based on intangible assets which do not have a physical substance but nevertheless grant rights and privileges to its owner (Lev, 2001). They comprise all value generating elements that exist in a company in addition to their tangible assets (Smith and Parr, 2000). We focus on intangible assets that originate from platform technologies. The Swiss venture WoodWelding SA owns such a platform technology. The patented WoodWelding® technology permits the fixation of porous materials with the use of ultrasonic energy. The technology has a platform nature as porous materials exist in various industries. Initially, the

WoodWelding® technology was only applied to wood in order to replace nails, dowels or seals. Today, WoodWelding SA is also active in several medical markets, in which the technology substitutes for traditional methods and sets new technological standards. Within this industry, the platform technology provides various medical solutions for e.g. traumatology, spinal surgery, cranio maxillo facial and dentistry. In order to leverage the full potential of the WoodWelding® platform technology, the company has to strategically manage its intangible assets. For an efficient exploitation and commercialization of these kinds of intangible assets, entrepreneurial ventures require additional supporting tangible assets (Reilly and Schweihs, 1999). They can enable the exploitation of the full value potential of intangible assets as they serve as necessary ‘tools’ for their commercialization. Usually, supporting tangible assets include manufacturing and distribution facilities as well as a sales department (Sullivan, 1998). As young ventures usually do not have the required resources to acquire the supporting tangible assets, the choice of commercialization strategies is of great importance for entrepreneurial ventures. Depending on the chosen strategy, the venture may not have to own complementary tangible assets itself. As described in section 3, it is possible that external parties like technology licensees or strategic partners provide complementary tangible assets for the commercialization of IP.

## **2.2 Platform technology as core intangible asset**

Platform technologies have the potential of being applied to several industries, markets, and applications (Kim and Kogut, 1996). They are comparable to sets “of subsystems and interfaces that form a common structure from which a stream of derivative products can be efficiently developed and produced” (Meyer, 1997). Contrary to technologies with a single application, platform technologies can thereby serve as cross-market technologies. Due to its broad expansion potential, a platform technology can play different roles in the life-cycle of an entrepreneurial venture. A platform technology enables a stepwise transfer of experience and enhanced technology expertise to further markets in the course of new venture growth. Companies are able to bring their knowledge to bear on different fields of application allowing them to realize high company growth (Kim and Kogut, 1996).

In addition to high growth potential, platform technologies permit reaping efficiencies by leveraging R&D costs across different markets. Through the access to different markets, unique corporate risk may be reduced by a broader company setup (Boer,

1999). Hence, another benefit lies in the risk reduction potential of diversifying the business through platform strategies. Due to these positive effects of platform technologies, they can provide immediate as well as future competitive advantage (Dornberger et al., 2005). Therefore, the ownership of a platform technology is very attractive for entrepreneurs as well as equity investors such as venture capitalists seeking for investments in a technology-oriented industry (Artley et al., 2003).

An underlying challenge of platform technologies lies in recognizing their existence. When creating innovations, a technology is often not recognized by the entrepreneur to have the broad potential of a platform technology. The venture then only focuses on one field of application – predominantly the one in which it has already expertise and experience – and the full potential of the technology is not utilized. Another challenge is the identification of an appropriate commercialization strategy for platform technologies as described in section 3. By entering more than one market at once, the venture may overestimate its capabilities and risk not to be successful in all segments (Dvorak, 2004). Therefore, available resources should initially be focused and directed at those applications and markets that are the most promising.

### **3 Value extraction through commercializing intangible assets**

#### **3.1 Commercializing intangible assets**

The value extraction potential of intangible assets depends partly on the availability of tangible assets. Supporting tangible assets are needed to leverage the intangible assets in accordance with the market demand with an effective commercialization strategy (Sullivan and Sullivan, 2000). This is likely to be an issue for young entrepreneurial ventures as they usually do not possess the required resources to build up the required tangible resources of IP exploitation.

The ability to legally protect intangible assets is another prerequisite that eases a successful exploitation (Artley et al., 2003). IP is more easily tradable than other intangible assets. Hence, IP allows a broader choice of commercialization mechanisms than non-legally protected intangibles.

