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Addressing the Challenges of Industrial Transition Processes – the Case of Photovoltaics Industry

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Addressing the Challenges of Industrial Transition Processes – the Case of Photovoltaic Industry

Abstract
The aim of the article is to explore the managerial practices that enable capitalizing on the critical instability during an on-going transition period in the life-cycle of an industry. The investigation followed a qualitative approach using a field-based case study method and a longitudinal design. Multiple data collection methods were adopted to reduce a systematic bias in the gathered data and to develop the case, shaped by the context and emergent data. The gathered rich data enabled the confrontation of industry transformation signals with the strategic maneuvering exhibited by the investigated firm. Observed options involved imitating, repositioning, exiting or entering. The study is a part of a larger project financed by National Science Centre of Poland (NCN) - 2013/11/D/HS4/03965

Keywords: industry life-cycle, industrial transition, photovoltaics, strategic positioning, value capture, value appropriation.

JEL classification: M00, L10

Formułowanie strategicznej odpowiedzi na wyzwania etapu przejściowego w cyklu życia branży – przypadek branży fotowoltaicznej

Abstrakt
Celem artykułu jest zbadanie praktyk menedżerskich, które umożliwiają tworzenie i zatrzymywanie wartości w okresie przejściowym w cyklu życia branży. Badania miały charakter podłużny, przeprowadzono je zgodnie z podejściem jakościowym za pomocą metody studium przypadku. Zastosowano zróżnicowane spektrum metod gromadzenia danych, aby zminimalizować ryzyko błędów systematycznych i jednocześnie opracować przypadek, kształtowany przez kontekst i pojawiające się w trakcie realizacji procesu badawczego dane. Zgromadzony materiał empiryczny umożliwił konfrontację sygnałów zmian w dynamice rozwoju branży z wyborami strategicznymi dokonywanymi przez badana firmę. Obserwowane opcje działań polegały na naśladowaniu, repozycjonowaniu, wychodzeniu lub wchodzeniu do pokrewnych branż. Badanie jest częścią większego projektu finansowanego przez Narodowe Centrum Nauki (NCN) - 2013/11 / D / HS4 / 03965.

Słowa kluczowe: cykl życia branży, rozwój branży, fotowoltaika, strategiczne pozycjonowanie, przechwytywanie wartości, zawłaszczanie wartości.

Introduction

Extant research shares the argument that a transition period in the industry life-cycle represents a critical time for incumbents as well as new entrants (e.g. Agarwal, Sarkar, & Echambadi, 2002). It brings about major changes in the competitive dynamics (Agarwal et al., 2002; Cusumano, Kahl, & Suarez, 2015) and, thus. generates attractive but temporal windows of opportunity. Hence, managers have a quite limited timeframe for reconfiguring deployed patterns of action in order to capitalize on those opportunities. One of the main challenges relates to the proper identification of possibly early signals of the shift in the competitive landscape of an industry. Extant literature has presented an appealing set of indicators informing about an industrial transition (Najda-Janoszka, 2017). However, provided evidence and analyses have been based on retrospective data on industries that already reached the stage of maturity. Thus, the informative potential of discussed indicators may be limited when used to assess the harbingers of an on-going industrial transformation. Given the paucity of studies reaching beyond the retrospection, this study is focused on an on-going transition process in the life-cycle of the photovoltaic (PV) industry. The aim of the article is to explore the managerial practices that enable capitalizing on the critical instability during a transition period. Given the explorative character of the study, the investigation followed a qualitative approach using a field-based case study method and a longitudinal design.

The remainder of the paper is organized as follows. The next section provides a theoretical background on the industry development trajectory, industrial transition assessment and strategic manoeuvring during transition. The section on methodology introduces the research design, criteria used for case selection and the data collection procedure. Findings are presented in the Results section, which is followed by Conclusions outlining implications for management research.

