Chapter 7
Creating Value in the Digital World

Raphaela Balzer and Anna Vojtková

Abstract Observing skyrocketing valuations of digital pioneers in the capital markets with Amazon hitting the USD one trillion market valuation in 2018, many industrial conglomerates have experienced plummeting stock prices and value destruction even though they have continuously and rigorously optimized their portfolios and business operations. The fundamental change of dynamics in the digital era implies an immense challenge for most global players searching for explanations and a new recipe on how to create and sustain value in the digital era. Consequently, the demystification of digital value creation and its determination is of utmost importance for decision-makers across industries who are required to succeed in a digital, networked economy of adoption, coopetition, and self-reinforcing dynamics. This chapter is an adapted extraction of the source: Balzer, R. (2020a) *Value Creation in the Digital Era*. Dissertation thesis, Technical University of Košice, Košice.

Introduction

> You are real, they are virtual.
>
> You build, they collaborate.
>
> You are product-driven, they are customer-driven.—(DiMaggio, 2001, p. 212)

Parida et al. (2019) define digitalization as "use of digital technologies to innovate a business model [1] and provide new revenue streams and value-producing opportunities in industrial ecosystems" (Parida et al., 2019, p. 6). The authors state that

[1] A business model can be defined as "structured management tools, which are considered especially relevant for success" (Wirtz et al., 2016, p. 36) or "a reflection of the firm's realized strategy"

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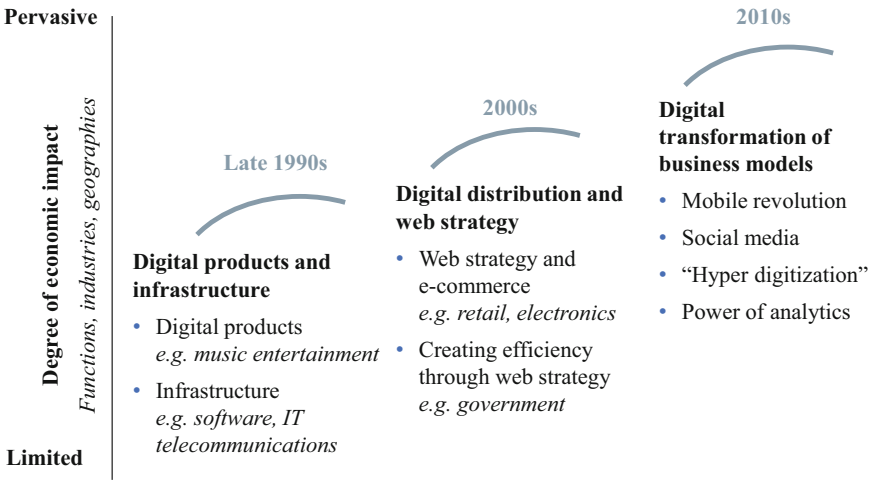

Fig. 7.1 Evolution of digital transformation (Berman and Bell, 2011, p. 4)

digitalization is a "general phenomenon, enabled by digital technologies that is changing the society at all levels" (Anttonen, 2018, p. 7). [2]

Luz Martín-Peña et al. (2018) agree and point out that digitalization has fundamentally changed the mechanisms of economics. Social networks, smart devices, and various interactive tools are now used to engage other economic agents, to determine who to trust, where and how to go, and what and how to buy. Consequently, under the virtue of sustained value creation, companies face new rules on how to succeed in digitalized markets. The global dynamics of Volatility, Uncertainty, Complexity, and Ambiguity (VUCA) become their new reality while responding to the shareholders' maxim of creating and sustaining value for their companies (Bennett & Lemoine, 2014). Therefore, they are forced to undertake their own digital transformations, rethink what customers value most, and create operating models that take advantage of digital technologies in scaling networks on platform business models. Their structure is evolving, and their boundaries are becoming more porous and less defined (Martins et al., 2015).

Figures 7.1 and 7.2 confirm these dynamic developments and show that digital transformations of business models impact both public and private sector organizations. In the 1990s, few organizations in selected industries were exploring digital products and services or building digital infrastructure. Currently, the situation

(Casadesus-Masanell & Ricart, 2010, p. 195). Another definition is "the designed system of activities through which a firm creates and captures value" (Yu et al., 2019, p. 239). Business models have become more important in recent years as a result of digitalization as they are associated with securing and expanding competitive advantages (Wirtz et al., 2010, 2016) and contribute to corporate growth (Chesbrough & Rosenbloom, 2002; Tikkanen et al., 2005; Zott & Amit, 2008, 2010; Teece, 2010; Zott et al., 2011; Teece & Linden, 2017; Zott & Amit, 2017).

[2] The terms digitalization and digitization are considered as synonyms in this chapter.

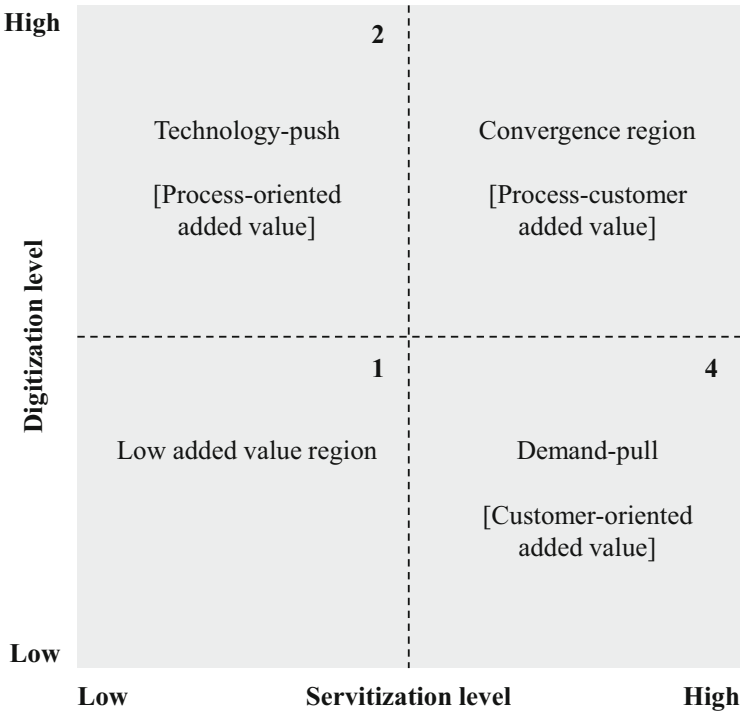

Fig. 7.2 Innovation trajectories for Industry 4.0 and servitization (Frank et al., 2019, p. 344)

requires new business models that enable decision-makers to understand and use the opportunities and challenges of digitalization (see Loebbecke & Picot, 2015).