There are four basic strategies for an entrepreneur to extract value from intangible assets through commercialization. First, intangible assets may be exploited internally, i.e.

within the company that developed it. Here, the owning company generates value by embedding its intangible assets into its own products or services. Second, a company can exploit intangible assets by cooperating with other companies. The venture would then pursue a mixed commercialization strategy as the provision of supporting tangible assets is shared between the cooperating companies. Third, the venture can sell its intangible assets, usually in the form of IP, to another company and generate one-time cash inflows. Fourth, the company can choose a licensing strategy and external licensees which own the necessary complementary tangible assets would then license the intangible asset. The venture can then benefit from royalty payments by the licensee (OECD, 2005; Kamiyama et al., 2006; Sullivan, 1998). In the case of an IP sale or a licensing strategy, only very limited internal complementary tangible assets are required. Therefore, these strategies can be categorized as external commercialization strategies.

*Figure 1: Four core commercialization strategies*

In order to generate value from intangible assets, a systematic choice of a correct exploitation mechanism is required (OECD, 2005). SULLIVAN (1998a) offers a systematic approach for the decision on which value adding mechanism to choose (Sullivan, 1998). A question flow chart supports a sensible innovation judgment and commercialization decision and can therefore help the entrepreneur to reduce the business risk. Similar concepts for testing the potential of an innovation are provided by other researchers (Artley et al., 2003). Questions regarding the availability of tangible assets are usually decisive for choosing the most suitable commercialization mechanism in these concepts. If predominantly generic complementary tangible assets which do not create any potential for differentiation are required for commercialization, an entrepreneur is likely to choose a licensing strategy or an IP sale (Sullivan, 1998).

Licensing of technology is typically used by R&D sellers for which the R&D activities constitute the core of their business (Razgaitis, 2003). They regularly choose the out-licensing mechanism as their commercializing strategy because they do not want to invest in costly additional tangible assets that are needed for the internal commercialization of their R&D findings. By licensing IP, a patent-owning company allows others to use its innovation in exchange for a royalty fee. The patent-owning

venture is therefore able to keep its tangible asset base relatively small and cost-efficient, as no manufacturing facilities have to be built. In case the licensee companies already have access to the supporting tangible assets, they can easily integrate the innovation. Prerequisites for a licensing contract are the existence of a patent owner (licensor), who wants to leverage an invention, and another party (licensee), who wants to commercialize this invention (Kamiyama et al., 2006). So-called technology markets can provide for an easier transfer of patented technology via sale or licensing. So far, those markets are not yet well established as structured marketplaces do not exist. They could, however, help to create an environment in which inventions are put in the hands of those parties that are most capable of providing general complementary tangible assets and, thereby, extracting the value by commercializing the technology (Kamiyama et al., 2006; OECD, 2005).

In case supporting tangible assets are required, strategic partnerships are also a viable commercialization option for entrepreneurial ventures which do not own these assets and are not able to build or to buy them completely on their own. The central advantage is that general as well as specific supporting tangible assets may be pooled and efforts may be shared by the strategic partners. Hence, this partnership strategy is more resource sensitive for ventures than complete internal commercialization (Sullivan and Sullivan, 2000).

If the young venture already owns or can easily acquire complementary tangible assets and has competitive market access, the complete integration of the innovation might be a sensible commercialization option for an entrepreneur. The venture would then handle all aspects related to innovation management, protection, and commercialization itself. This commercialization route is most resource and cost intensive in comparison to the aforementioned options. Yet, it enables the venture to act independently, to have direct market recognition and to receive most of the market revenues. In contrast, with a licensing strategy the IP owning company receives only a percentage of market revenues (Sullivan, 1998).

### **3.2 Commercializing platform technologies**

As the term 'platform' already indicates, platform technologies enable broad applications across several markets. The core technology serves as a platform for the company's expansion (Kim and Kogut, 1996). Consequently, business models of young venture that are based on a platform technology have to take platform management



specific issues into account in their commercializing strategy. A platform technology provides the opportunity for diversification and therefore for risk reduction (Boer, 1999), but also increases corporate complexity. The aforementioned decision process concerning the commercialization strategies is required for each possible field of application of the platform technology. Hence, the necessary decisions are varied and complex.

