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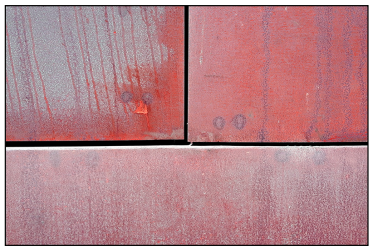

KTH Stockholm; Photo by C. McPhee (CC-BY)

Insights

Welcome to the October issue of the *Technology Innovation Management Review*. We welcome your comments on the articles in this issue as well as suggestions for future article topics and issue themes.

Carleton UNIVERSITY

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Overview

The *Technology Innovation Management Review* (TIM Review) provides insights about the issues and emerging trends relevant to launching and growing technology businesses. The TIM Review focuses on the theories, strategies, and tools that help small and large technology companies succeed.

Our readers are looking for practical ideas they can apply within their own organizations. The TIM Review brings together diverse viewpoints – from academics, entrepreneurs, companies of all sizes, the public sector, the community sector, and others – to bridge the gap between theory and practice. In particular, we focus on the topics of technology and global entrepreneurship in small and large companies.

We welcome input from readers into upcoming themes. Please visit timreview.ca to suggest themes and nominate authors and guest editors.

Contribute

Contribute to the TIM Review in the following ways:

- Read and comment on articles.
- Review the upcoming themes and tell us what topics you would like to see covered.
- Write an article for a future issue; see the author guidelines and editorial process for details.
- Recommend colleagues as authors or guest editors.
- Give feedback on the website or any other aspect of this publication.
- Sponsor or advertise in the TIM Review.
- Tell a friend or colleague about the TIM Review.

Please contact the Editor if you have any questions or comments: timreview.ca/contact

About TIM

The TIM Review has international contributors and readers, and it is published in association with the Technology Innovation Management program (TIM; timprogram.ca), an international graduate program at Carleton University in Ottawa, Canada.

Editorial: Insights

Chris McPhee, Editor-in-Chief

Welcome to the October 2018 issue of the *Technology Innovation Management Review*. The authors in this issue share insights on using machine learning for customer foresight and service design, enhancing industry–academia collaboration, and understanding the impacts on incumbents when new digital platforms enter existing markets.

The articles in this issue were selected and developed from papers presented at the ISPIM Innovation Conference in Stockholm, Sweden, from June 17–20, 2018. ISPIM (ispim-innovation.com) – the International Society for Professional Innovation Management – is a network of researchers, industrialists, consultants, and public bodies who share an interest in innovation management.

Next year's event in North America – ISPIM Connects Ottawa (ispim-connects-ottawa.com) – will be held in Ottawa, Canada, from April 7–10, 2019. The TIM Review and its associated academic program at Carleton University, the TIM Program (timprogram.ca), are proud to be the local hosts of the event in collaboration with other partners. See Box 1 for further details about this event, and please note that the deadline for submissions of outlines (bit.ly/2LzkUCS) is December 1, 2018.

About this issue

In the first article, **Daniel Gentner**, **Birgit Stelzer**, and **Bujar Ramosaj** from Ulm University in Germany and **Leo Brecht** from the University of Liechtenstein present a case study in strategic foresight using machine learning algorithms to analyze a customer database. Using the CRISP-DM data mining methodology, they supported a manufacturing company's efforts to obtain a profile of high-potential customers and their need for a new technology. The case study shows how quantitative customer foresight based on machine learning can help identify weak signals in a customer database, which, in turn, can be translated into specific actions for sales teams.

Next, **Jyrki Koskinen**, founder of Avaamo Konsultointi in Finland, shares lessons learned from a coaching program to help companies develop the data analysis and design thinking competencies needed to develop new, data-driven services. The coaching courses and supporting innovation platform of processes, methods, tools were developed and delivered by a consortium of Finnish universities and

Box 1. ISPIM *Connects* Ottawa ispim-connects-ottawa.com

ISPIM *Connects* Ottawa is a three-day event that will bring together world-renowned innovation managers, researchers, and business and thought leaders to share insights on specific local and global innovation challenges. Hosted by local universities in partnership with industry and the public sector, ISPIM *Connects* Ottawa seeks participation, submissions and presentations from academia, industry, research organizations, consultants, intermediaries, and policy makers.

Ottawa is Canada's Capital City and it boasts a highly educated and skilled technology workforce, world-class research and higher-education institutions, strong startup ecosystems, and nearly 2,000 knowledge-based businesses. But, it takes more than that to stand out on the global stage. Invest Ottawa – the city's leading economic development agency – recently completed its new strategic plan, which focuses on the city's need to create local capability to be competitive in global markets, with the ultimate goal of cementing Ottawa's status as a global technology hub. With this goal in mind, ISPIM *Connects* Ottawa will highlight three local innovation challenges that are also of global importance:

- **Scaling Startups:** How can we design and sustain a startup ecosystem in a way that enables new ventures to grow early, rapidly, and securely? How can we help startups quickly reach a scale where they can make a real impact on the local economy and in global markets?
- **Adopting AI and Analytics:** How can we move from hype to real customer value and competitive advantage? How can we transform the use of AI and machine learning to enable SME innovation and growth? How do we encourage adoption while navigating ethical issues?
- **Innovating with Government:** How can we encourage collaboration between industry and government to drive innovation and provide benefit to citizens? How can we use this as an opportunity to develop advanced capacity and capability in startups, SMEs, and large companies?

ISPIM *Connects* Ottawa will also feature various other innovation management topics, as detailed in the call for submissions: bit.ly/2LzkUCS

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other organizations. Following a six-week course, participating companies undertook an eight-week case project to develop a new service or product by leveraging machine learning for predictive analysis. The article share details of the program's development and insights gained from its implementation and outcomes.

Then, **Els De Maeijer**, **Tom Van Hout**, **Mathieu Weggeman**, and **Ger Post** from universities in the Netherlands and Belgium examine how the changing role of academics is reflected in the interaction between industry and academia, specifically during meetings. The authors closely studied project meetings in collaborative industrial–academic settings, mostly serving the semiconductor field. They sought to understand how the choice of linguistic features shapes social and interpersonal relations in industry–academia collaborations by focusing on open innovation as a socially contingent process. Their findings challenge the typical industry–academia dichotomy implied by much of the literature, and they suggest practical approaches to stimulating open innovation in such collaborations.

Finally, **Andreas J. Steur** from Ulm University in Germany examines the impacts on incumbents when a new digital platform enters a market. The results of a time series analysis of the impacts on the taxi industry in New York City following Uber's market entry show that new platforms must overcome a chicken-or-egg problem because their platform's success depends on network effects, whereas the business models of incumbents typically do not. The analysis shows that the time needed for a new platform to reach a critical mass – at least one year in this case – can give incumbents a relatively brief but potentially critical chance to react to the new entrant.

For future issues, we are accepting general submissions of articles on technology entrepreneurship, innovation management, and other topics relevant to launching and growing technology companies and solving practical problems in emerging domains. Please contact us (timreview.ca/contact) with potential article topics and submissions.

Chris McPhee
Editor-in-Chief

About the Editor

Chris McPhee is Editor-in-Chief of the *Technology Innovation Management Review*. Chris holds an MASc degree in Technology Innovation Management from Carleton University in Ottawa, Canada, and BScH and MSc degrees in Biology from Queen's University in Kingston, Canada. He has nearly 20 years of management, design, and content-development experience in Canada and Scotland, primarily in the science, health, and education sectors. As an advisor and editor, he helps entrepreneurs, executives, and researchers develop and express their ideas.

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Keywords: machine learning, customer foresight, data mining, data analysis, service design, design thinking, industry–academia collaboration, open innovation, digital platforms, market entry

Strategic Foresight of Future B2B Customer Opportunities through Machine Learning

Daniel Gentner, Birgit Stelzer, Bujar Ramosaj, and Leo Brecht

> *"Foresight of phenomenon, and power over them, depend on knowledge of their sequences, and not upon any notion we may have formed respecting their origin or inmost nature."*
>
> John Stuart Mill (1806–1873)
> Philosopher, political economist, and civil servant
> In *Auguste Comte and Positivism*

Within the strategic foresight literature, customer foresight still shows a low capability level. In practice, especially in business-to-business (B2B) industries, analyzing an entire customer base in terms of future customer potential is often done manually. Therefore, we present a single case study based on a quantitative customer-foresight project conducted by a manufacturing company. Along with a common data mining process, we highlight the application of machine learning algorithms on an entire customer database that consists of customer and product-related data. The overall benefit of our research is threefold. The major result is a prioritization of 2,300 worldwide customers according to their predicted technical affinity and suitability for a new machine control sensor. Thus, the company gains market knowledge, which addresses management functions such as product management. Furthermore, we describe the necessary requirements and steps for practitioners who realize a customer-foresight project. Finally, we provide a detailed catalogue of measures suitable for sales in order to approach the identified high-potential customers according to their individual needs and behaviour.