Theoretical Background

The nature of industries evolves over time and the observed cumulative change extends beyond the mere statistics of firm entry and exit (e.g. Klepper, 1996; Audretsch, Houweling, & Thurik, 2004; Cusumano et al., 2015). The continuous interplay between environmental changes and firms' strategic choices brings about major qualitative transformations in the industry's competitive landscape (Agarwal et al., 2002; Cusumano et al., 2015). Regularities and disruptions in the trajectory of industrial development have been commonly explored with the reference to the concept of industry life-cycle (e.g. Abernathy & Utterback, 1978; Klepper, 1996; Miles, Snow, & Sharfman, 1993; Anderson & Tushman, 1990; Agarwal et al., 2002).

Much attention has been directed toward mechanisms that produce a life-cycle pattern of an industry (e.g. Agarwal et al., 2002; Klepper, 1996). Accordingly, there are three main research streams that provide alternating explanations for the driving force of industry evolution through stages of emergence, growth, maturity and decline. According to the evolutionary economics, the key mechanism is represented by a knowledge regime, which drives the cost-spreading effect and determines the minimum efficient scale barriers (Klepper, 1996; Malerba, 2006). In turn, the technology management perspective points to technological developments (discontinuities) that create competition for dominance between multiple alternative product/technology designs (Abernathy & Utterback, 1978; Anderson & Tushman, 1990; Christensen, Suarez, & Utterback, 1998). The last research stream of the organizational ecology focuses on the density of population (industry) that enhances its institutional legitimacy and facilitates competition over the same set of finite resources (Hannan & Carrol, 1992; Wade, 1995; Baum & Oliver, 1991). Although provided explanations appear quite distinct, the insights are not mutually exclusive, rather complementary. The explanatory strength and complementary linkages are affected by the diverse nature of industries (Agarwal et al., 2002; Petloniemi, 2011). Further, regardless of the theoretical roots, extant research shares an important argument that the transition from growth to the maturity stage represents a critical time in the industry life span (e.g. Agarwal et al., 2002; Cusumano et al., 2015). It is a period when the variation is being taken over by the selection process (Petloniemi, 2011). An industrial transition is highly demanding with regard to strategic maneuvering, as managers have a quite limited timeframe for reconsideration and reconfiguration of firms' strategic behavior (Agarwal et al., 2002). Deciphering the harbingers of an upcoming transformation is a difficult challenge due to important limitations in the assessment techniques and abilities. Firstly, depending on a particular research stream, authors have tended to focus selectively on either the properties of the knowledge base, technology advances or population density and structure (Najda-Janoszka, 2017). Secondly, numerous studies have stressed the conditional validity of proposed indicators (Najda-Janoszka, 2017; Petloniemi, 2011). Finally, the provided causal explanations of transformation have been based on retrospective data on industries that already reached the stage of maturity. There is an evident lack of research focused on the evaluation of an on-going industrial transition, when competitive ramifications for introduced innovations, developments in technology, market conditions or institutional arrangements have yet to be determined. Moving beyond historical analyses toward an uncertain, ambiguous, partially visible competitive landscape implies building more on the complementarities between the extant research streams; hence, considering and evaluating not selected, individual indicators, but a broader set of possible early signals (Najda-Janoszka, 2017). A broad scanning can enhance the identification of various localized changes that may in a short run develop into tendencies spanning across the industry (Teece, 2007; Najda-Janoszka, 2016a, b). Given the accelerating pace of changes shaping the evolutionary pattern of industries, the timeframe for sensing and responding to shifting circumstances shortens substantially (Agarwal et al., 2002; D'Aveni, 1994; Najda-Janoszka, 2016b, c), and competitive rearrangements generate both strategic opportunities and threats for incumbents as well as new entrants. Depending on the type of sensed signals and the comparative costs of adjustments, firms can choose different strategic options aiming at capitalizing on the transitional instability (Argyres, Bigelow, & Nickerson, 2015). Strategic maneuvering by incumbents may involve not only imitating or exiting, but also repositioning into niches, while de novo entrants may consider entering by innovating or imitating successful solutions (Argyres et. al., 2015). Interestingly, each of those strategic options has been discussed as an individual yet comprehensive response to the transition signals (Argyres et al., 2015). There has been an evident lack of research providing insights into the usage of those options in a combination. Hence, this study challenges the perspective by treating strategic options as potentially transitory not ultimate solutions.