Within the framework of searching for the ideal business model for the digital age, for example Fjeldstad and Haanæs (2018) [3] formulate three key features of a digital company: (1) human and digital agents working together, (2) technologies that can potentially enhance everything (e.g., products and/or services, internal operations, relationships with customers and/or suppliers), and (3) members' ability to self-organize, thus saving many the costs of hierarchy and enabling collaborative activities. In other words, according to the authors, a digital company should be "collaborative, agile, and minimally hierarchical" (Fjeldstad & Haanæs, 2018, p. 93).

In practice, many startup companies use digital technology to build new products and business models that disrupt and take customers away from firms that cannot

[3] According to Fjeldstad and Haanæs (2018), an example of a digital organization is Google. Google organizes itself into flexible, diverse, and modular units of employees that can be reconfigured quickly. To enable cross-functional collaboration, Google fosters a "marketplace of ideas," in which briefs about new ideas and projects are published internally. Employees can vote for the most promising projects and choose which ones to support with their time.

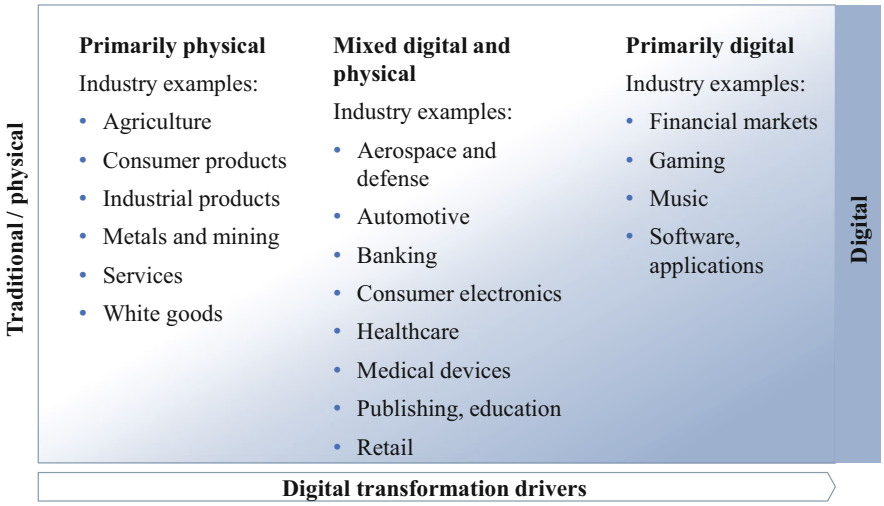

Fig. 7.3 Degree of product and service digitalization (Berman & Bell, 2011, p. 6)

change or adapt, and therefore are not flexible enough. Established companies also understand that digital technology can help their businesses with greater speed to a lower cost, and in some cases, they invite their customers to co-design and co-produce their products and/or services. This disruption is pushing all industries toward the digital end of the physical-digital continuum (see Fig. 7.3).

However, the fast-emerging digital economy is primarily changing definitions of value while redefining the means of its creation. Digitalization affects and determines all aspects of how customers behave and how companies create and capture value.

While digital pioneers attract investors to follow the digital hype, global traditional established incumbents face challenges to creating sustained value for shareholders based on their deeply rooted competitive advantage (Bughin et al., 2017). For that reason, with the DNA of strong capabilities and competences in their industry, these incumbents have to reinvent themselves at a fast pace to win the digital race by setting technological and innovational standards. As a result, the "digital winner takes it all and fast" mentality forces companies to disrupt their core along the wide range of resources, competences, and capabilities without losing focus on the paradigm of value creation resulting in long-term stable profitability levels. The need to gain a better understanding of the underlying digital mechanisms of value creation is unquestionable and of urgency to be responded to by most companies.

In order to shed a light of insight on digital value creation from a financial and strategic perspective, the remainder of this chapter is organized as follows: The digital dynamics of disruption and split economics, resulting in a dominance of the digital pioneers, are presented. From a theoretic approach, the financial core

concepts of PVGO (present value of growth opportunities) and real options are outlined. Moreover, these academic concepts are introduced to explain the virtue of value creation in the digital era. Next, three strategic recommendations on how to maximize option value are elaborated upon. Finally, a summarizing conclusion offers a future outlook on the subject.

Value in the Era of Digital Disruption

From an analytical point of view, the valuation of a company is an important tool to identify the value drivers (Rohlfs, 1974; Katz & Shapiro, 1994; Corelli, 2017).

According to Manyika et al. (2018) and their analysis on the company "superstars" [4] conducted from 2010 to 2014 based on the largest nearly 2400 corporations, with the rise of digital companies, profitability expressed in economic profit becomes more concentrated. [5] Manyika et al. (2018) find that the top 10% of the companies comprise 80% of the economic profit in the group of companies with revenues of more than USD one billion, which, in the Silicon Valley, are the startup companies called "unicorns." They refer to their study as the power curve. The pattern is similar at both ends of the curve, namely, nearly 10% of the low performing companies at the bottom account for a similar amount of value destruction. They state that over time, the concentration has become more intense.

As Manyika et al. (2018) show, all companies generate USD 920 million of annual operating profits, based on USD 9.3 billion invested capital earning a return of 9.9%. After investors and debt holders claim 8% for their cost of capital, the remaining 1.9% points translate into USD 180 million of total average economic profit. The resulting curve clearly shows a dramatic exponential fall and rise at both ends which exemplify "fat tails." Most of the companies in the middle are barely generating economic profit as they only generate the required cost of capital.