The various markets that may be served by platform technologies usually have different entry requirements and dynamics and every field of application requires supporting tangible assets. Therefore, it can be a difficult management task to serve different markets. The company that owns the platform technology has to judge whether it is capable of meeting the complex requirements of entering a number of different markets. The exploitation of multiple applications of a platform technology requires more complementary tangible assets than the exploitation of a single technology. An extensive exploitation of a platform technology is difficult to reach for an entrepreneurial venture if only internal commercialization is chosen due to the required resources and know-how to enter different markets (Ratner, 1999). Hence, the decision between the resource-intensive internal strategy (complete integration), the mixed strategy (partnering), and the external strategies (IP sale or licensing) is highly important for the exploitation of platform technologies.

The entrepreneurial venture has to consider interrelations between different platform applications or products when deciding on the commercialization strategy of platform technologies. Flexibility in timing the commercialization of different platform segments enables the platform owner to react successfully to the competitive environment. When a platform owning company decides against resource-intensive exploitation mechanisms and focuses initially on the production of one application or merely on licensing, the company has time to gather experience. This can later be transferred to other potential fields of application. Hence, future expansions might then benefit from the former resource savings, and the accumulation of experience (Kim and Kogut, 1996).

In case entrepreneurial ventures choose a licensing strategy for their platform technology, they have to cope with the legal aspects concerning the patent structure of the technology. In addition, the need to stay competitive and to preserve their know-how and innovation pool can result in “practices that force licensees to grant back to the

licensor rights or options related to future related IP assets” (OECD, 2005), further inventions or improvements of the base technology.

## **4 Suitability of quantitative valuation methods for platform technology based entrepreneurial ventures**

### **4.1 Systematic map of valuation requirements**

The specific characteristics of platform technologies and the different commercialization strategies affect the selection of adequate valuation methods for platform technology based entrepreneurial ventures. The challenge lies not only in quantifying the financial impact of intangible assets like patents (Cohen, 2005; Damodaran, 2006), but also in understanding the underlying value drivers of commercializing intangible assets based on platform technologies. They have an impact on the data required for the valuation and on the choice of the appropriate quantitative valuation method.

The monopolistic type of market situation is one important driver of the value of entrepreneurial ventures based on platform technologies. IP is based on the requirement that the underlying asset is novel and unique. With respect to technology based IP, the status quo has to be outperformed which often results in setting new standards. In most cases, hardly any comparable asset exists (OECD, 2005). Hence, valuation methods for entrepreneurial ventures should not rely solely on market data derived from peer-groups or comparables.

IP of platform technologies offers high flexibility to the management and their cross-market applicability provides a high level of scalability. The management has to decide on which market to explore, which commercialization strategy to use for each application field, whether to prolong or abandon patent protection and whether to expand patent protection internationally in different application fields (Spranger, 2006). The scalable character of platform technologies results in a high complexity of the value extraction process. As already described in Section 3.2, this is due to a wide range of commercialization possibilities, the interrelation between various application areas and asset types, and the differing market requirements. Thus, valuation methods must embrace the scalable and flexible nature of platform technologies if the calculated value is to provide a fair portrait of the value extraction potential.

The illiquidity of intangible assets is another key characteristic of entrepreneurial ventures based on platform technologies. A liquid market for trading and selling intangible assets does not yet exist even though first initiatives to create such a market were taken. Non-transparent deals, information asymmetries between buyer and seller as well as legal aspects are reasons for the limited marketability of intangibles (Smith and Parr, 2000; Lev, 2005). Furthermore, technology-based intangibles are mostly embedded within organizational structures. Hence, it is difficult to isolate them and liquidate them separately (Boer, 1999).

Another key value driver of intangibles is, as already indicated above, the need for supporting tangible assets. Intangibles require complementary tangible assets for their commercialization. Hence, intangible assets or IP have a distinct value but the full potential of this value can only be realized with the support of tangible assets (Reilly and Schweih, 1999; Sullivan and Sullivan, 2000). Depending on the type of commercialization strategy, the importance of supporting tangible assets differs substantially. Internal commercialization leads to the highest importance of tangible assets whereas IP sale leads to the lowest importance. Consequently, adequate valuation methods have to take into account the interrelation between intangible assets and complementary tangible assets within a particular commercialization strategy. In any case, single assets should not be separated from each other for the purpose of valuation. Otherwise, calculated values do not reflect a realistic portrayal of the value potential of young ventures based on platform technologies.