Methodology

Given the explorative character of the study, the investigation followed a qualitative approach using a field-based case study method, which facilitates a holistic understanding of context-bound and complex phenomena (Eisenhardt, 1989; Yin, 2014). The implemented procedure complies with the instrumental case study design framework (Stake, 1995). The case selection procedure involved three main stages. The first one included the identification of a dynamically growing industry exhibiting potential for transition. It was followed by the selection of candidate firms with a minimum of 5 years' performance history and operating in that industry. The final stage was focused on selecting a suitable firm providing a satisfactory level of richness and diversity of data, as well as ready access to key informants in a longer time span. In order to examine changes in competitive conditions of the chosen industry and a pattern of strategic choices made by the selected firm, the study followed a longitudinal approach. Multiple data collection methods were adopted to reduce a systematic bias in the gathered data and to develop the case, shaped by the context and emergent data (Stake, 1995; Eisenhardt, 1989). The case relies on current and retrospective data collected through:

- four waves of semi-structured, two- to three-hour in-person interviews carried out in 2012, 2013, 2015, 2017 with highly knowledgeable managers of the selected firm (top and project managers),
- three direct observations conducted in the years 2013–2016,
- extraction from internal firm documentation (a total of 18 documents, which included financial statements, project documentation, audit reports),
- extraction from external secondary sources (press releases, industry statistics and reports of the International Renewable Energy Agency – IRENA, International Energy Agency – IEA, Joint Research Centre (JCR) of the European Commission, World Intellectual Property Organization –WIPO).

All relevant information was retrieved according to a developed data collection protocol and was recorded into the case study database (Yin, 2014). Because of high sensitivity of collected data, the names of the investigated firm and related corporations were disguised.

The study represents a part of a larger project "Dynamics and determinants of the process of appropriating value from projects implemented in the inter-organizational networks" financed by the National Science Centre of Poland (NCN) on the basis of the decision number 2013/11/D/HS4/03965.

Results

Challenged by the spatial constraints and the trade-off between better stories and better theories (Eisenhardt & Graebner, 2007, p. 29), the extensive narrative way of presentation was compromised and broken down to a more theory-oriented description. Hence, obtained results were divided into four parts: concise characteristics of the chosen industry, a brief description of the selected firm, the identification of the features of industrial transition, the evaluation of the firm's strategic response to sensed signals.

Photovoltaics industry

Solar photovoltaic (PV) technologies enable the conversion of a uniquely abundant resource – the sun's radiation – into electricity. A solar cell, the basic element of the PV system, becomes a source of direct current (DC) when exposed to sunlight. Yet, generating usable alternating current (AC) involves grouping cells into modules, panels, arrays, and finally into whole systems. Those systems equipped with electric system components allow for the conversion of the output of PV solar panels into utility frequency AC and for the connection to the grid. The value chain of the PV industry depicted in Figure 1 clearly reflects the logic. It begins with the raw material (silicon, compounds), proceeds through basic cell and module production, and continues all the way to installation, operation and maintenance (Figure 1).