In addition to the graph illustrated in Fig. 7.4, the analysis reveals that 20% of the analyzed companies generate 90% of the created total value. Very few companies strongly outperform others, fueling back into the idea of the cross-industry digital phenomenon of "the winner taking it all." The other side of the "fat tail" indicates that only a relatively small number of companies are responsible for a significantly big share of value destruction, while the clear majority seems to be "stuck in the middle" with only an 8% chance of moving to the top quintile. As the capital markets favor those share investments that have the highest economic profit and future perspective, a cycle of capital availability in a concentrated way shows that there will be clear winners and losers in the future across industries.

[4] "Superstars" are companies that have a significantly greater share of income and generate high economic profits.

[5] The authors define economic profit as the total profit after cost of capital.

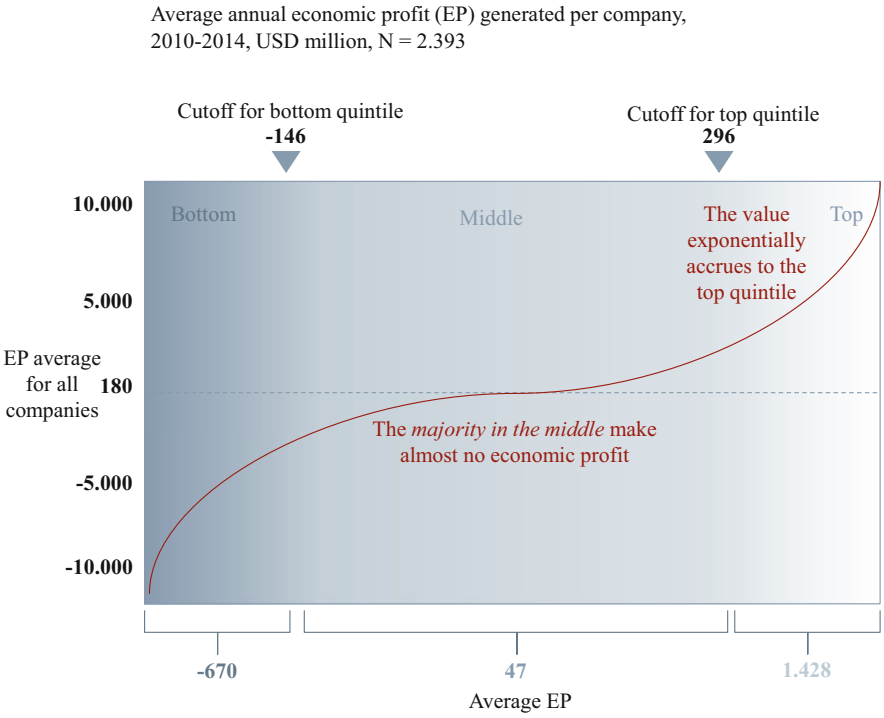

Fig. 7.4 The power curve of economic profit (Manyika et al., 2018; Ramaswamy et al., 2019)

According to the authors, another main reason for the differences in value creation is the issue of unattractive industries. In a nutshell, the key insight into the digital era can be summarized as follows: It is better to play with an average performance in an attractive market than to outperform in a less attractive market; where you play matters more than how you play. Logically, the implication for management is to manage product and market portfolios in a constant, proactive way. Multinational conglomerates like General Electric and Siemens acting in multiple businesses around the globe are forced to proactively manage their portfolios: to invest in the most attractive markets aggressively while divesting the less attractive.

In fact, value creation through digitalization can be alternatively described as two sides of the same coin: While investors require companies to sustain extraordinary levels of returns to sustain their values, corporate management therefore seeks to identify, select, and execute projects and investments generating positive NPV (Net Present Value) or economic profit. The technology leap of digitalization serves as the key enabler for companies to invest in digital technology and software expertise.

Also, Heuser (2018) notes the high levels of profitability and the question is raised which companies and dynamics are characteristic for the top performers. Even

though the authors do not list the names of the companies, they allude to the fact that there are not only digital pure players but also companies across industries which meet the criteria of "superstars." The key differences to the digitally mature players, as the authors point out, are investments in intangibles that are two to three times higher than industry average, high shares of foreign revenues, and inorganic growth strategies. Finally, the study reveals that the key skill of those firms is their ability to select and execute their investment opportunities in an excellent manner. The labeling of high growth startup companies as "unicorns" was initiated in 2013, when venture capitalist Aileen Lee named a company which has been valued more than USD one billion by its investors in private or public markets a "unicorn" (Lee, 2013). She refers to those startups with this terminology to a unicorn symbolizing an extremely rare, "magical" phenomenon from the mythical world. According to her findings, three to four super-unicorns are "born" every decade, such as Google, Amazon, and Facebook.

The matter of being a digitally mature company plays such a critical role because the awareness of digitalization and its new investment opportunities has increased over the last decades. According to Andreessen (2011), technology is finally available to globally scale digital ideas. The prerequisites have been established since the mid-twentieth century: six decades after the computer revolution, four decades of the existence of the microprocessor, two decades of the Internet, most of the world population has access to the mobile Internet.

Evans and Schmalensee (2016a, 2016b) share a similar point of view regarding why digitalization is fully unfolding now. They count six technology breakthroughs responsible for the success of matchmaking companies driving their value based on multisided platform business models: [6] the performance of computer chips, the Internet, the world wide web, broadband communication, programming languages, and the cloud technology. All these technologies have been hardware- and software-related and form a variety of digital opportunities allowing matchmaking companies to transform industries over the course of many years. Evans and Schmalensee (2016a, 2016b) see digitalization rather as a transformation process to happen over decades.

The Phenomenon of Split Economics

To encompass the magnitude of the digitalization related to the economic success of a few "superstar" companies, economists have also developed a new set of categorizations to capture the contrast of industrial firms versus digital companies. In the following, some examples of frameworks are depicted to clarify the differences.

[6] In platform business models, the peer is responsible for large parts of the value creation, acting as a micro-entrepreneur in suppling goods and services to the platform's customers (Eckhardt & Bardhi, 2016).