These four value drivers lead to a distinct high risk and high return profile of platform technology based entrepreneurial ventures. The platform character leads to an exceptionally high growth potential (Smith and Parr, 2000) while the intangible assets lead to high uncertainty. Technology-related, market-related and legal uncertainty are key factors which form the high risk profile of intangible assets (Lev, 2005; Spranger, 2006). Figure 2 summarizes the specific requirements for quantitatively valuing a platform technology based entrepreneurial venture. These requirements are used as a systematic map in the following sections to discuss different quantitative valuation methods in detail.

*Figure 2: Map of specific requirements for valuing platform technology based entrepreneurial ventures*

## 4.2 Discussion of quantitative valuation methods

### 4.2.1. Cost approach

#### *General characterization*

The cost approach is based on the view that setup costs of the sum of the assets of a company are equal to the economic value of a company. In the cost approach, the value of an asset can be calculated in two different ways. The value can either be based on all historically accumulated costs for the asset or can be derived from an estimate of the reproduction or replacement costs of the asset. Typically, cost-based calculations are applied to tangible assets for accounting or taxation purposes.

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First, the cost approach does not consider the unique and novel characteristics of IP because costs do not reflect the benefits resulting from monopolistic types of situations. Second, regarding the scalability/flexibility requirement, the cost approach is not able to reflect the underlying growth and expansion potential of a platform technology. Future economic benefits which may increase due to the scalability are not considered within the cost approach (Pitkethly, 1997; Reilly and Schweih, 1999; Smith and Parr, 2000). The cost approach is not able to take into account the impact of different commercialization strategies on the company value. Third, the cost approach cannot fulfill the requirement to take into account the need for supporting tangible assets as one of the requirements for valuing platform technology based entrepreneurial ventures. The correct assignment of costs is almost impossible, as complementary tangible assets, which are required for the commercialization, have cross-market functionality and serve different intangible assets. Hence, their individual costs are difficult to value as a single cost block of a venture (Schmidli and Vassalli, 2006). Due to these drawbacks, we conclude that the cost approach is not suitable to value platform technology based entrepreneurial companies. Therefore, the cost approach is not further analyzed in this paper.

#### 4.2.2. *Market approach*

##### *General characterization*

The market approach is based on the concept that values can be derived from public market values or transaction values of comparable companies from private markets. The value of comparable companies is converted into peer-group multiples by dividing the value by a performance indicator. Earnings before interest and tax (EBIT), earnings before interest, tax, depreciation and amortization (EBITDA), free cash flow and book value are performance indicators that may be used for this purpose. Alternatively, generic industry multiples may be used (Pratt, 2001).

After applying a multiple, major differences between the valuation target and the industry or the peer-group have to be considered. Usually, it is difficult to identify and collect sufficient data for applying the market approach to privately held ventures. Therefore, premiums and discounts, as the illiquidity discount or the minority discount, are often applied to adapt the data to the target company (Damodaran, 2001).

The market approach requires a liquid and transparent market in which a market value can be observed. The market approach is easy to use and, if a functioning market exists, provides quick results. Therefore, it is commonly used in order to validate values calculated with other approaches. In addition, the market approach reflects current market moods and informs about current price levels (Pratt, 2001). This is an important indication even if the market is not liquid or transparent.

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Appropriate multiples usually do not exist for the valuation of platform technology based entrepreneurial ventures mainly for two reasons. First, IP on platform technologies is characterized by uniqueness and, second, there is no liquid market for the trading of this type of IP (Kossovsky et al., 2004; Schmidli and Vassalli, 2006). Therefore, market multiples are likely to not sufficiently represent the value of the unique IP of the target company. Identified comparable IPs may differ in terms of the intended commercializing strategy and the corresponding complementary tangible assets. The commercialization strategy of the comparable company and its respective context is expected to not fully represent the value potential of the asset to be valued (Pitkethly, 1997). Cross-market applicability of a platform technology is not adequately reflected in the market approach because industry multiples only refer to a single

industry and comparable companies of peer-group multiples are usually only active in one industry or in a different portfolio of industries.

As mentioned above, the commercialization decision process is complex and likely to vary among companies. Hence, multiples will be based on companies with commercialization strategies that are different from the valuation target and, therefore, will not be appropriate to value the target. In addition, multiples are often influenced by individual strategic deal premiums. Consequently, valuations based on these multiples will be biased. Different commercialization strategies require for a specific set of complementary tangible assets. This is not considered in applying either industry multiples or peer-group multiples and, therefore, the market approach does not fully comply with the requirement of taking into account the need for supporting tangible assets (Kossovsky et al., 2004). In addition, the explicit consideration of high risk profiles and uncertainty is not part of the market approach. Yet, with improving and growing technology and IP markets, a valuation based on the market approach will lead to better results than currently possible.