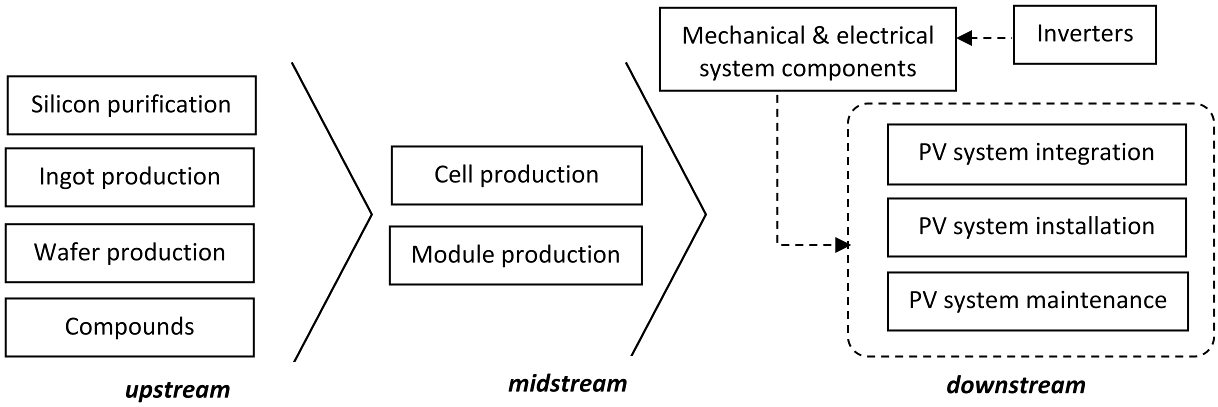

Fig. 1. PV industry value chain. Source: Authors' own work.

The upstream part of the value chain, involving raw material production, is commonly recognized as technology- and capital-intensive (International Renewable Energy Agency [IRENA], 2016; Jäger-Waldau, 2017). On the contrary, the midstream business is more labor-intensive; hence, entry barriers are related predominantly to the economies of scale (IRENA, 2016; Jäger-Waldau, 2017). The downstream industry is again a technology-intensive one (IRENA, 2016; Jäger-Waldau, 2017). Business activity of the investigated firm Solaris Ltd. involves the production of main components of inverters, i.e. electrical converters of the current; hence, the company's operations are linked with the downstream part of the industry value chain.

Although the first conventional PV cells were produced already in the late 1950s, and in the 1980s PV became a common power source for consumer electronic devices, for many years solar PV power systems were considered an expensive luxury (IRENA, 2016). The introduction of large subsidy programs at the turn of the millennium provided the critical trigger for the dynamic growth of PV systems and the whole industry. Over time, the economic potential of solar PV power has become a major issue when discussing its development trajectories (Zou et al., 2017). With a stronger emphasis on the economic efficiency of PV power systems, a growing number of countries have recently begun to shift from heavy subsidization toward retroactive measures (International Energy Agency Photovoltaic Power Systems Programme [IEA PVPS], 2018). Given the high dependency of the PV industry on complex support policy mechanisms, the observed regulatory changes occurring across global markets may substantially affect the hitherto forecasted PV deployment trajectories (Ito, 2015).

Currently, the solar PV industry has become one of the fastest growing industries with the compound annual growth rate of 40% (since 2001) (IEA PVPS, 2018). Increasing prices of electricity from conventional energy sources, a continuous decrease of PV system prices and heavy subsidization of PV investments have been stimulating the development of solar energy markets – in 2016, investments reached EUR 103.4 billion, i.e. 55% of all new renewable energy investments (Jäger-Waldau, 2017). The global inverter market was estimated at around USD 6 billion in 2017 (GTM Research). Growths have been reported in the world PV market for both utility-scale and rooftop solar PV systems (IRENA, 2016). The observed trends have highlighted a dramatic increase of mini PV installations owned by individuals (IRENA, 2016; Information Handling Services [IHS], 2015). In terms of geography, the number of significant PV markets has been growing steadily – by the end of 2017, there were 29 countries with at least 1 GW of cumulative PV capacity. Nevertheless, with the global total installed capacity of 402.5 GW at the end of 2017, the world market was dominated by China (131 GW), USA (51 GW), Japan (49 GW) and Germany (42 GW), and at the same time 90% of the global PV market was represented by only 10 countries (IEA PVPS, 2018). The growing significance of the industry in the global economy can be also seen in the labor market, as the employment level has reached almost 3 million people across the PV value chain (IRENA, 2016).

Solaris Ltd.