Govindarajan (2018) categorizes digital and industrial markets into three different types. Type 1 are purely digital markets, with information goods as main products. Through Internet connectivity, digital players like Google and Facebook orchestrate the variety of positive network effects to extract abnormal profits. Type 2 of the markets has converted from analog to digital products. Books, music, and media are sold as services on digital platforms instead of physical assets. The most prominent digital players to be named are Amazon and Netflix as well as the Internet giant Google again. Type 3 is still subject to experience a subtle level of digitalization. The industrial Internet, also referred to the Internet of Things, interlinks physical products using software. The Internet connectivity enables to integrate the tangibles and intangibles and thereby generates new sources of value in existing industries. The most interesting aspect in this category revolves around the potential of success of native digital versus native industrial players.

While Govindarajan (2018) lists barriers to overcome for both groups of players, he is unclear about the success of the "hybrid" company Amazon, combining the e-commerce industry with almost unparalleled success. Nevertheless, his categorization eases a structured understanding of the industrial versus the digital markets though admitting to being vastly imperfect.

Along the lines of the idea of split economics, Arthur (1996) draws a clear picture of two bifurcated worlds of business. The industrialized world, which he labels "Marshall" world, is based on materials and processing, maintaining profitability based on optimization in an overall paradigm of diminishing returns.

In contrast, the information- and knowledge-based economy enjoys increased returns based on networks and embraces psychology, cognition, and adaptation. Arthur (1996) alludes to organizational differences between both worlds by describing the effects of unpredictability, positive feedback loops with a "casino gambling, where part of the job is to choose which game to play" (Arthur, 1996). Thereby, he clearly positions software as the dominating transmitter of information. Key success factors are the right timing, financial capacity, and strategic pricing to resign profits.

In yet another similar idea of split worlds, Silicon Valley's famous venture capital investor Andreessen (2011) states in a Wall Street Journal article that "software is eating the world." In his foray about software innovation disrupting and reshaping complete industries, Andreessen argues that software substitutes large parts of the value chain of many industries which are allocated to the physical world. From the automotive industry, oil and gas players, healthcare, and education, digitalization continues to transform the economic landscape. In 2011, Andreessen provoked with the statement that stock markets "hate technology" (Andreessen, 2011). He refers to the P/E (price-to-equity) ratio range between 10 and 15 of Apple as being "undervalued" in the notion of financial multiples. In 2018, the P/E ratio ranged at a higher rate between 16 and 19 (see Fig. 7.5). Yet, it remains questionable whether venture capitalists would consider those rates as an "emotional" swing due to the appreciation of technology companies.

Alluding to the concentration of profits as a phenomenon of digitalization (Manyika et al., 2018), the world of academia and business describes new times of economics, which are contrasted as a bifurcated world by Arthur (1989): The

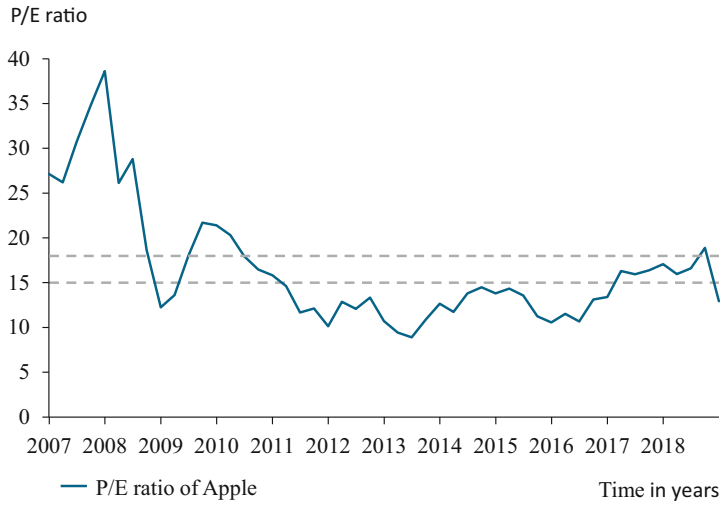

Fig. 7.5 Apple P/E ratio 2007 to 2018 (macrotrends.net, 2018)

industrialization with its long-term constant or even diminishing returns has dominated the global economy. Now, the dynamics of the digital era unfold immense growth opportunities of value creation to digital companies with increasing returns. According to Arthur (2014), the times of neoclassic economics are superseded by complexity economics, which are commonly also referred to as economic times of volatility, uncertainty, complexity, and ambiguity (VUCA).

Another study of the strategy consultancy BCG has presented value creators and value exploiters in an annual ranking on maximal total shareholder return (TSR). Thereby, they define value creators as companies creating a higher PVGO as a percentage of market capitalization than the median of the S&P 500 industry peer group and exploiters as companies below the median.

Based on a legacy of success, the core business of those value stock companies is "overexploited" whereas the disruptive market dynamics would suggest disrupting and innovating to obtain scaling growth opportunities. With PVGO taken as a proxy for the degree of exploration, Reeves et al. (2015) show the level of PVGO dropping by 10 percentage points between 2004 and 2014 (see Fig. 7.6). Even though they attribute a portion of growth in 2009 to large share buybacks and high dividends, the authors find especially large and established companies to literally ignore growth opportunities.

In their analysis, Reeves et al. (2015) find large corporates to face inertia as a negative effect on size scale and therefore not pursuing enough future growth opportunities rather than focusing on cost reductions to maintain profitability levels.