Despite these limitations, the market approach yields at least from a practical point of view useful results when applied to a platform technology based entrepreneurial venture. Through applying the market approach, an outside equity investor can get a view on current market price levels for companies with similar business models. Even though these companies may only be remotely comparable to the target company, the current market price level gives an important indication on the price range which can potentially be achieved in negotiations.

#### *4.2.3. DCF approach*

##### *General characterization*

The DCF approach is based on the assumption that the value of a company depends on the potential of its assets to generate future cash flows. With the DCF method, the company value is calculated as the present value of future cash flows. The present value of cash flows is calculated by applying a discount rate which adequately reflects the cost of capital. Consequently, the DCF method requires three major components: the forecast cash flow, the projected economic life of specific projects and IP, and the appropriate cost of capital (Brealey and Myers, 2005).

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There are several reasons why the DCF approach is preferable for valuing platform technology based entrepreneurial ventures. The DCF approach is based on future potential of the venture to generate positive cash flows which reflect the unique and novel nature of intangible assets and IP. Monopolistic situations can be modeled in a forecast and can therefore be included in the estimation of future economic value. In addition, the DCF method explicitly meets the requirement of satisfying the inherent risk of intangible assets and IP as the discount rate reflects the level of risk and uncertainty. The regular procedure includes the use of forecast cash flows and risk adjusted discount rates. A second possibility deals with certainty equivalent forecast cash flows which are then discounted with risk-free rates. The discount rate may vary over time because of the dynamic risk profile of a company. The DCF method can take this into account by means of a dynamic discount rate. Furthermore, the DCF method accounts for the duration of the period in which intangible assets are protected. The future cash flows, which can be generated within the protected period, are then forecasted for that time period and adjusted for the post-protection period (Pitkethly, 1997; Kossovsky et al., 2004).

The DCF method is able to incorporate the scalability as well as flexibility of platform technologies to a certain degree because it can attempt to forecast the cash flows resulting from entering different markets with the same technology (Reilly and Schweih, 1999). However, the DCF method will always be based on a single line of cash flows which makes it difficult to include the flexibility of the entrepreneur to decide to enter new markets. The assumption on the start of the terminal value is challenging when using the DCF method for platform technology based entrepreneurial ventures. The growth rate assumed for the terminal value has to be sensible.

Even though some market data, e.g. to derive market based risk adjusted cost of capital, is also needed for a DCF calculation, the valuation is not as dependent on it as in the case of the market approach. Therefore, the income approach can be characterized as having medium compliance with the requirement of taking into account the illiquidity of intangible assets based on platform technologies.

The approach is based on the ability of entrepreneurial ventures to generate positive cash flows and, thereby, assumes that the ability to generate value depends on the interaction of all corporate assets. This fulfills the requirement of taking into account the

need for supporting tangible assets. All assets, tangibles as well as intangibles, are needed to generate positive cash flows and therefore contribute to the company value (Smith and Parr, 2000).

#### 4.2.4. *Real option approach*

##### *General characterization*

In the real option approach, the company value consists of the sum of the passive company value and the active company value. The passive company value is derived from applying the DCF approach to value components of the company which are option free. The active company value represents all entities of the company which have optional characteristics and it is calculated based on financial option pricing models (Brealey and Myers, 2005). The key difference between the DCF and real options method is the underlying understanding of risk and flexibility. Whereas the DCF method incorporates a negative perspective of risk, the real options method focuses on the chance that is embedded in the uncertainty and risk (Trigeorgis, 1996).

Real options identify and put a value on managerial flexibility. The valuation of options originates from the context of financial options (e.g. valuation based on Black-Scholes or the binomial model). Despite fundamental differences, there are similarities between financial and real options. Hence, the valuation approach of financial options can be transferred to non-financial scenarios.

The real options method is especially useful in valuation scenarios that are characterized by high levels of flexibility and uncertainty (Amram and Kulatilaka, 1999). However, the real options approach is complex in its use and the identification of correct input variables is difficult. Therefore, the method's acceptance among practitioners is low. In addition, the very positive perception of risk and uncertainty can easily mislead an investor in his understanding of the company's value potential (Damodaran, 2001).