Solaris was founded in 1991. It entered the semiconductor industry as a producer of transformers and induction components for electrical applications in the automotive and railway industries. Despite a small size and limited resources, Solaris exhibited a strong orientation towards quality and innovativeness right from the early days of operating (winner of prestigious national awards for innovative firms). It invested heavily in the development of its own R&D department – shortly, major patented innovations were put into mass production. "*It was extremely challenging for a small firm as ours to secure its highly innovative solutions against highly interested competitors. We had to put a lot of effort to develop our know-how protection system*". By maintaining the sensitive knowledge base proprietary (Najda-Janoszka, 2016a), Solaris was able to build a strong position on the market served. At the turn of the millennium, the company became a developer and supplier of components for the PV industry. Soon, the quality and innovativeness of provided solutions paved the way for the firm's future in the promising PV industry. In just 4 years of operating on the PV market, the firm's turnover increased by 1000% and net profits by 1500%. By the end of the decade, Solaris was categorized as a large company and became the major supplier for the global inverter producer Sun Corp. (cf. supplier upgrading in Gancarczyk & Gancarczyk, 2016). By cooperating closely with Sun Corp., *"the firm has benefited not only through increased sales volumes, but also got access to new advanced management practices allowing for substantial cost reduction*". In 2011, Solaris was sold to the cooperating partner Sun Corp. As a subsidiary, it maintained a high level of decisional autonomy. With a sudden PV market collapse in 2012, Solaris experienced a drop in sales (approx. 35%) for the first time in its history. However, in a short time, it adjusted to market changes through cost reduction as well as customer and product diversification. At the beginning of 2014, the downward trend was stopped, and in subsequent years sales stabilized at a lower but satisfactory level – "*even in tough times, the firm maintained 20% return on sales*".

Industry transition features and strategic response

The analysis covers the period of 2000–2017, which reflects the most intensive development of the industry. With the introduction of large subsidy programs, the whole industry began to develop at a much faster pace than forecasted. Nevertheless, given the technological and financial limitations as well as changes in the support policy regulations, the development trajectory observed and experienced by incumbents and de novo entrants was far from a straight line. Results presented in the table below (Table 1) reflect that complex picture. For each indicator of industry transition, there were clearly confirming signals, but also quite ambiguous ones suggesting alternative scenarios.

Transformation indicators	Confirming signals	Non-confirming / ambiguous signals
Increasing share of process innovations at the expense of product innovations (Cohen & Klepper, 1996)	A steep learning curve, with an increase of process innovations enabling cost reduction (80% price decrease in the period 2008–2015). A considerable number of process innovations protected by secrecy, not patents. In the period 2008–2011, most process innovations generated in the midstream (cell and module production). From 2011, an increase observed in process innovations enabling the reduction of inverter cost (cost pressure shifted from modules toward Balance of System [BoS] – inverters, mounting systems, batteries). At the end of the first decade of the new millennium, firms began to	From 2011, patent data suggested a shift in research from the conventional crystalline silicon technology toward the next generation of technologies, e.g. thin film, organic PV. From 2011, a significant increase observed in product innovation measured in terms of improved conversion efficiencies (world records broken almost every year after 2010, before – a rather slow progress). According to data, the price dive observed in 2008–2015 was caused not only by continuous technological improvements but also by over-production and over-capacity stimulated by policy support measures.