As top value creators in 2015, the study names the decacorns Amazon and Google being able to execute "dual discipline" even at scale. They "explore" and "exploit" value in parallel. In the ranking from 2018, the technology sector takes six

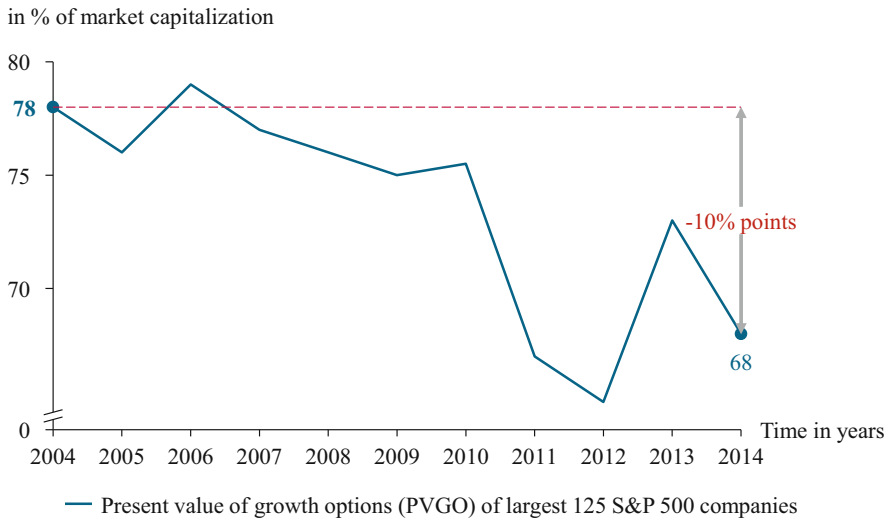

Fig. 7.6 Large companies neglect exploration (Reeves et al., 2015)

and the media sector takes three out of the first ten spots. Both industries have also been identified as digitally advanced in other studies (Hansell et al., 2018). The power of digitalization, especially in those industries with digital native companies like Netflix, Facebook, and Amazon outperforming on value creation, is remarkable. Therefore, it is essential to comprehend the source of value creation based on the core financial concepts of PVGO and real options, before integrating those with the more strategic concept of maximizing option value according to Kester (1984).

PVGO: The Financial Core Concept

Brealey et al. (2010) define that the value of growth opportunities is based on the required rate of return earned on future investments to exceed the firm's cost of capital. Furthermore, they describe tangible assets as units of productive capacity, while intangible assets are considered options to expand additional units. The sum of the option values is defined as PVGO, the present value of growth.

Investments in future opportunities, which Myers (1977) refers to as PVGO, contribute significantly to the company's equity value range. Even decades later, Brealey et al. (2010) define PVGO as the value of a firm's options created to invest and expand.

They explain the price of a stock, thus its valuation, in a two-folded approach when referring to growth: The first component is defined as the capitalized value of average earnings under a no-growth policy, consequently expressed as a perpetuity formula with EPS (earnings per share) discounted at the market capitalization rate

r. The second element PVGO is defined as the present value of growth opportunities. Those growth opportunities are a value summarized as the value of all future expected cash flows stemming from internal projects with a positive NPV, earning more than the market capitalization rate r.

$$P_0 = \frac{\text{EPS}_1}{r} + \text{PVGO}$$

If investors are paying a significant fraction of their share price for those growth opportunities, the share is commonly categorized as a growth stock. Assuming market efficiency, the PVGO can serve as an approximation to provide one piece of the valuation puzzle. However, the complexity in the application of native digital companies is apparent: While startup companies are known for negative cash flows and earnings, the formula might not always apply in its original sense (Brealey et al., 2010).

Originally, Myers (1977) illustrated the concept of investment opportunities as growth options with an empiric elaboration on five companies and their respective PVGO ratio of 66% in relation to the market value of equity ranging between 36.5% and 87.1% (Brealey et al., 2010). Two decades later, Brealey et al. (2010) refer to the decacorn Google as a "growth stock" as roughly 50% of the stock price stem from value based on investors' expectations about Google's future investment opportunities.

In the time of increased attention on digital pioneers in the Silicon Valley, Brealey et al. (2010) contrast the separation of growth and value stocks based on the PVGO concept: they depict that investors distinguish between growth and income stocks, also known as value stocks. It is the investors' motivation to buy growth stocks for the expectation of future capital gains compared to the motivation for investors of value stocks to buy those for cash dividends.

In terms of PVGO, the authors describe growth stock attributed to a high PVGO compared to the capitalized value of EPS, hence they have low ratios of book value to market value. Even though growth stocks are quickly expanding, their PVGO is assigned to the profitability of new investments.

The set of value stocks with high ratios of book-to-market value, according to Brealey et al. (2010), inhibits a higher long-run return than growth stocks. He refers to a rate of 5.2% annual difference between both types of stocks since 1926.

Myers and Turnbull (1977) extend the idea of PVGO as they refer to the payoff for shareholders depending on the endogenous availability of projects, the "assets depend on future discretionary investment by the firm" (Myers, 1977, p. 155). They distinguish between assets-in-place as tangible, non-discretionary, sunk costs whereas future investments are intangible, discretionary investments. Furthermore, they define discretionary investments as all variable costs, such as marketing expenses, research and development costs, maintenance costs on plants and equipment, and expenses on raw materials. They explicitly connect the distinction between both asset types: Real assets have a market value that is independent from

the firm's strategy and real options are the opportunity to purchase real assets on possibly favorable terms, meaning positive NPV.

Pindyck (1988) introduces the call option analogy in a similar way: The capacity is defined as the firm's real assets and real options as the option to add more units. The investor's option is compared to the real option to add more capacity. Pindyck (1988) claims the value of capital in place to be less than 50% of the market value depending on demand volatility even though he does not provide any empiric proof. While most authors build on the analogy of real assets and real options, it has been rejected by Danbolt et al. (2002).

Kester (1984) builds on the concept of PVGO with a strong focus on the strategic and competitive perspective for business practice, transferring the concept from the financial to the strategic angle, stating that "value comes initially in the form of growth options rather than cash flows" (Kester, 1984, p. 14). He considers the attractiveness of tomorrow's available investments to be based on the assets put in place today.

In addition, Kester claims that real options are split in non-firm-specific, such as cost reductions, and firm-specific, defined as having no value to another firm. Examples of firm-specific real options are economies of scale, learning curves, and patents. Describing those firm-specific real options, Kester (1984) builds on his idea, calling options either proprietary or shared. Apart from timing flexibility and the characteristic of compound options, he formulates those as the three main ingredients to create value in dynamic markets—an idea which will be elaborated upon in the following.