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From a theoretical perspective, the real option approach offers a number of advantages for valuing platform technology based entrepreneurial companies. First, real options portray the unique and novel characteristics of intangible assets. Monopolistic situations can therefore be modeled in the option valuation. Second, it offers the opportunity to model the entrepreneurial flexibility and, thereby, the cross-market applicability of a



platform technology explicitly. The value entails different lines of cash flows that can be generated if certain decisions are taken in the future due to changing circumstances. The decision for or against the exploitation of a platform technology in additional fields of application can be viewed as an option to expand (Chang, 2005). It creates flexibility which itself is considered a source of value. Furthermore, the flexible process of choosing an adequate commercialization strategy for the various platform applications is treated as value component. This flexible process can be understood as a portfolio of options to expand where each applied commercialization strategy leads to new options to use the same commercialization strategy for other applications. When estimating the value of these options to expand interaction effects between them have to be taken into consideration which adds further complexity to the valuation task (Trigeorgis, 1993).

Based on the underlying theoretical concept, using the real options method is sensible because it explicitly portrays the inherent flexibility of platform technologies. Yet, PITKETHLY states that it is “by no means a straight forward task” (Pitkethly, 1997). The complexity of valuing real options is higher than the complexity of using the DCF method alone. In order to value real options, valuation methods of financial options are applied and several assumptions have to be made to estimate the required inputs (Pitkethly, 1997; Laxman and Aggarwal, 2003; Spranger, 2006). These include the value of the underlying asset, which is usually estimated based on the gross present value of expected cash flows, the volatility of the underlying asset, the exercise price, the time to maturity, the costs of postponement and the risk free interest rate (Luehrman, 1998). In line with the DCF approach, the real option approach requires some market data in estimating these inputs. Therefore, the real option approach offers medium compliance with the requirement of taking account of the illiquidity of intangible assets. The option values represent interaction of all corporate assets, including intangible and tangible assets and, hence, the real option approach fulfills the requirement of incorporating the need for supporting tangible assets.

It is very difficult to derive sensible and reliable proxies for the required inputs for a real option valuation. In addition, the financial option models to calculate the active company value are complex. Hence, the real option approach is not often used in practice to calculate a quantitative company value. However, real option thinking is often used as a strategic management tool to identify valuable options the management might have.

### 4.3 Comparison of suitability of quantitative valuation methods

The analysis of the cost, market and income approaches has shown their relative suitability for valuing platform technology based entrepreneurial ventures. The fulfillment of the valuation requirements identified above differs greatly between the three methods.

The cost approach is not able to take into account the high risk-return profile of intangibles as they do not reflect the factors of risk and uncertainty (Smith and Parr, 2000). The implicit assumption that costs reflect the value of an asset is not true for valuing platform technology based entrepreneurial ventures because their growth potential is not embedded in a cost estimate (Kossovsky et al., 2004; Spranger, 2006). Consequently, the cost approach was found to not be applicable to platform technology based entrepreneurial companies.

The market approach fulfills the valuation requirements to a larger extent than the cost approach. Yet, the main problem of the market approach is that markets are neither liquid nor transparent. Although the market approach is easy to use, a target-oriented internal calculation seems to be preferable over a valuation based on questionable multiples. However, the market approach does give an indication of the level of prices that are paid for technology companies (Cockburn and Griliches, 1988; Kossovsky et al., 2004). This indication should not be ignored e.g. by an outside equity investor such as a venture capitalist who is interested in investing in an entrepreneurial venture based on a platform technology.

Our analysis has shown that the DCF approach is a suitable approach to value platform technology based entrepreneurial ventures as it fulfills two valuation requirements completely and the other two to a certain degree. In addition, it is less complex and more accepted in practice than the real option approach. The DCF approach enables the equity investor to come up with a detailed portrayal of a quantitative company value. Essential company value drivers, like monopolistic types of market situation, cross-market applicability of technology and the need to take into account supporting tangible assets are considered in the valuation approach. Therefore, the DCF approach can be considered the most helpful approach to arrive at a quantitative value. Yet, the fundamental problem of finding sensible assumptions for the required inputs remains.