	focus more on branding-related activities – an exponential growth of the use of trademark protection for PV products and services.	
Technological convergence facilitating the emergence of a dominant design (Abernathy & Utterback, 1978; Anderson & Tushman, 1990)	Dominant types of PV cells include crystalline (mono and poly) PV cells, which account for close to 90% of the world's market. Designs based on wafers of silicon dominated from the early 90's. The inverter market, initially dominated by central inverters, became divided between central and a more flexible string technology. The string inverters gradually increased their global market share. Microinverters remained a niche solution, considered as a premium product (notably higher cost).	During the height of the polysilicon bottleneck (2004–2009), the alternative thin film technology increased the market share up to 18% (2009), challenging the silicon technology. With cheaper silicon – crystalline silicon took over the market again from 2010. Coexistence of parallel solutions (silicon, thin film, organic, multijunction) commercially available on a global scale. In 2017, the observed growth of central inverters comprised in a modular way, thus enabling design flexibility, the key advantage of string inverters.
Introduction by a single firm of a new product that benefits from a large, unanticipated surge in demand – innovation shock (Argyres, Bigelow, & Nickerson (2015)	Introduction of a commercially successful microinverter in 2008 by Enphase. The invention received a wide recognition as a disruptive value proposition. Forecasts from 2010 estimated a steep price drop – steeper than for central inverters. Fast reaction by large incumbents – observed investments in microinverter technology.	In 2016, microinverters considered still promising, yet a premium product of a higher price. Market share remained low (niche product for the residential market), while string and central inverters maintained dominance.
Shakeout while industry input is still growing (Abernathy & Utterback, 1978; Jovanovic & MacDonald, 1994)	Major wave of bankruptcies and shutdowns observed after the silicon crisis (overcapacity build-up, incumbents locked in high-priced contracts while new entrants could benefit from low-cost silicon feedstock) and subsidy curtailment – period of 2010–2013. Some diversified firms decided to leave the industry. A wave of exits included many small but also large corporations.	Although numerous firms went bankrupt or left the industry, many small companies survived, preserving the fragmentary structure of the large part of the industry.
Increasing concentration of resources in fewer large organizations (Utterback & Abernathy, 1975; Helfat, 2015)	Up to 2004, a relatively high concentration observed across the industry value chain – top five firms, mostly from Europe, accounted for 60–100% of the market. After a massive entry period (2004–2010), the industry experienced bankruptcies and acquisitions, widespread overcapacity, retroactive measures in supporting policies, rise of antidumping actions, which heightened expectations for the upcoming consolidation. Introduced antidumping tariffs (from 2012) triggered geographical expansion and diversification of incumbents.	Starting from 2004/2005, high concentration decreased notably till 2012 as many new firms entered the dynamically growing industry, with a substantial support provided by favorable regulations. A decrease observed in IP concentration (up to 2011), indicating fragmentation of the industry. From 2014, a significant number of new entries as well as re-entries of large semiconductor, construction or energy-related companies. Up to 2017, midstream and downstream businesses remained highly fragmented.

	Accordingly, the inverter market developed from quite consolidated (up to 2010, top five firms accounted for 65 % of the market) to fragmented (2012–2014, top five firms accounted for less than 50% of the market) and back again to more consolidated (2016–2017, top five firms accounted for 60% of the market).	
Increasing disintegration along the value chain (Stigler, 1951)	Many successful pure players operating across the industry. Numerous highly diversified corporations present at different parts of the industry value chain. Specialization tendencies observed in the downstream business – installers, integrators, maintenance services providers.	Up to 2008, the whole value chain was dominated by module suppliers. First signals of vertical integration directed downstream observed during the financial crisis of 2008 (limited financial support for PV projects). Solar PV manufacturers invested in project development to generate demand for their own upstream products. Following the price dive in 2011 and a severe drop in profit margins, many upstream and midstream firms turned to the downstream business in search of profit margins – some global players integrated along the whole value chain. Affected by the price pressure from 2011, inverter producers invested in complex solutions for PV system management and recently (2015) in digital platforms (opportunities to expand the market – entry into parallel industries e.g. e-mobility, energy storage, heating and cooling).

Tab. 1. Industry transition features 2000-2017. Source: Authors' own work.

Strategic response to transition signals

At the next stage of the analysis, the industry dynamics was confronted with the activity pattern of Solaris Ltd. Accordingly, all major strategic decisions of Solaris became accompanied by a corresponding context throughout the period of 17 years. The figure below illustrates the results on a single time line (Figure 2).