Introduction

During the last 20 years, the research field of strategic foresight has played an increasingly important role in corporate strategy. The dynamic environment of companies necessitates, on the one hand, rapid adoption of incremental changes and, on the other hand, radical reorientation towards new business opportunities, technologies, or markets (Rohrbeck, 2011). Strategic foresight aims to detect development lines and trend interruptions in customer needs, technologies, law, and lifestyle habits through different foresight approaches – earlier than competitors (Hamel & Prahalad, 1995).

Within the strategic foresight literature, technological trends have been a major object of investigation. Technology foresight can be defined as the capability of identifying and integrating new technologies (Birke, 2011; Stelzer, 2016). It enables corporate management to gain insights about future differentiating competencies and to secure the company's competitive advantages (Schuh & Klappert, 2011; Stelzer, 2016). Therefore, methods and processes have been developed, largely established, and applied.

As a result, increasing professionalization in customer foresight and proactive market orientation is considered as the next major evolutionary step for most corporate foresight systems (Rohrbeck & Gemünden, 2007; Voola & O'Cass, 2010). Customer foresight as part of strategic foresight (see Figure 1) deals with the identification of early customer needs. Consideration of these future needs in idea generation and validation of concepts is required for radical and disruptive innovation, which is an important prerequisite for innovation success (Rohrbeck & Thom, 2008; Trommsdorff & Steinhoff, 2007). In B2B industries in particular, great potential can be seen in this research field, as a single

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customer relationship is associated with significantly higher value than in B2C industries (Nenonen & Storbacka, 2016). Recent studies in B2B industries have shown that a continuous development of future beneficial customer assets carried out by strategic management influences firm performance in a significant positive way (Nenonen & Storbacka, 2014; Patatoukas 2011).

However, even today, customer foresight still shows a low capability level. Foresight tools, their application within companies, mechanisms to force acceptance and utilization, as well as a foresight friendly culture are still underdeveloped (Rohrbeck & Gemünden, 2007). In particular, B2B companies lag behind their B2C counterparts when it comes to analyzing an entire customer base in terms of future customer applications, needs, and affinity for new technologies (Gentner et al., 2017; Stein et al., 2013). Among common techniques, there are, on the one hand, socio-cultural trend analysis and megatrend studies, which focus on markets and therefore follow a macro customer level (Rohrbeck & Gemünden, 2007; Rohrbeck & Thom, 2008). In many B2B companies, mainly in the manufacturing industry, these techniques are still based on management heuristics and do not cover the complexity of customer relationships (Lilien, 2016; Nenonen & Storbacka, 2016). On the other hand, lead user studies, explorative interviews, diary research, day-in-the-life visits, and insight clinics (Arnold et al., 2010; Rohrbeck & Gemünden, 2007; Rohrbeck & Thom, 2008) force investigations to focus on a single-customer level and are often applied by single operative sales representatives (Keränen & Jalkala, 2014). This often leads to a lack of early insights into changes in market trends and inefficiencies in market development.

A quantitative customer foresight approach that integrates customer insights of an entire customer base in order to identify future customer needs does not exist. Furthermore, the combination of an individual customer level with a market view cannot be found in recent B2B literature (Hämäläinen et al., 2015).

One research stream that has the potential to drive the development and application of such quantitative foresight approaches is the identification of weak signals (Kim et al., 2013; Porter, 2005). Weak signals are conspicuities or rare events indicating future changes (Ansoff, 1984; Hiltunen, 2008). While nowadays their importance is widely recognized, research on detection models is not sufficiently taken into account (Kim et al.,

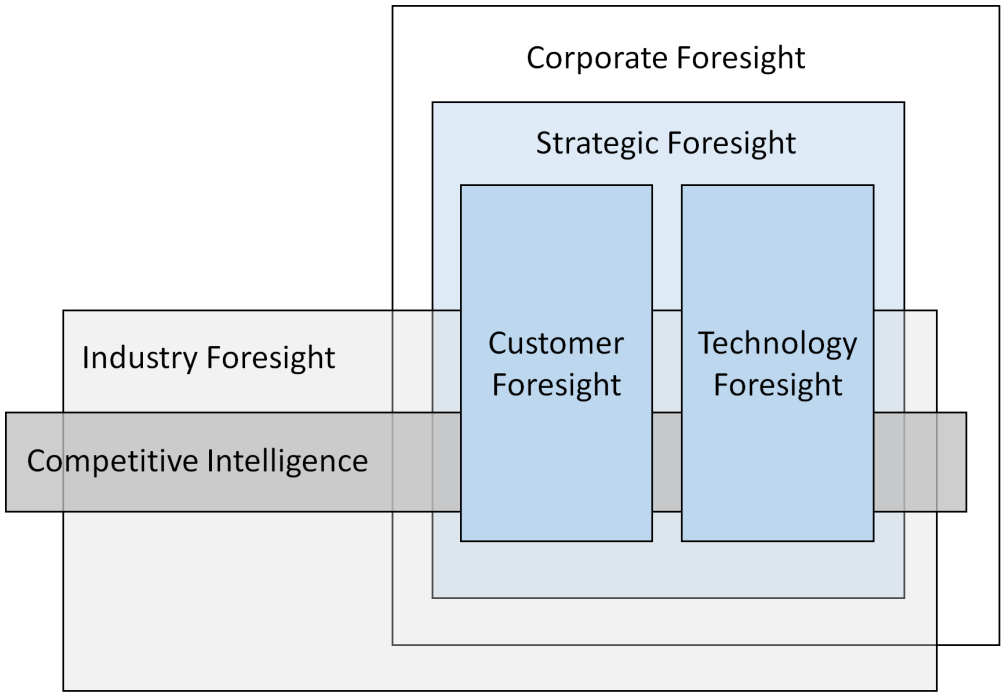

Figure 1. Customer foresight as part of strategic foresight (Adapted from Müller & Müller-Stevens, 2009 and Ramosaj et al., 2018)

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2013; Porter, 2005). In addition to qualitative detection approaches such as Delphi studies, futurists and information scientists increasingly use data mining (Nohuddin et al., 2011) to analyze collaborative knowledge (Boyd & Potter, 2003; Kim, 2013; Sureka et al., 2011). As described by Han and colleagues (2012), "machine learning investigates how computers can learn […] to recognize complex patterns and make intelligent decisions based on data". Research on the applicability of machine learning techniques such as nonlinear classification approaches or rule-based models has mainly been done within the field of technology foresight (Kim et al., 2013; Klerx, 2010; Schmidt & Hoyer, 2013; Stelzer et al., 2015). A common methodology used for machine learning projects is the so-called cross-industry standard process for data mining (CRISP-DM) (Wirth & Hipp, 2000). Its application within strategic decision making in B2B companies has been discussed by Niño and colleagues (2015).

Based on the situation described above and the current understanding, we will provide an answer to the following question: How can a strategic foresight team of a manufacturing company automatically identify weak signals within an existing customer base indicating customer groups with high future potential and need for a new technology?

We will show how to obtain a profile of high-potential customers due to their affinity and need for a new machine control sensor using data patterns out of two customer databases. Furthermore, we will highlight major obstacles, proceedings, and intermediate conclusions of a quantitative customer foresight approach following the CRISP-DM methodology. Finally, we will discuss in detail which measures to introduce in order to strategically develop the future most relevant markets and to manage a company's sales force most effectively.