Referring to his empiric analysis, Kester quantifies the PVGO by industry: He investigated PVGO in his empiric study in 1984 and amounted the minimum of 5% of PVGO in food processing and up to 85% of PVGO in electronics. In his paper in 1986, he calculated PVGO portions of nine companies in three industries: a PVGO of 56% in electronics, 43% in chemicals, and 43% in the paper industry.

The Split Concept of Real Options

Following the maxim of value creation, the time and scope of exercising the option can be steered: Investments as real options can be deferred, abandoned, expanded, shortened, switched, and compounded. This structuring of option characteristics (Trigeorgis, 2002) suggests that corporate finance literature agrees on the basic principles of the real options approach which serve as the fundament for more sophisticated quantitative empiric models.

Along the findings of other literature, Koller et al. (2010) describe the main variables correlated to flexibility value. While high investment costs and cash flows lost to competition are negatively correlated, other factors are positively linked: the longer the time to expiration, the higher the uncertainty about present value and the higher the risk-free interest rate, the higher the present value of cash flows and its flexibility value (see Fig. 7.7).

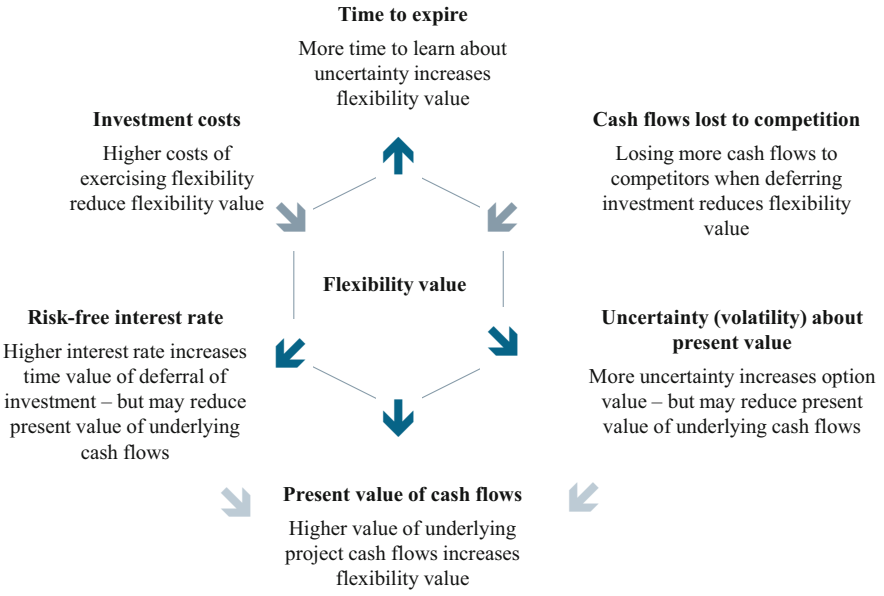

Fig. 7.7 Drivers of flexibility value (Koller et al., 2010, p. 685)

In line with others, Trigeorgis (2002) regards uncertainty and flexibility as key determinants, hence the value of options benefits with greater variability of outcomes. He extends the concept of NPV by decomposing the value into a sum of a passive NPV, flexibility value, and strategic value. In this aspect, Trigeorgis solves for the limitations of the NPV concept under uncertainty: He defines the portion which Myers (1977) refers to as "intangible" as a flexible and strategic.

In Myers' view, the flexibility value is the real option value which increases with high uncertainty, long investment horizons, high interest rates, and compound options. Flexibility is regarded as the option to defer, reverse, stop, restart, and switch investment projects (Guo & Zmeškal, 2016).

Besides, Trigeorgis (2002) considers the strategic value as a multistage value, also called compound value. Trigeorgis (2002) notes that "empirically, companies in industries with higher uncertainty that involve multi-stage (compound) options tend to have a higher proportion of their stock price deriving from growth opportunities (PVGO/P), providing an indirect confirmation of the validity of real option predictions" (Trigeorgis, 2002, p. 13). Trigeorgis, like Kester, bridges the gap between the corporate financial and corporate strategy perspective as he explains how strategic value depends on whether the investment is proprietary or shared and whether it damages or benefits rivals. He points out the competitive pressure as a WTA (winners take all) race. When firms are induced to invest, the prisoner's dilemma occurs: Companies who share investment opportunities lose if both pursue those individually. Consequently, they are better off coordinating with joint research and shared investment cost to maximize the strategic portion of value of equity. In

another study of Trigeorgis (1991), he applies a scenario analysis in a duopoly to define the optimal timing to invest (also see Balasubramanian et al., 2000)

This aspect of introducing game theory to consider competitive reactions has been followed by many authors in their theoretic models, especially as duopolies in networked markets (Tsai & Ghoshal, 1998; Angelou & Economides, 2008, 2009a, 2009b).

Real Options and PVGO: A Fit for VUCA Times

To reflect the digital dynamics under uncertainty in the intrinsic value of a company, most corporate finance academics agree that the real option model applied to future cash flows (Götze et al., 2015) is the most accurate reflection. As a critical element of the optimal portfolio selection, investors obtain the character of an option: By paying the share price, they receive the value of the company without growth and the option to grow, referred to by Brealey et al. (2010) as the PVGO model. The investment in the PVGO is naturally hedged to its PVGO value, with an enormous upside potential based on volatility and high growth rates (Balzer, 2020a, 2020b).

Literature based on PVGO and the real options approaches the factor of risk in positive correlation to the value of growth opportunities. As the negative result is limited to the sunk cost of the acquired growth option, the upside potential of the growth option is positively related to its risk. In other words, risky projects create value. Again, Kester (1984) demonstrates straightforward arguments regarding why risk should be treated as a positive investment opportunity, analog to a call option on securities (see Fig. 7.8).

This insight might appear rather trivial from an academic perspective. Yet, it is counterintuitive to all corporates and their credo to reduce and mitigate risk wherever possible. Therefore, it could be argued that the notion of risk of the corporate management requires fundamental change. In times of digitalization, the perception of risk is still a key characteristic differentiator between large global corporates, represented as value stocks, and digital pioneers maintaining a startup style to embrace risk—appreciated by the capital markets in terms of high PVGO values.