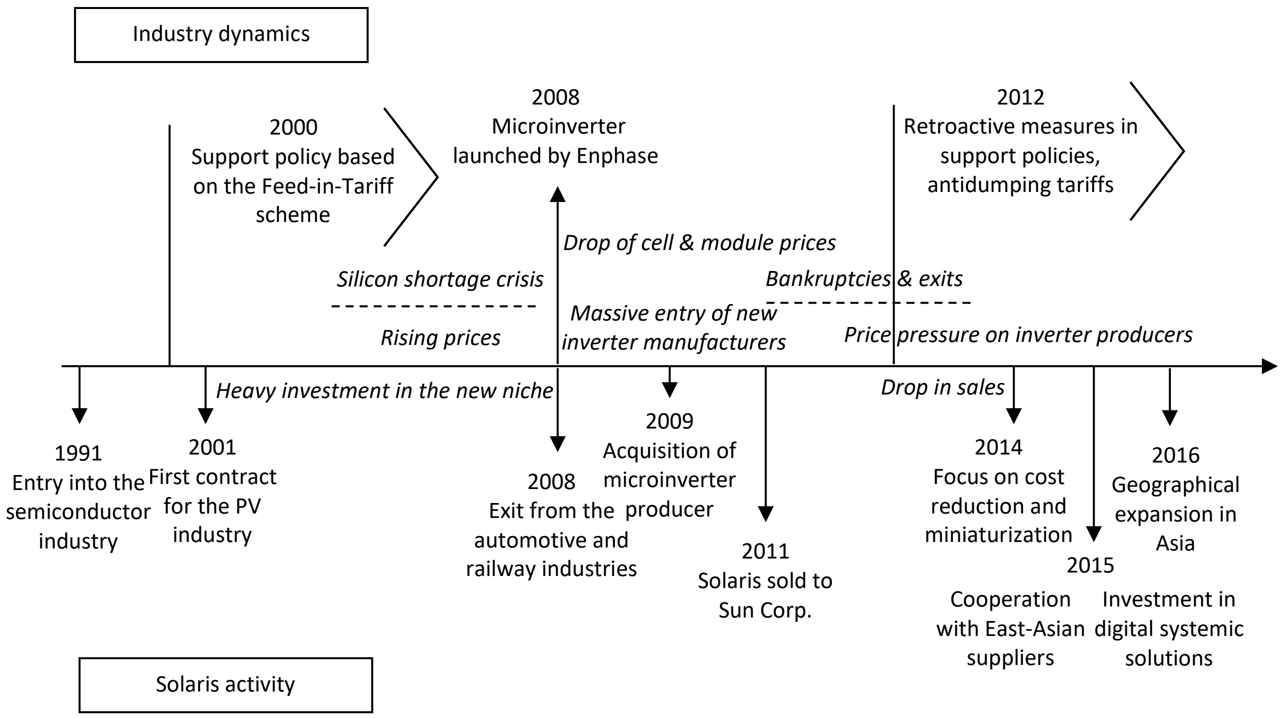

Fig. 2. Strategic response. Source: Authors' own work.

Strategic maneuvering exhibited by Solaris has involved a combination of all options discussed in the literature, i.e. entry, repositioning, imitation, exit. The firm entered the semiconductor industry with highly innovative solutions offered for the automotive and railway businesses. Being aware of strong competition in those industries, in 2001 Solaris seized the opportunity to reposition toward a niche represented by the promising PV industry. By the year 2008 (end of the silicon crisis), the niche became the only business of Solaris – it exited the automotive and railway industries. However, with the rising attractiveness of the PV industry, also the number of new entrants and the intensity of competition grew. Challenged by the new context and the time pressure, Solaris decided to use the imitation strategy. The microinverter technology introduced by Enphase in 2008 was then considered as a disruptive value proposition with the potential to completely rearrange the inverter market. Observing the market reaction and competitors' investments, Solaris decided to imitate the new solution by acquiring in 2009 a small company with the necessary know-how. Despite the fact that microinverters turned out to remain a niche, premium product, Solaris capitalized on the acquired know-how by advancing capabilities in miniaturization. At the end of the first decade of the millennium, there were already some weak signals of possible changes in support policy regulations, which could affect the PV industry dramatically. Hence, owners of Solaris decided to sell (exit) the company to the cooperating partner in 2011, right before the major shakeout in the industry followed by a drop in sales experienced by Solaris for the first time in its history.