Research Design

The empirical research comprised a single case study of a quantitative customer foresight approach within an international German manufacturer of full-line equipment for hydropower plants and related lifecycle services. The company had more than 19,000 employees and generated a sales volume of €4.3 billion ($6.4 billion CAD) in 2016. During a foresight project carried

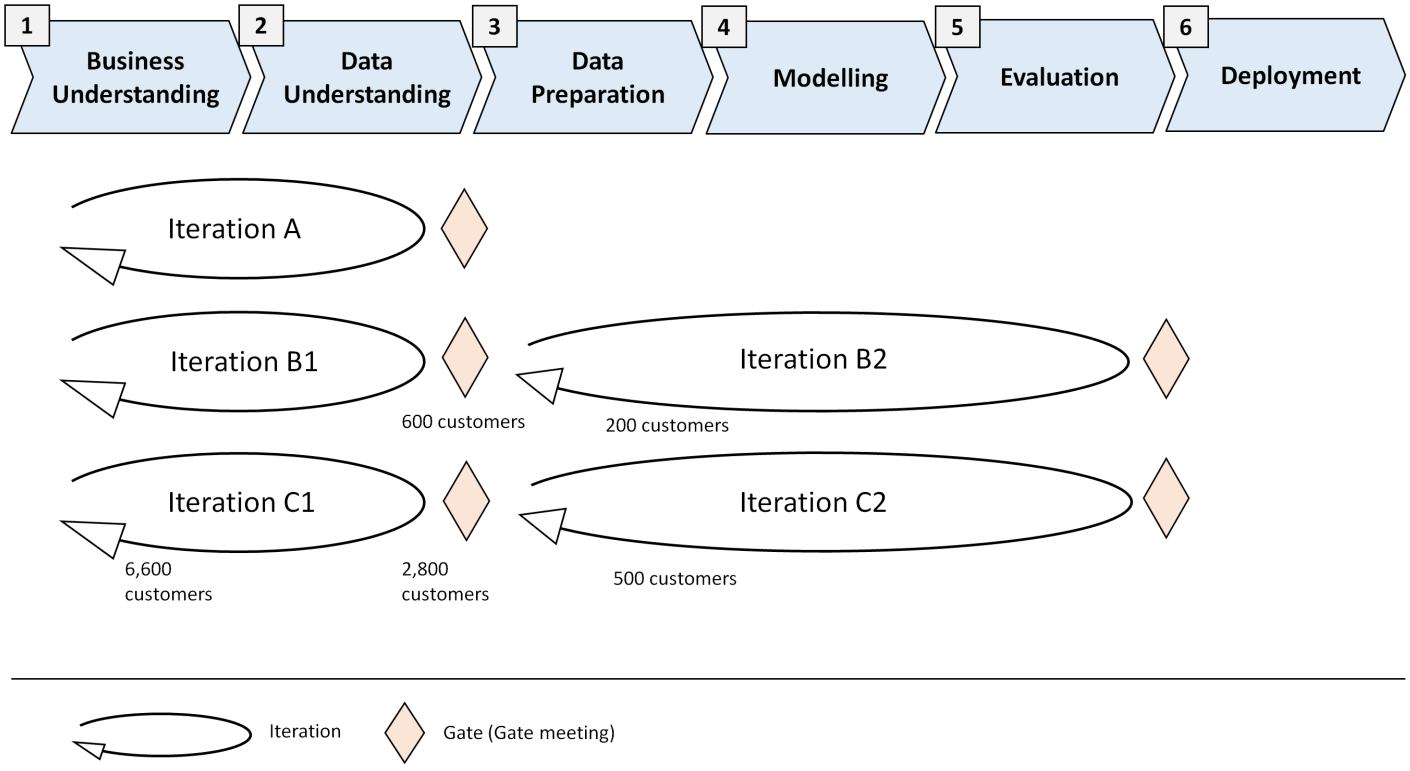

Figure 2. Project-specific iterations and gate meetings following the CRISP-DM methodology (based on Wirth & Hipp, 2000)

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out from September to January 2018 in the strategic product management department, which was also responsible for the development of product and project business, approximately 2,800 worldwide customers, mostly powerhouse operators, were analysed through machine learning applications.

The data analysis followed the CRISP-DM methodology. Due to adjustments to the selection of variables, improvements in data quality, and an increase in the size of the dataset, several project-specific iterations were necessary. Therefore, the process steps *Business understanding* and *Data understanding* were run through three iterations, whereas the entire data-mining process was executed twice (see Figure 2). All statements within the present research contribution relate to the last two iterations (C1 and C2).

The case study was carried out using action research, which allows the researcher to gain academic knowledge by solving a practical problem (Hult & Lennung, 1980). In the present case study, action research enabled strong collaboration between the researchers and the organization, and it led to a systematic understanding of the object of investigation and the benefits of the implemented customer foresight approach for the company (Guertler et al., 2017; Lewin, 1946). The action research process used in the present case study is described by Susman and Evered (1978) as "a cyclical process consisting of five phases: diagnosing (identifying or defining a problem), action planning (considering alternative courses of action for solving a problem), action taking (selecting a course of action), evaluating (studying the consequences of an action), and specifying learning (identifying general findings)" (see Figure 3).

Customer Foresight Using the CRISP-DM methodology

As described above, in addition to the action research process, the CRISP-DM methodology serves as a guideline for the data-mining procedure conducted within the customer foresight project of the manufacturer of hydropower plant equipment. Therefore, we describe the analytic approach following the CRISP-DM steps. Within each step, major interactions between researchers and practitioners as well as major action research procedures are highlighted.

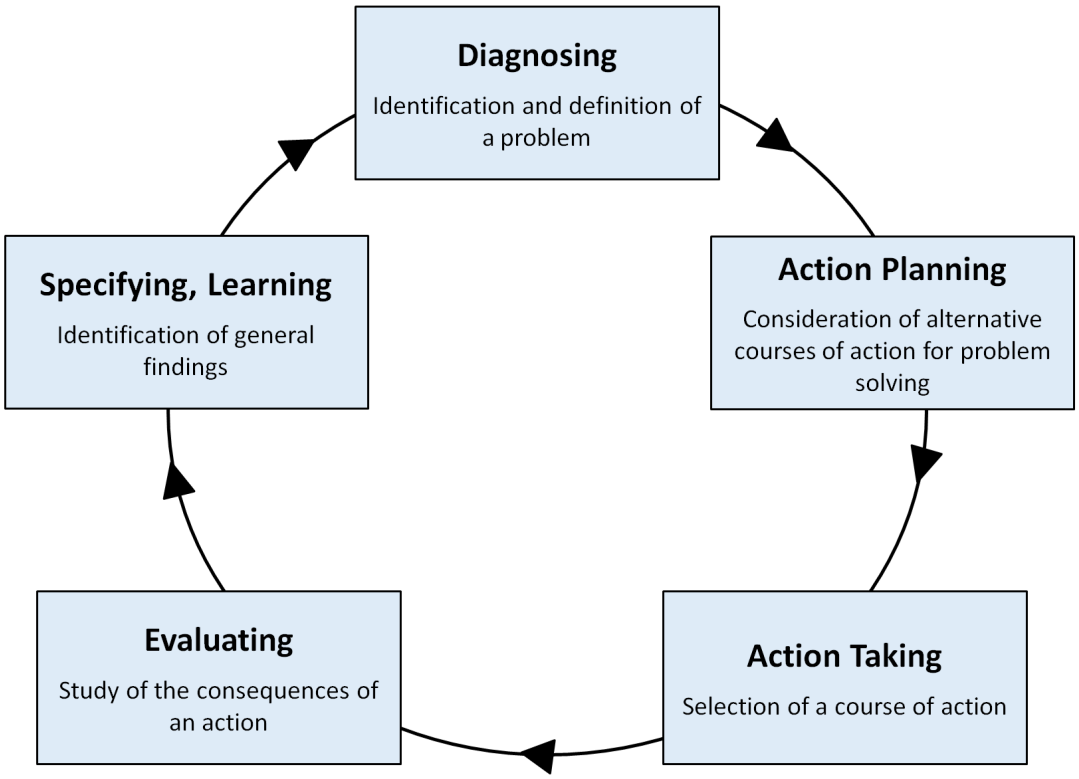

Figure 3. The cyclical action research process (based on Susman & Evered, 1978)

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Business understanding

The product management team of the manufacturer of hydropower plant equipment was preparing the market launch of a new sensor. The innovative sensor allows the collection of condition data in turbines and the offer of associated unique maintenance services. The market launch was planned for 2018. For this purpose, we identified innovators and so-called early adopters from a global customer base with a total of approximately 6,600 customers during a customer foresight project. These customers usually showed high affinity for new technologies as well as deep product and operating knowledge. Due to their ability to generate awareness for their innovativeness, they are often suitable as reference customers (Rogers, 2003).

The company's assignments usually were large-scale projects that took several months to several years. These assignments were often initiated by the customer through a tendering process. Previously, the company lacked a quantitative information base for the strategic prioritization of such large-scale projects and related customers. By applying classification algorithms, we created a profile for the customers with the affinity and the need for new technologies. In addition, we used the profile to predict the customers' suitability for the sensor.

These project objectives were developed during an in-house meeting in the product management department as well as during two two-hour preliminary discussions between the scientific representative, a head of product management, and his staff. The meetings and discussions took place between the end of October and mid-November 2017. In terms of the action research method, these iterations were assigned to the subprocesses "diagnosing" and "action planning". Table 1 sums up main interactions and research results.