Furthermore, while the DCF valuation assumes investors to be passive while ignoring volatility, the attractiveness of the PVGO model is dedicated to valuing the option of growth. At this point, active investors can decide whether and when to exercise the option of growth. Apparently, the following rule applies: the higher the market volatility, the higher the value of its flexibility (see Table 7.1).

As Brealey et al. (2010) concluded, the volatility increases the value of the option, the PVGO, and can therefore justify a higher pricing: Consequently, the value of native digital companies is dominantly attributed to the positive effect of volatility and its upside potential based on the real options approach (see Table 7.2).

In their empiric models, the authors Brealey et al. (2010) apply an equity risk-premium at a nominal rate of 8.4% (US 1926 to 1994) while Kester (1984) discounts at a nominal rate of 15%, 20%, and 25%, respectively. Danbolt et al. (2002) criticize

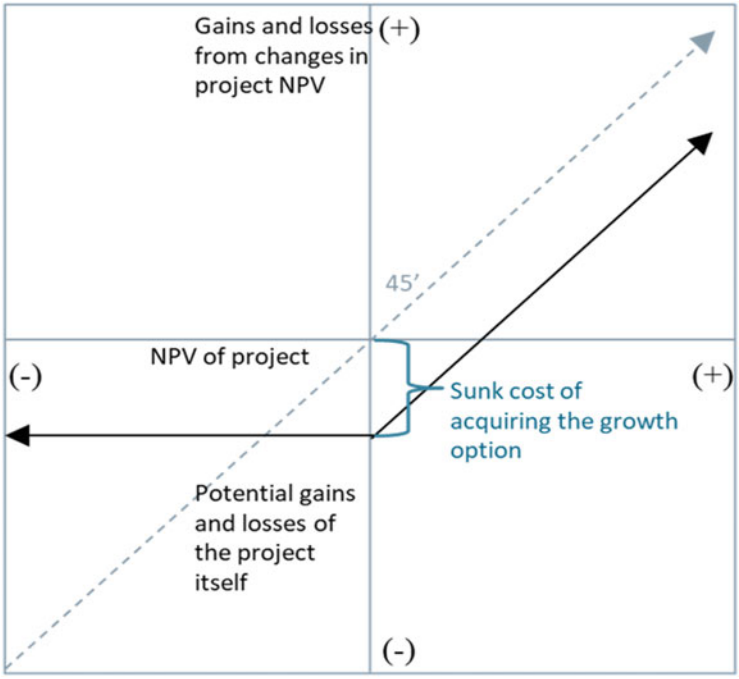

Fig. 7.8 The asymmetry between upside gains and downside losses (Kester, 1984)

Table 7.1 Volatility of establishment industries versus digital organics (Brealey et al., 2010, p. 518)

	Establishment industries	Digital organics
Number of options	100,000.00	100,000.00
Exercise price	USD 25	USD 25
Maturity	5 years	5 years
Current stock price	USD 22	USD 22
Stock volatility (standard deviation of return)	24%	36%

the variety of applied discount rates while using an 8.6% real interest rate for UK companies in their empiric study. Danbolt et al. (2002) demonstrate the limitations of the PVGO model. Overall, it can be concluded that the quantitative perception in academia of the discount factor varies.

Maximizing Value in VUCA Times

The excitement of digital technologies stems from the idea to catch new, hopefully positive, NPV opportunities. Whereas the attractiveness of the market beats all other

Table 7.2 Value of options: establishment industries versus digital organics (Brealey et al., 2010, p. 539)

	Establishment industries	Digital organics
Stock price (P)	USD 22	USD 22
Exercise price (EX)	USD 25	USD 25
Interest rate (rf)	0.04	0.04
Maturity in years (t)	5	5
Standard deviation (σ)	0.24	0.36
$d_1 = \frac{\log\left[\frac{P}{PV(EX)}\right]}{\sigma\sqrt{t}} + \sigma\sqrt{t}/2$	0.3955	0.4873
$d_2 = d_1 - \sigma\sqrt{t}$	−0.1411	−0.2177
Call value = $[N(d_1)xP] - [N(d_2)xPV(EX)]$	USD 5.26	USD 7.40

criteria in terms of value creation potential according to recent studies, corporate management can proactively create value by analyzing digital technologies in the light of potential value creation. This can be achieved by maximizing Kester's (1984) three main ingredients of exclusivity, timing flexibility, and compound options. Additionally, a more positive perception of risk as a positive attribute in investment decision-making requires a fundamental change in today's corporate thinking—with the options' nature to have limited losses while enjoying huge upside potential.

In the following, the three major ingredients stemming from the Kester framework for value creation on realizing positive NPV projects, also referred to as exercising options, are elaborated upon.

The first principle of value creation is related to the characteristic whether the option is exclusive to a company or shared within the market. Starting from the angle of corporate finance, the exclusive right to own the option increases its value: While some companies enjoy the exclusive rights of exercising real options, those are proprietary. Exclusive options are highly valuable as the value created falls to the company owning the right to exercise the option.

On the other hand, if the option has to be shared with other players in the market, it is less valuable as the probability of competitors to take away value is given and likely in most markets. While academics apply game theoretic approaches, they incorporate the aspect of competition in their models and thereby overcome the original limitations of the DCF and NPV concepts.

Clearly, the characteristics whether an option is firm-exclusive or proprietary can be interpreted as the result of capability of the management to exercise its strategy successfully by dominating markets. Hereby, in general, they steer the market dynamics as they can initiate changes regarding advanced technology or pricing adjustment (Kester, 1984). This strong position allows the market leader to control the timing and anticipate the outcome. The strategic positioning of a first mover pioneering in technologies or the second mover, also referred to as fast follower, matters critically to the optimal timing of exercising a real option by investing. Now,

the variety of opportunities becomes apparent: With several new digital technologies introduced to global markets reaching a certain degree of maturity, the digitalization enables companies to move fast into new markets or build up new barriers to enter as incumbents. Depending on the potential of digitalization, new opportunities will emerge and will be taken by the first company to be able to monetize them. For academics, the modeling of game theory in combination with behavioral finance coincides with the latest technology trends. In business, the minimum skill set for future managers to create shareholder value is an in-depth analysis of the vertical IT technologies to identify tomorrow's growth opportunities.