This is particularly difficult for inputs on the cash flow potential of the platform technology due to its innovative character.

Even though the real option approach fulfills even more requirements than the DCF approach, the difficulty of deriving the required inputs and the high complexity of the underlying option valuation models leads in practice to inferior suitability of the real option approach compared to the DCF approach. However, the real option approach can be seen as useful management tool to identify important value drivers.

*Figure 3: Comparison of the suitability of different valuation approaches*

## 5 Conclusions

This paper examines the challenges of quantitatively valuing platform technology based entrepreneurial ventures. One of the important strategic decisions for an entrepreneur is the choice of a commercialization strategy which, in turn, has an impact on the company valuation. The specific characteristics of platform technology based entrepreneurial ventures have to be considered when selecting commercialization strategies.

The cost, market, DCF and real option approaches to valuation were discussed in regard to their suitability to value platform technology based young ventures. In order to do so systematically, a map of specific requirements was developed. Four requirements for a suitable valuation approach were identified as key characteristics of entrepreneurial ventures based on platform technologies: monopolistic type of market situation, cross-market applicability of technology, illiquidity of intangible assets and the need for supporting tangible assets. In addition, the distinct high risk-return profile needs to be taken into account in the valuation.

The DCF approach can be considered as a suitable approach for entrepreneurial ventures. It fulfills more of the specific requirements than the cost or market approach and it is less complex than the real option approach. However, disadvantages of the DCF approach were also identified. The DCF approach relies on several assumptions, which are difficult to estimate for young ventures. If these assumptions are not made rigorously and sensibly, the final quantitative company value will be biased.

In conclusion, there is no perfect valuation method and even though the DCF approach is the most suitable method to value platform technology based entrepreneurial ventures it also has disadvantages. Therefore, a valuation method mix could be considered. By

applying the market approach, an indication on the current market prices for technology companies is given and by applying the DCF approach, a fundamental value of the venture can be calculated. In comparing both values, a range for a plausible company value can be estimated which can be particularly helpful in negotiating financing rounds e.g. with outside equity investors such as venture capitalists. In addition, the real option approach can be used qualitatively to identify important value drivers in a platform technology based entrepreneurial company.

## 6 Figures

Figure 1: Four core commercialization strategies

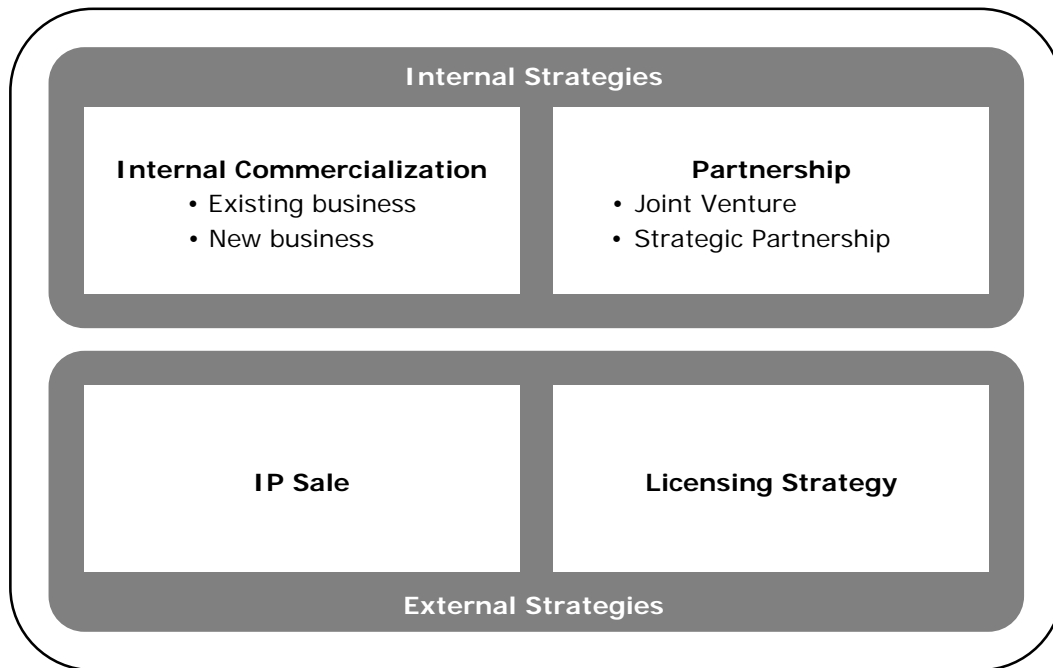


Figure 2: Map of specific requirements for valuing platform technology based entrepreneurial ventures