Data understanding

The process step data understanding consists of selection of attributes and granularity; evaluation of data quality; identification of multicollinearity; and outlier detection (Berthold et al., 2010), as described below:

1. Selection of attributes and granularity: For the analysis, two datasets were used: one obtained from the manufacturer's customer relationship management (CRM) system and another obtained from the enterprise resource planning (ERP) system. Both consisted of 23 customer- and product-related variables, such as country, outstanding opportunities, business segment, turbine type, generator type, capacity, degree of automation, as well as need for repair and education. The data showed different levels of granularity: some variables were related to single generators, whereas others were related to entire power plants or related customers. Therefore, the two databases were consolidated and transformed on a single-customer level. Some variables such as business segment or turbine type showed five to 10 specifications. Hence, each specification was transformed to a new variable, which was either

Table 1. Approach, roles, and results following the CRISP-DM subprocess: *Business understanding*

Approach (CRISP-DM)	Approach (Action Research)	Roles	Results
1. Problem identification (missing, quantitative information for the prioritization of calls for tenders) 2. Derivation of resulting analysis objectives	1. Introduction into the practical problem by the practitioners (Diagnosing) 2. Problem diagnosing by the scientific representative 3. Demonstration of applicable analytic methods by the scientific representative (Action planning) 4. Joint development of project objectives (Action planning) 5. Action planning through scientific representative and practitioners	• Head of Strategic Product Management • Product Manager • Scientific Representative	1. Defined analytics objective: Identification of customers with high suitability or need for a maintenance sensor and related services 2. CRISP-DM steps with major activities

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classified on a binary basis or just defined as the total amount of related items, for example, number of turbines of a special type per customer. These variable splits led to an extension of the final dataset up to 66 variables. For two years, customers were judged qualitatively by responsible key account managers and sales staff for their product knowledge and operation experience as well as their affinity for new technologies. According to these criteria, the customers were classified into four categories from "basic" to "scientist". This pre-existing customer segmentation served as input for the target variable named "customer knowledge".

2. Evaluation of data quality: The final dataset showed a high missing value rate of 49%. Therefore, customers with more than 15 variables without record were removed. As a consequence, the dataset was reduced to approximately 2,800 customers.

3. Identification of multicollinearity: The proof of multicollinearity via Spearman correlation matrix and variance inflation factor (VIF) led to a reduction of the data set to 38 variables (Dormann et al., 2013).

4. Outlier detection: A calculation of studentized deleted residuals, Cook's distance, and leverage values did not indicate any anomalies (Cousineau & Chartier, 2010).

After a detailed data evaluation by the representative of science and the communication of the final results during iteration A and B, the evaluation for iteration C was briefly discussed during an online meeting in December 2017. A data report summarized the data evaluation approach as well as data-quality defects and adopted measures. The approach again covered the action research processes "diagnosing" and "action planning" (see Table 2).

Data preparation and Modelling

Out of the 2,800 customers within the final dataset, only approximately 500 were labelled by the target variable "customer knowledge". Within this dataset of labelled data, few customers had been classified as "scientists". For this reason, the original four specifications of the target variable had to be transformed into binary classes.

The data were prepared for the modelling process by intermediation of missing values and the adjustment of scales according to requirements of the machine learning algorithms used within the *Modelling* process step. The preparation was implemented by a data workflow in the open source software KNIME (knime.com/software) (Berthold et al., 2010).

The data, which until then have only been assessed in two-dimensional descriptive chars were analyzed by two classification algorithms implemented using KNIME. A resilient backpropagation multilayer neural network (Riedmiller & Braun, 1993) served as an example for nonlinear classification models and the C4.5 decision tree algorithm (Quinlan, 1993) was used as a rule-based classifier. Although neural networks are known for high prediction accuracy, decision-tree algorithms show very intuitive outcomes that can easily

Table 2. Approach, roles, and results following the CRISP-DM subprocess: *Data understanding*

Approach (CRISP-DM)	Approach (Action Research)	Roles	Results
1. Use of an existing qualitative customer segmentation according to customers' knowledge 2. Proof of available data according to relevant attributes and their granularity level, data quality, correlations, and outliers	1. Company in-house analysis of data availability (Diagnosing) 2. Joint evaluation of data availability by scientific representative and practitioners (Diagnosing) 3. Data consolidation by scientific representative 4. Action planning through scientific representative and practitioners under consideration of available database	• Head of Strategic Product Management • Product Manager • Scientific Representative • CRM System Administrators	1. Consolidated dataset with improved data granularity and quality 2. Result report about selected approach, data quality issues, identified multicollinearity, and outliers

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be interpreted by practitioners (Quinlan, 1993; Riedmiller & Braun, 1993).

In order to evaluate the prediction accuracy, the dataset of the 500 labelled customers was split into a training dataset (representing 80% of the data) and a test dataset (20%) through stratified sampling (Berthold et al., 2010; Stehman, 1996).

In this way, the remaining 2,300 unlabelled customers were classified according to their probability of being "scientist" or "basic".

In order to increase prediction accuracy, a principal component analysis workflow was implemented. It reduced the dataset to 19 dimensions or principal components, which explained the major proportion of the variance (Wold et al., 1987).

Reasons for the transformation of the target variable as well as possible impacts were discussed within the product management department. The process steps *Data preparation* and *Modelling* were executed by the scientist. In the context of action research, executed activities were related to "Action taking", "Evaluation", and "Specifying, learning" (see Table 3).

Evaluation and Deployment

The highest prediction accuracy achieved during 10 workflow loops of the C4.5 decision-tree algorithm was 74.5%. This result was slightly higher than the one obtained from the neural network (73.2%). The application of a pruning procedure did not improve the results (Furnkranz, 1997). Table 4 shows the confusion matrix, which indicates instances in a predicted class versus instances in an actual class as well as the prediction accuracy, a percentage of correct classified customers (Story & Congalton, 1986).

Table 5 depicts extracts of the paths and major indicators (weak signals) and split values for "scientist" and "basic" customers as well as related prediction accuracy. The split values were falsified for reasons of data protection. The only indicator identified for "scientist" customers was "station size". Customers with more than 4.5 large stations showed a high probability of being a "scientist" customer. Specific business segments such as "repair", a certain range of revenue as well as a total amount of large stations less than 4.5 indicated a "basic" customer.

For the business development of the new sensor, these indicators (weak signals) were not sufficiently informat-

Table 3. Approach, roles, and results following the CRISP-DM subprocess: *Data preparation* and *Modelling*

Approach (CRISP-DM)	Approach (Action Research)	Roles	Results
1. Aggregation of specifications of selected, independent variables 2. Definition of the target variable 3. Creation of the analysis workflow through the KNIME open source software 4. Adaptation of data scaling 5. Replacement of missing values 6. Calibration of workflows 7. Feed-in of data and start of algorithms 8. Collection of result templates	1. Data preparation by the scientific representative (Action taking) 2. Communication of necessary dataset modifications to the representatives of product management (Evaluating / Specifying, learning) 3. Joint discussion about the impact of the proposed changes (Evaluating) 4. Initiation of change activities and preparation of the analysis by the representative of science (Action taking) 5. Data analysis by scientific representative (Action taking)	• Head of Strategic Product Management • Product Manager • Scientific Representative	1. List of necessary changes within the records 2. Catalogue of actions (approved by the practitioners) 3. Processed records 4. Analysis workflows 5. Result templates

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ive. Although indicators for "basic" customers were very detailed and suitable for a customer profile, "scientist" customers were weakly characterized. Nevertheless, a comparison of the customer information gained with exiting qualitative profile data confirmed the results. Customers who were extremely comfortable with new technologies operated a group of several large power plants while customers with low technological affinity requested maintenance, repair, or operation of small plants.

In addition to the analysis of the 38 variables and in order to raise the prediction outcome, the principal components were used as input for the C4.5. They were applied to a training dataset, which consisted of the entire labelled database (500 customers). This procedure increased the prediction accuracy up to 78% due to the high data variance explained by the few principal components. The remaining 2,300 unlabelled customers were ranked according to their probability of being a "scientist" customer. As a result, 51 customers could be classified as "scientists". By taking a closer look at these companies, all showed a high level of product and operation expertise as well as technological affinity.

After the evaluation of the model results, the product management team was able to define the following actions suitable to fulfil the objective of the customer foresight project (see Business *understanding*):

- Analysis of identified "scientist" customers and exiting qualitative profile characteristics

Table 4. Confusion matrix and prediction accuracy of the test dataset by the C4.5 decision-tree algorithm (based on KNIME software version 3.0.1.)

Confusion Matrix		
Customer knowledge binary (to number) \ prediction (customer knowledge binary (to number))	0	1
0	56	7
1	19	20
Correct classified:	76	
False classified:	26	
Accuracy:	74.51%	
Error:	25.49%	

Table 5. Extracts of C4.5 decision tree paths, which are major indicators of customer knowledge and prediction accuracy (based on KNIME software version 3.0.1.)