The second element of value creation to be elaborated upon is reflected by its flexibility on a timeline. The option to choose the ideal timing to initiate or alter an investment project contains flexibility value. The longer the time horizon to maturity, for example to defer a project, the greater the flexibility for the management to identify the optimal time to exercise the option, meaning to realize the project.

According to Dixit and Pindyck (1994), the optimal timing of exercising the option is when it is "deep in the money," meaning when the option prices rise significantly above the value of the underlying asset. The option of leaving becomes valuable, for example due to demand shocks as most competitive companies wait before leaving to see if the market recovers or if rivals leave. The authors' view on investment projects as tangible assets in, for example, manufacturing industries contains a trade-off between economies of scale to produce large amounts despite uncertain demand and revenues. Those have to be balanced with incremental investments to incorporate the flexibility of options. Here, digital companies have an advantage due to their business relying on rather intangible assets.

The academic field of corporate finance inspired by Trigeorgis (1991) has developed numerous studies applying the rules of game theory and thus incorporating the competitive view into markets, as the ideal time depends on the maturity of the market as well as competitor moves, as noted before.

Corporate management, however, should refrain from investing earlier than required, as the option to defer the investment has its value and would be destroyed—this would be more critical if the investment is irreversible versus reversible. In addition, management is inclined to rather invest too early if NPV is high and risk levels and industry rivalry are low. One can conclude that the rationally optimal time to invest can only be found by a constantly self-challenging analysis based on real options and other strategic tools such as game theory.

The third element of value creation focuses on the characteristic of compound projects. Amongst other leading academics, Kester classifies projects or options according to the kind of value they create: Simple options create value as cash flow streams, according to the DCF scheme. A practical example could be restructuring programs or initiatives to increase efficiency based on cost reductions.

In the digital era, those projects will and have been vastly available to many players, increasing the level of automation in an industry. As those project opportunities are shared within the industry, the value created is shared among the players. Furthermore, it can be regarded as a hygiene factor for the industry as all players will be forced to enable those optimizations in order to sustain their profit levels. Those

projects create value through cash flow originating from the assets-in-place. Another typical example in times of digitalization is the booking of flights online in the airline industry: With the digitalization of B2C markets, airlines are pressured to offer their flights with online booking and quickly establish the main sales channel in the industry in digitalization to secure future operational cash flows.

In contrast, compound projects include also further options for future projects and contain the option to generate additional cash flows in future. Typical examples include R&D projects, product, or market expansions. Yet, compound options bear a higher level of complexity, thus the management has to assess them according to their overall fit of the company's strategy (Kester, 1984). In short, simple options are a necessity while compound options can be interpreted as the "icing on the cake" to monetize on positive NPV and a necessity for all companies with the ambition to generate future growth.

Without a doubt, literature has identified far more parameters impacting the value of options in a negative or positive correlation. This insight can be inferred from the empiric studies published since the burst of the dot-com bubble in the early 2000s. As Amram and Kulatilaka (2000) note, growth options are not visible to external financial investors, but PVGO provides a level of transparency to shareholders. The authors clearly see that framing Internet growth options is a "judgement call," as growth in new markets is unknown contrary to matured markets.

The paper of Schwartz and Moon (2000) has received major attention in the academics of corporate finance due to its focus on a rational model to explain the excessive pricing of Internet company's stocks. Schwartz and Moon (2000) argue for the key determinants to impact high company valuation being changes in revenues and changes in revenue growth rates. Hereby they build their model based on the split of a core revenue stream and additional revenues from growth as exercised options. This distinction of labeled PVGO or real options and assets-in-place is at the core of valuation model. The main contribution of the insight can be attributed to the explanatory character of high valuations for an Internet company. With a high sensitivity to both key determinants, the authors imply further aspects of corporate finance literature in their discretionary model: They consider the changes in revenues and growth rates to be extremely high in the short term but to converge to the mean of reasonable industry in the long term.

Alluding to this aspect, they refer to the empirical study of Fama and French (2000) which was able to show a conversion to the mean of profitability across industries even experiencing abnormal rates of return before. Following the ambition to analyze the rational pricing, they apply the conversion to the mean to their respective revenues and growth rates to adjust for a still realistic future scenario. The example of decacorn Amazon allows the authors to empirically conclude the possibility of rational pricing for digital pioneers based on the groundwork of Miller and Modigliani (1961), Myers (1977), Kester (1984), and Trigeorgis (1991, 2002).

Conclusion

Clearly, the demystification of digital value creation and its quantification is of utmost importance for decision-makers in all industries who are required to succeed in a digital, networked economy of adoption, coopetition, and self-reinforcing dynamics.

Digitalization has rewritten the rules of value creation which are truly mastered only by a small number of companies, leading to a high concentration of capital, fueled by immense future growth. In an attempt to explain the value drivers, the core financial concepts of PVGO and real options have been introduced.

In the financial and strategic perspective taken by the capital markets, Kester (1984) refers to the value creation based on PVGO in a framework of three key characteristics. He claims that the value of the growth option is positively correlated to three main characteristics: (1) the exclusiveness, the proprietary of the option, (2) its flexibility regarding the time, scope, and reversibility of exercise, and (3) the compound effect of access to further future options.

In parallel, Arthur (1989) points out the three major strategic decision parameters to succeed in networked industries: (1) the ability to balance the level of competition and cooperation with other market players, summarized as the management of shared versus proprietary markets, (2) the importance of the optimal timing to enter, for example as a first mover, and (3) constant adoption which he states the growth of networks is based on, as markets are "self-reinforcing," building on their own dynamics.

Those similarities of findings across academic domains indicate that the virtue of digital value creation follows certain patterns which have been demystified in several fields of academic research already. As a conclusion, the innovation that fills the research gap can rather be interpreted in combining those theoretic approaches and substantiating those with a comprehensive empiric study as a next step in academic research valuable for business practice.

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