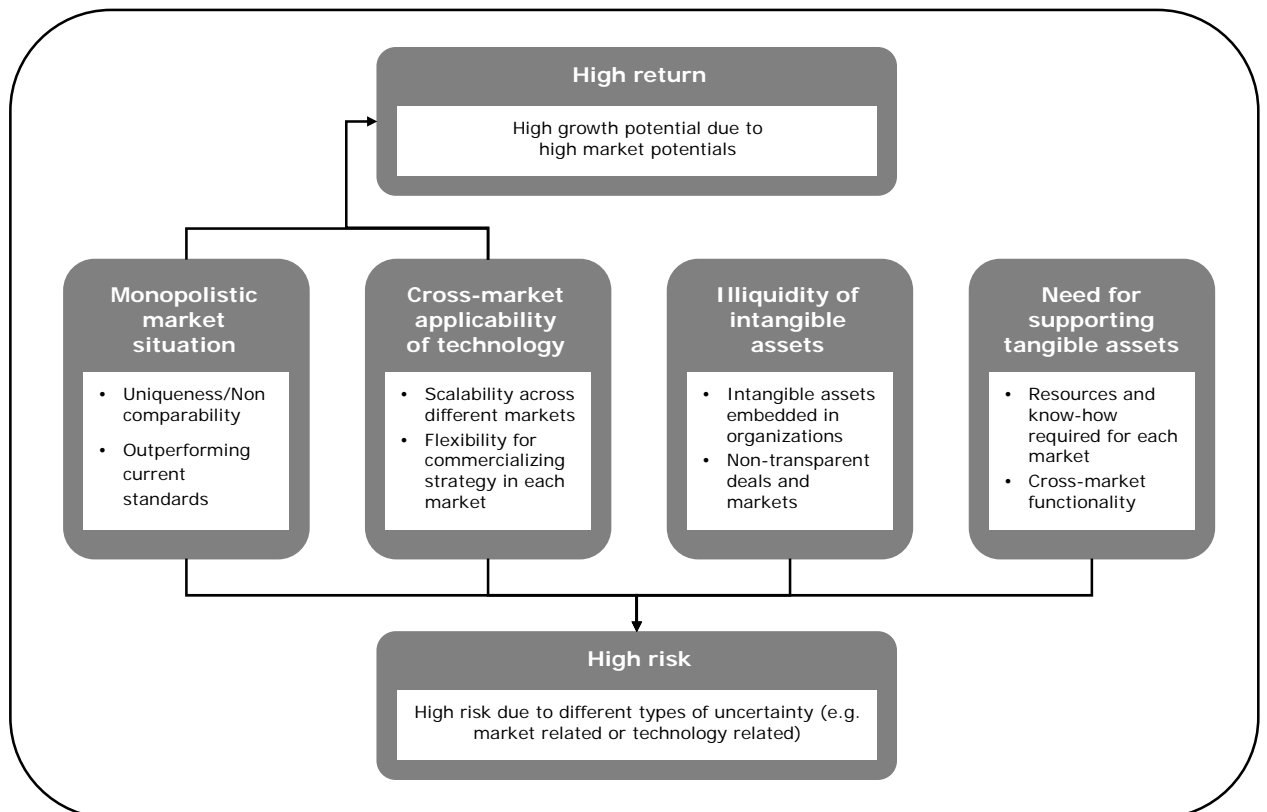


Figure 3: Comparison of the suitability of different valuation approaches

COMPARISON OF VALUATION APPROACHES					
	Monopolistic market situation	Cross-market applicability of technology	Illiquidity of Intangible assets	Need for supporting tangible assets	Other key advantages/disadvantages
Market approach	✘	✘	✘	○	+ Easy to apply + Gives an indication of market price levels
DCF approach	✓	○	○	✓	- Difficult to estimate required inputs + Less complex than real option approach
Real option approach	✓	✓	○	✓	- Complex underlying valuation models - Difficult to estimate required inputs + Useful as qualitative strategic management tool

✓ full compliance    ○ medium compliance    ✘ no compliance

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