Path	**Prediction Customer Knowledge Binary (to number)**	**Number of Items (Customers)**	**Number of Correct Classified Items**
"Segment" = "Repair" AND "Revenue" <= 2,326,435.627 AND "# Station size Large" <= 4.5	0	166	130
"Segment" = "Parts" AND "Revenue" <= 2,326,435.627 AND "# Station size Large" <= 4.5	0	78	58
…	…	…	…
"Revenue" > 2,326,435.627 AND "# Station size Large" <= 4.5	0	60	33
"# Station size Large" > 4,5	1	122	79

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- Acquisition of reference customers for the new sensor out of the predicted "scientist" customers by sales department and product management
- Market analysis by the sales department and identification of further "scientist" customers not yet contained in the company's customer base
- Expansion of the profiles of "scientist" customers through personal interactions at the point of sales and resulting new insights, for example, about specific requirements, field of application, installed base, or potential
- Integration of the "scientist" customers in market tests
- Consideration of the identified requirements of the "scientist" customers in further product updates and variants

In addition, a catalogue of general key take-aways, long-term actions, and unused potential was formulated to help the manufacturer build on experiences made during this customer foresight project. Major aspects were:

- Improvement of data quality, especially the missing value rate through the provision of data, for example, via mandatory fields within the electronic sales reports of the CRM system
- Increase of data-mining expertise within indirect business departments
- Communication of the general potential of data mining via machine learning for strategic decision making
- Extension of qualitative market and customer knowledge through quantitative customer foresight, which combines detailed technical, product-related information with a customer and market view
- Effective, proactive sales support based on a quantitative customer prioritization

Although the evaluation of the model accuracy was executed by the scientific representative, the interpretation of the results, covered in a detailed final project report, as well as the deployment were realized by the product management team. The measures encouraged the communication of the foresight results to the sales department at an early stage of the deployment process. Following *Evaluation* and *Deployment,* the action research subprocesses were "Diagnosing", "Evaluating", as well as "Specifying, learning" (see Table 6).

Table 6. Approach, roles, and results following the CRISP-DM subprocess: *Evaluation* and *Deployment*

Approach (CRISP-DM)	Approach (Action Research)	Roles	Results
1. Analysis of the result templates of different analytic workflows and comparison of results 2. Interpretation of major outcomes in the context of the customer foresight objective 3. Derivation of measures 4. Communication of measures 5. Initiation of measures	1. Evaluation of the output templates by the scientific representative ("evaluating") 2. Interpretation of the results by science and practice ("evaluating" / "specifying learning") 3. Derivation of measures by science and practice ("specifying learning" / "diagnosing") 4. Communication of measures to other departments such as sales 5. Implementation of measures by responsible departments	• Head of Strategic Product Management • Product Manager • Scientific Representative • Sales Department	1. Result report 2. Catalogue of measures 3. Implementation plan including responsibilities

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Scientific Contributions

The results of our research provide scientific value in the field of customer foresight, which is illustrated by the following three aspects:

1. A quantitative and predictive customer foresight approach is shown, which completes existing qualitative applications in B2B industries by adding the identification of weak signals. The approach allows a systemic analysis through the consideration of influencing factors such as customer applications, needs, or new technologies (Schuh & Klappert, 2011). The volatility and variance of customer requirements can be tracked through customer-related variables such as customer knowledge.

2. The approach combines common applications that are either used on an operative single-customer level or on a strategic-market level in order to integrate all operative customer insights into one company-wide model for strategic decision making. On a single-customer level, the product–customer fit can be managed proactively, which increases sales effectiveness (Zallocco et al., 2009). On a strategic-market level, we address the research field by examining how to gain an early majority of customers by starting with few innovators in order to reach market success with new products (Moore, 2002).

3. Recent literature discussing the application of the CRISP-DM methodology for strategic decision making in B2B companies has been expanded by including the complete data-mining process. The present case study delivered detailed insights into the approach within each subprocess as well as responsible roles and achieved results. Due to the application of action research, a scientific project focus allows for a comparison between the present approach and all results to previous and future studies in the same research field.

Practical Implications

Strategic management, business development, product management, and sales in B2B companies will increase the efficiency and effectiveness of customer foresight and proactive market orientation by implementing the present case study results.

The company-specific project results consist of valuable weak signals that describe "basic" customers and separate this customer segment from so-called "scientist" customers. Furthermore, the patterns identified by the classification algorithms allow for the prediction of customer knowledge of 2,300 unlabelled customers. By doing so, another 51 "scientist" customers were identified. The results were equally important for business development, product management, and sales. All roles received a better understanding of potential users of a new machine control sensor.

The case study showed that open source software that is available in complete versions equipped with a powerful set of newest machine learning applications is suitable for a fast method launch within the organization. This enables the efficient execution of customer foresight on a quarterly basis, thereby ensuring a continuous awareness of weak signals and an updated customer prioritization. The implementation can be optimized by including the lessons learned following the CRISP-DM methodology. By focusing on those customers showing the highest future profitability and considering their needs within strategic decision making, an effective market development can be achieved that exceeds heuristic approaches.

In addition to previous studies, the present case study provides further evidence that the CRISP-DM methodology can yield complex customer foresight projects. An iterative approach and even agile sprints, for examples those executed by a Scrum team (Schwaber, 1997) can be easily realized. Furthermore, the applied machine learning techniques will provide a substantial gain of information resulting from a profound input of a company-wide customer base in a standardized and partially automated way. In particular, the manufacturing industry can benefit from the opportunity to combine detailed information related to technical products, applications, and requirements with profound customer and market insights. This reduces the risk of missing market requirements as well as mid-term customer- and technology-related trends.

Conclusion

The present single case study provided a holistic example of a successful customer foresight approach for the identification of weak signals. The following three insights gained during the foresight project led to further research questions and topics not yet covered within this context.

First, by using machine learning applications for customer foresight, existing markets and customer bases can be valuable objects of investigation. However, the

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detection of disruptive trends, which requires a radical reorientation of existing business models or market focus, is not yet guaranteed. Therefore, further research has to analyze methods and types of data which allow for this expansion of this market view.

Second, especially when considering the manufacturing industry, with its complex technical requirements and fields of applications, a question arises about the possible interactions between customer and technology foresight. How can a foresight team benefit from these customer- and product-related insights when detecting new technologies? One research topic dealing with this question within the product management and new product development literature is the so-called "loop closing". Loop closing makes the gap between two product lifecycles a subject of discussion. Researchers and practitioners try to close this gap by transferring product- and application-related market insights into ideation and early stages of the development process. In the future, these interactions could take place in an automated way (Ameri & Dutta, 2005; Kiritsis et al., 2003).

Finally, this study has shown vividly that the biggest obstacles of applying machine learning in indirect business departments of manufacturing companies are no longer the complex data resulting from profound customer relations and appropriate models suitable to dealing with those data. Particularly, the availability of high-quality data gained through these customer relationships will be the next issue to solve. This imposes new organizational requirements concerning cross-functional interactions, channel and data management, incentives, and responsibilities.

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How to Build Competencies for a Data-Driven Business: Keys for Success and Seeds for Failure

Jyrki Koskinen

> *"The constant dilemma of the information age is that our ability to gather a sea of data greatly exceeds the tools and techniques available to sort, extract, and apply the information we've collected.*
>
> Jeff Davidson
> Author and speaker

Data analysis to create deep understanding and insights holds vast potential for innovation, but there is a severe shortage of data scientists. How then can a company create the competencies needed to obtain a competitive edge in the era of data-driven business? This article describes "Data Driven Business", a program developed to coach company teams in Finland in the use of an innovation platform combining data analysis and service design using real-life case projects. The results suggest that this approach is an efficient way to build data-analysis competencies in a company: after taking the 14-week coaching course, 58% of the participating companies had launched a new product or service in the market within six months from the end of the course. After the program, a network called DOBit was established to share experiences among the members and to leverage data analysis and service thinking in society. This article describes the development and implementation of the course, its results and outcomes, and the keys for success and seeds for failure when attempting to build competencies for a data-driven business.

Introduction

Data is the new oil for innovation in many ways, as we know. But what does it take to exploit data for insights? Where can a company find the data scientists? Product-based business models are vulnerable to local and global price competition. So, how can a company differentiate? To meet this challenge, customer-centric service design is a promising approach for companies to create added value with customers and to differentiate from competitors. To illustrate this promise, consider Google, which is a splendid example of a successful company that integrates data analysis and service design in the nucleus of their strategy. But Google is exceptional. So, we must ask: How could *any* company combine data analysis and design thinking into new competencies and business?