Affected by the pressure on inverter producers to cut prices, Solaris followed the trend and focused more on process innovations allowing for cost reduction. Shortly, the company decided to go further and entered Asian markets with joint-ventures and co-production (entry), as one of the first western PV inverter-related firms to do so. Recognizing that after the dive of module prices the attention shifted toward the Balance of System (BOS), and that high profit margins could still be made in the downstream business, Solaris turned again to repositioning by investing in digital system solutions. Although currently a niche activity, the management board has considered the digital direction as the first footstep into new parallel industries.

Conclusions

The foregoing analysis has shown that deciphering the on-going transformational processes along the evolutionary trajectory of an industry is a very challenging task (Najda-Janoszka, 2017). Gathered evidence has suggested that an industry transition may not necessarily follow a typical pattern (Helfat, 2015). During the critical period of 2000–2017, incumbents and de novo entrants experienced and evaluated a multitude of contradictory signals. Relatively clearly visible trends, compliant with indicators discussed in the literature, were disrupted by events, business activities and regulatory changes that in turn suggested alternative scenarios, e.g. the assumed innovation shock of microinverters, thin film development during the silicon crisis, retroactive measures introduced in Spain or Germany. In other cases, indicators appeared in a modified way, e.g. persistent coexistence of multiple dominant designs (cells, inverters) as well as vertically integrated and disintegrated corporations. Thus, the obtained results have confirmed the arguments that, depending on the specificity of a given industry, particular indicators may vary in their relevance and in the amount of information they can provide at a given point in time (e.g. Filson, 2001; de Vries, de Ruiter & Argam, 2011; Breschi, Malerba, & Orsenigo, 2000; Helfat, 2015). The peculiarity of the PV industry relates not only to its technological profile but even more strongly to its subsidy-induced boom-and-bust cycles (IEA PVPS, 2018; Jäger-Waldau, 2017). It has been commonly agreed that the dynamic growth of the PV energy use, faster than provided for in official forecasts, was driven mainly by public incentives (Zou et al., 2017). Hence, the observed retroactive measures in support policies, a tendency that has gradually spilled over the globe, can be considered as an additional indicator of the PV industry transition – from an artificially oversized to competitive and profitable without subsidization. The example of the PV industry has stressed the importance of a broad perspective for assessing the changes occurring in the competitive conditions of an industry in order to take advantage of them in a timely and effective manner (Najda-Janoszka, 2017, 2016b). The investigated firm Solaris Ltd. implemented such approach and managed to formulate appropriate responses at the right time. The longitudinal design of the research has provided a broader picture of the strategic maneuvering practiced by Solaris during the PV industry transition period. The analyzed transition has been depicted as a process that evolves over years; hence, as a process that opens the door to multiple strategic options and not just one optimal solution. The exhibited high sensitivity to various signals, a result of the continuous scanning activity, provided necessary time for undertaking key strategic decisions – all major signals were addressed with a response almost instantaneously, e.g. the entry to the PV industry, acquisition of the microinverter know-how, exit before the shakeout. Moreover, as a quite narrowly specialized firm, it managed to successfully implement all types of strategic options, i.e. entry, repositioning, imitation, exit (Argyres et. al., 2015). Undoubtedly, the technological know-how formed the basis and the core of the business; yet, it was an outstanding sensing ability that enabled Solaris to navigate successfully through the dynamically changing competitive context of the PV industry (Gancarczyk, 2017). Hence, the strategic maneuvering of the firm involved dynamic switching between strategic options as the industry transformation progressed.

Nevertheless, according to the gathered data, the transition process did not stop in 2017. Support policies have been continuously reviewed for further alternations. Hence, the overall picture of the PV industry may change in upcoming years, and so may the market position of the investigated firm, which has been recently investing in cross-industry solutions. Therefore, the timeframe limitation of the study can serve as a point of departure for further studies focused on the on-going transition processes and managerial decision making in highly uncertain conditions.

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