To help companies exploit the benefits of data analysis and service design, the author organized a pilot development program called "Data Driven Business" (DOB; https://coss.fi/projektit/dob/dob-in-english/) (in Finnish, *Datasta oivalluksia ja bisnestä*) The pilot DOB program was run from August 2016 to December 2017 by seven organizations: the University of Tampere, the Finnish Centre for Open Systems and Solutions (COSS), the University of Oulu, Laurea University of Applied Sciences, the Metropolia University of Applied Sciences, the City of Vantaa and TIEKE (The Information Society Development Centre). The program received additional funding from the City of Tampere, Hartela Pohjois-Suomi, and the Ministry of Transport and Communications, as well as from European Regional Development Fund.

The program developed an innovation platform consisting of processes, methods, and tools for data analysis and service design. The platform was customized and piloted in three working packages. In the first two packages, the platform was used to create services for seniors and for travellers at Helsinki Airport in Vantaa, Finland, respectively. The focus of this article is on the third package – a training course called DOB Coaching,

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which was designed to update a company's competencies in data analysis and design thinking using the DOB innovation platform.

This article introduces the innovation platform created in the DOB program and describes the results and experiences of the DOB Coaching course to train organizations competencies needed to exploit data analysis, services thinking, and design thinking. The purpose of the article is to introduce the platform developed and to share the results and outcomes of the DOB Coaching course. The article is particularly relevant to business developers who want to exploit data analysis and service design to develop new business and to human resources staff who want to have company competencies updated accordingly.

The DOB Innovation Platform

The DOB innovation platform is a general platform to solve problems and create new solutions exploiting data analysis and design thinking. The platform consists of innovation processes supported by methods and tools selected by the author in consultation with the University of Tampere (for data analysis) and Laurea University of Applied Sciences (for service design) to support curriculum development. Figure 1 illustrates the key elements of the DOB innovation platform, which are further described in the subsections that follow, including how they were applied as part of DOB Coaching course.

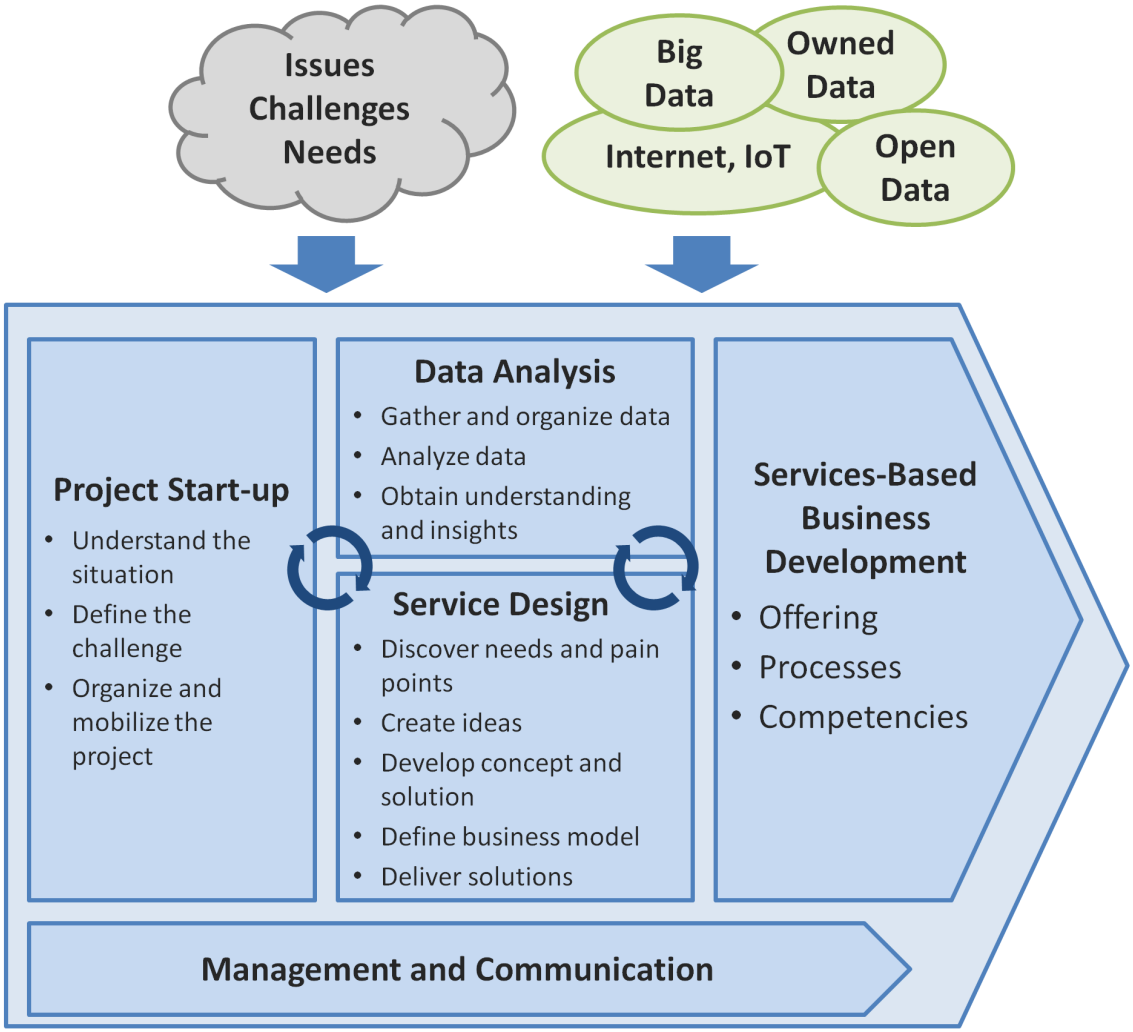

Figure 1. The DOB platform for exploiting data analysis and design thinking

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DOB project start-up, management, and communication
The first phase when applying the DOB innovation platform is to define the challenge and then organize the DOB project. What is the issue to be explored or problem to be solved? Why it is worth solving? What is the expected value? Who is the owner of the project? Who are the stakeholders? What are the organization, budget, and funding? Which other resources are needed, for example, which data might be useful to be analyzed and where can this data be found? Project management and communication include activities to run the project in an efficient and effective way to achieve the goals as part of organization's development program.

DOB data analysis
Data analysis is a process of examining, cleaning, transforming and modelling data with the goal of discovering useful information for understanding the issue and making more informed decisions and also finding valuable insights for innovation (Pyle, 1999; Theodoridis, 1993; Wikipedia, 2018). In the DOB program, the data analysis process consists of tasks, which are iterated when needed:

1. Understand the situation and needs.
2. Gather and prepare the data matrix.
3. Understand the data.
4. Make the model and apply it.
5. Evaluate results.
6. Report and deploy the results.

The analysis methods used in DOB coaching were descriptive, diagnostic, and predictive. Descriptive analysis was used to understand the data – what has happened, what you can see straight from the data using statistical analysis for instance distributions with medians, percentiles, and clusters. Diagnostic analysis was used to understand why something happened, for instance, by understanding correlations between phenomena. For example, in the DOB coaching course, one company helped their customer to better understand the usage of their products. The analysis revealed how customers were able to exploit the products and helped the company better understand the current status of their customers' operations. The results of the analysis helped to create relevant customer segments and to develop new services based on customer behaviour and needs. Predictive analysis was applied to foresee what will happen in the future using both guided and unguided machine learning. Predictive analysis is able to come out with a predictive model. The insights are based on better understanding and findings provided by data analysis, which are then brought to the service design process. In the DOB coaching course, predictive analysis was used, for example, in a case project to understand which drivers predict malfunction of a machine. This helped the company to create a predictive-maintenance business model to minimize outage and maximize the efficiency of the machines.

The analysis tools used in DOB coaching were R software (r-project.org) to create statistical models and run analyses and MySQL (mysql.com) for database management. They are both open source software without a license fee.

DOB service design and services-based business development

The DOB innovation platform exploits design thinking and service design as the mindset for value creation no matter whether the company is in product or service business. Design thinking "is a human-centered approach to innovation that draws from the designer's toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success" (Brown, 2018). In contrast, "service design is all about taking a service and making it meet the user's and customer's needs for that service" (Interaction Design Foundation, 2018).

The DOB innovation platform uses a double-diamond process for the service-design domain (The Design Council, 2015), as shown in Figure 2, which cycles through phases of divergent and convergent thinking, thus forming the diamond patterns. The process starts by gaining a general understanding of the issue with the stakeholders involved: What does the customer do as well as other stakeholders that have a role in the value chain? This is the "what is?" phase. The key question is what is their ultimate aim and what are the pain points that can be addressed to help them achieve this aim? The next phase is to create ideas about how to fix the issues and pain points by asking: What is the dream? This "what if?" phase sets the goal and defines the problem. Service design continues with an idea phase about how to achieve the goal – "what wows?" Different options are evaluated, and the most feasible

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one is chosen for delivery – "what works". The delivery phase consists of fast trial-and-error activities to find the solution that meets the needs of the customer and is doable. A business plan sums up the offering describing how the organization will create value with the customer as part of customers everyday life and processes. It identifies and describes the key resources to deliver the solution, the partners needed, and the business case. It also explains where the money will come from. A business model is needed when communicating with the stakeholders, for instance, to obtain buy-in from sponsors for investments. Service design is really only "done and ready" once the service is in use.

Developing a services-based business is an ongoing process expanding the offering, processes, and competencies together with the value network creating value together with the customers, customer's customers, and partners – with the ecosystem.

Co-creation was facilitated during DOB coaching using the CoCo Cosmos co-creation tool (tinyurl.com/ybae8u99). This tool was used to understand the current situation and to plan for the future. Brainstorming with post-it notes was used for ideation and different visualizations and prototypes were used when sketching and designing the solution to be developed for delivery. The business model was created using the service business model canvas (Ojasalo & Ojasalo, 2016).

DOB Coaching Course

DOB coaching consisted of a six-week joint-education section with lessons and rehearsals followed by an eight-week real-life case project, which each company ran by themselves to create a new service or product. The data analysis part was trained by teachers from Tampere University; the service design part by teachers from Laurea University of Applied Sciences. The

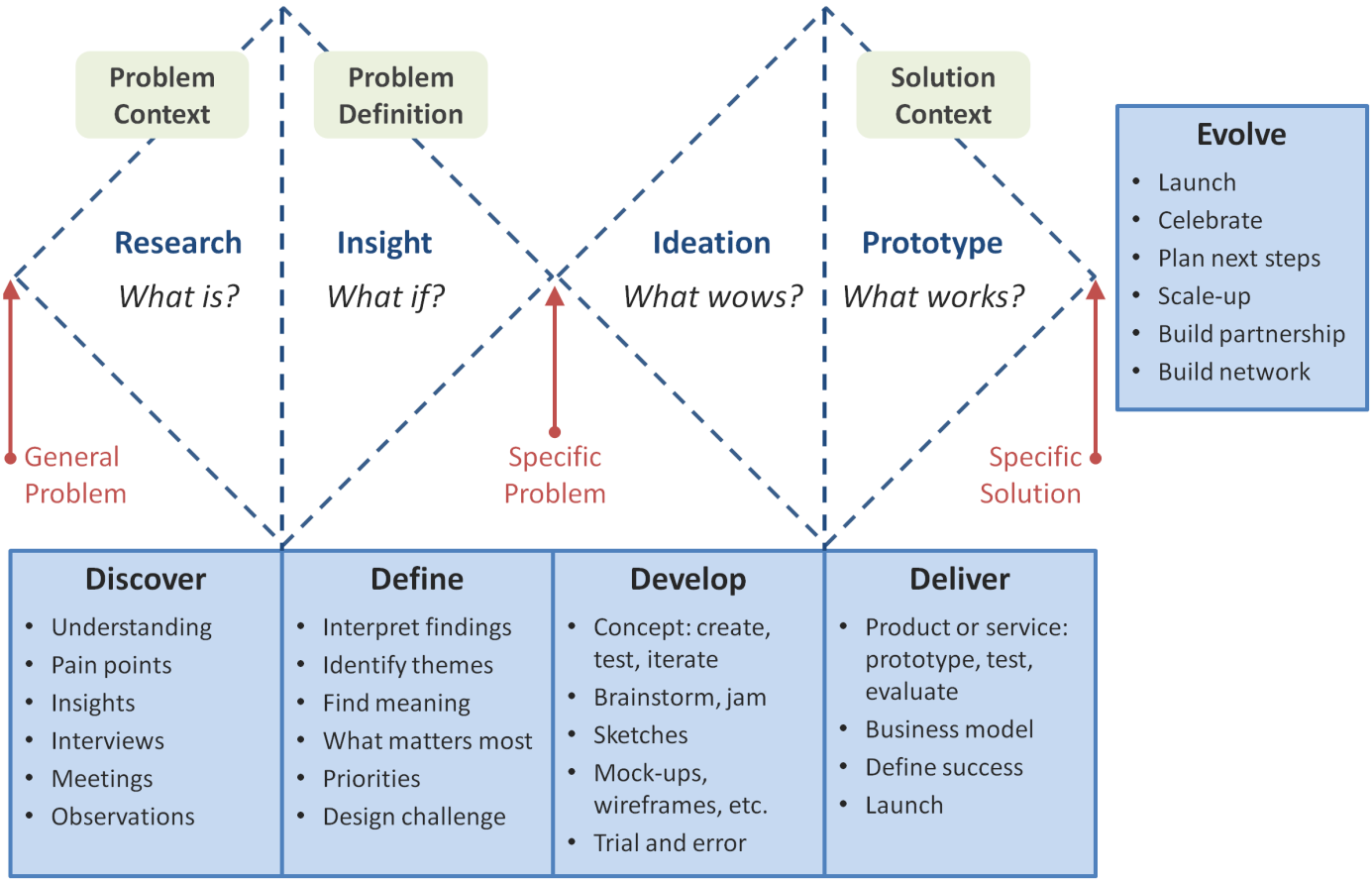

Figure 2. The DOB service design and service-business development process, which draws on a double-diamond process (The Design Council, 2015)

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Finnish Centre for Open Systems and Solutions (COSS) was in charge of the whole coaching course, having also played the role of a business consultant in the case projects. The training material – with rehearsal tasks and solutions and videoed lectures – are published (in Finnish) in the DOB Toolbox in the program website (coss.fi/projektit/dob/tyokalupakki/). The material is licensed under the Creative Commons Attribution License (CC BY 4.0; creativecommons.org/licenses/by/4.0/) and may therefore be used by anyone, including for commercial purposes.

The course started with an orientation meeting with each participating organization in order to understand their business and needs and why they wanted to attend. The meeting also helped to set expectations for the course. The educational phase featured a series of joint sessions with lectures and rehearsals. There were four joint sessions for both data scientists and service designers, eight sessions for data scientists only, and 2 sessions for service designers only. The lessons and rehearsals totalled 44 hours for data scientists and 27 hours for service designers. The educational phase was followed by a case project phase in which each team ran their real-life project together with their value network of customers and suppliers. The case project started with a case kick-off in which the challenge was defined and the project plan (with goal) and actions (with schedule and resources) were agreed. The case projects were supported by trainers conducting interventions and providing support as needed. After a couple of months, a follow-up session was arranged for the first two courses to understand how the case project had proceeded and to give support for the development process. During the 18-month DOB program, three courses were run in three cities, and 18 teams with 70 data scientists and service designers were trained.

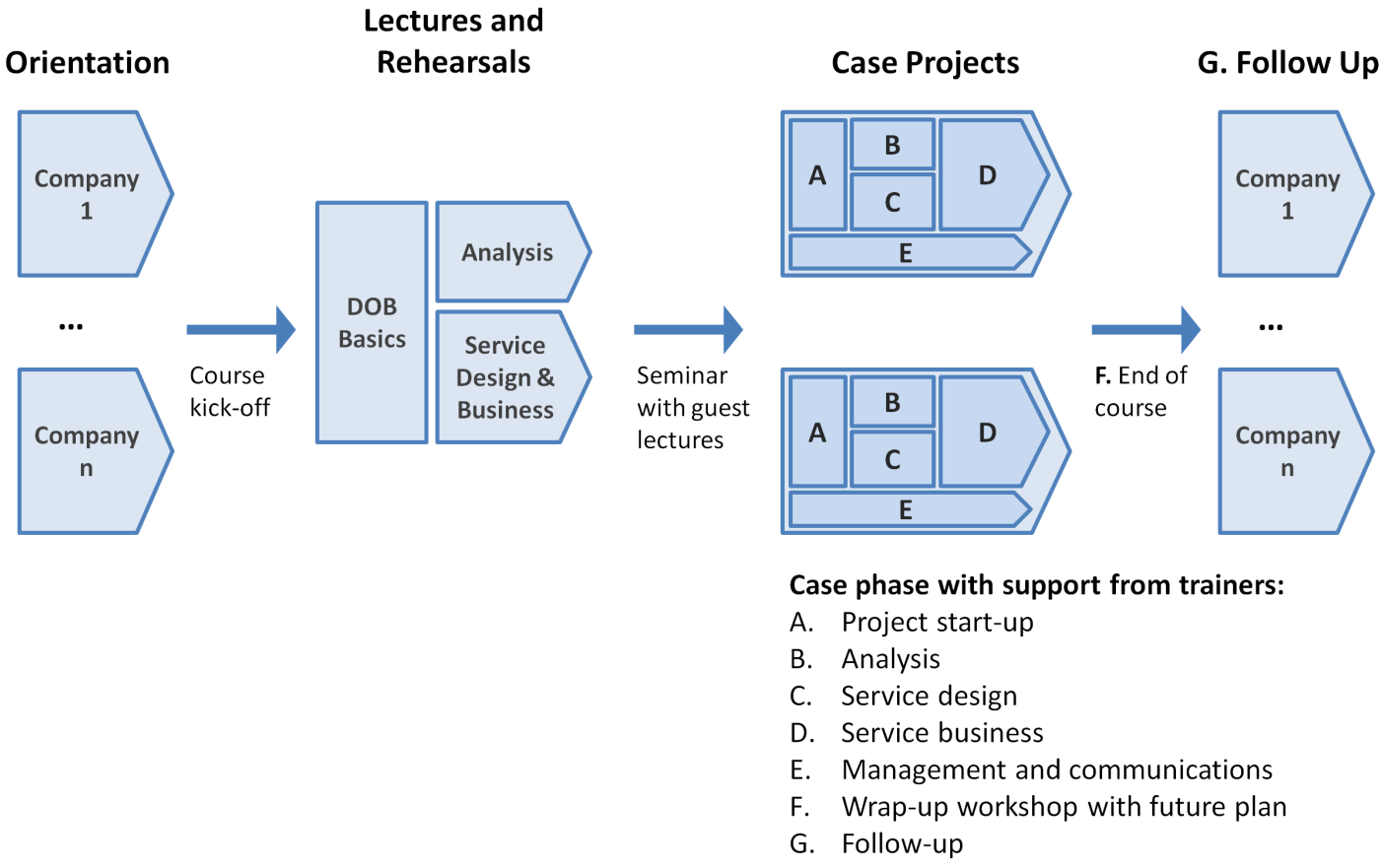

Figure 3. Structure of the DOB coaching course

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The course was free of charge for the participants and the amount of de minimis support for the participant was €9,500 ($14,000 CAD), which was the estimated market value for the course. A precondition for the course was that the data-scientist-to-be had to have basic skills in mathematics and statistical science as well as hands-on skills in programming. The typical team consisted of 1–2 data scientists and 2–4 service designers. The exceptions were one organization that sent a team of 6 people and one small start-up company that sent only one person to capture both skills. Also, one organization sent two teams to subsequent courses. The participating organizations spanned a number of sectors:

- ICT products and services: Fujitsu Finland
- Software products and ICT services: Aditro Public, Citynomadi , Granite, and Viimatech
- Consulting and ICT services: Avarea, Conmio Qentinel, Solita, Vincit, and Metosin
- Wellbeing products and services: Vivago
- Industrial services: FlowPlus
- Business consulting: FlowBrainer
- Energy consulting and services: Enegia
- Sustainable development: Natural Step
- Aviation: Finavia
- Economic research: Pellervo Economic Research Institute
- City: City of Espoo

Program Outcomes

During the program, seven teams out of twelve in the first two courses were able to release a new service or product in the market. The third course ended in November 2017, but no services or products had been released by that point and further details of outcomes are unfortunately not available.

Three of the seven products and services released during the program are described below to illustrate the types of outcomes experienced by the participants:

1. **Qentinel** (qentinel.com) is a consulting and ICT service company that works with businesses "where quality provides an edge". Qentinel exploited the DOB coaching course when developing a new service called "Qentinel Touch" (qentinel.com/customer-experience-management/) to manage the customer experience. Qentinel customized the framework and model that they had developed to understand how customer experience is born. Qentinel applies their model for customers by populating the model and its customer experience metrics with relevant data. The model with relationships is created using machine learning to understand which aspects drive customer experience and how. As a result, the customer receives a roadmap to be shared with the whole ecosystem to understand and manage the customer experience.

2. **Vincit** (vincit.fi/en/) is a publicly listed consulting and ICT service company, which has been awarded as the best employer by Great Place to Work for several years running (reviews.greatplacetowork.com/vincit). Vincit had two alternatives for the case project – an internal project to develop their human resources and a customer case to help their industrial customer to develop their business. Vincit chose the customer case, but the customer postponed the project following a reprioritization of their business development portfolio. Instead, Vincit turned to the other option, the human resources opportunity, and applied methods and lessons learned to develop their management system resulting in the "Leadership-as-a-Service" offering (LaaS; laas.fi/en/). Vincit's management system relies on self-management, where the employee is the focus. Human resources and management are there to help. Vincit's LaaS was originally developed for Vincit's own needs, but it is not limited to IT organizations; the tool can be used in all kinds of expert and production organizations. Implementation of the service relies strongly on service design. Right now, the tool is being used by over ten different organizations. LaaS is an online service that helps people to manage themselves easily and effortlessly. It helps employees to set personal goals, and it supports them in reaching them. When the service is used, usage data is gathered and analyzed, and it is used to develop the service further.

3. **Viimatech** (viimatech.fi) is a start-up company providing ICT services for industrial customers. Viimatech created a consortium with two other companies that took part in the DOB coaching course: FlowPlus is in the pump maintenance business and FlowBrainer is a business consulting company. Their joint case pro-

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ject dealt with predictive pump maintenance. Several new services are in the funnel. The first one launched was a service to optimize energy consumption and provide smart forecasting for outages based on predictive analyses of pumps.

The majority of the organizations trained in the program also exploited their newly acquired competencies outside of their case project, as part of their everyday business. In particular, service design has been widely adopted. Among the participants, there were many ICT companies and most of those companies updated their consulting offerings based on data analysis and service design but without an explicit launch of their updated service. One team did not come out with a new service from their case project but for a very good reason: the newly trained data scientists were recruited to a customer project the company had won because of the new competencies developed through the DOB coaching.

The DOB course helped organizations to expand and strengthen their ecosystems. In total, 19 organizations took part in the course and formed 18 teams. An additional 14 organizations were asked by the trainee companies to join the case projects as customers and partners. Two companies that met each other during the course have published a joint service development effort for healthcare and wellbeing. Six companies have started R&D cooperation activities with a university.

Key Findings

This section summarizes the key findings of the DOB coaching course with case projects to create skills needed for data analysis and service design and to apply them in the case project and beyond. The findings are distilled into recommendations for others applying this program or one like it.

1. At project start-up, do things right and do the right things
When defining the DOB challenge, it is crucial that the challenge is worth solving and that it is backed up by a well-reasoned business case that makes the owner willing to prioritize the project and invest the resources needed. The case project should be challenging enough to demonstrate the strength of analytics and service design, which will help the approach gain credibility for future work.

The DOB team should be a multidisciplinary combination of data analysis, design thinking, substance experience, and customer understanding. A DOB team needs a data analyst to combine the data sources and a data scientist who runs the analysis and is able to dig out the insights that are evaluated together with the owner and subject matter experts for their relevance. The service designer is the role with empathy, which helps people to find problems and needs and comes up with solutions together with the stakeholders. The service business designer turns the invention into innovation with a business case.

When developing a service, product, or process, the whole value chain needs to be involved. However, one needs not to keep all the "bits and pieces" to oneself; partners with needed competencies can be involved. The most important point of view in the development is that of the customer, for it is with the customer that value is to be created, and it is the customer who will pay the bill.

2. Well managed, rich data is essential
Data analysis brings new understanding and may create valuable insights. The more granular and detailed the raw data, the better the opportunities for the data scientist to find patterns to help understand the phenomena. Rich data that brings surprising insights is often a combination of various sources of raw data. However, joining various datasets is laborious and does not always succeed. The two data fields in two systems may have the same name but they may have different meanings. It may be that data is not accurate or values are missing. The preparation phase to refine the data to be analyzed is usually the hard phase and does not always succeed. It often happened in DOB case projects that 10% of the effort in data analysis was the actual "fancy data analysis" and 90% was the hard work to get the data matrix in place to be analyzed.

The European Union's General Data Protection Regulation (GDPR; eugdpr.org) for data privacy has made the usage of personal data more sensitive. Someone's personal data can be used only with their permission and for the purposes agreed unless there is a legal reason. Organizations face the risk of heavy fines if their data usage does not follow the regulation. The current problem is that there are not yet concrete guidelines about how to apply the GDPR, including how to assure that analyses of data from various data sources gathered for years is aligned with the legislation. The regulation protects data privacy but, at the same time, it has clearly slowed down the usage of data analytics while industry waits for national laws and interpretations of GDPR and data management procedures to become aligned accordingly.

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The findings also underscore that the owner of the most valuable data to be analyzed is not always the owner of the challenge to be solved. If the investment incentive is not clear enough, it may be too time-consuming and laborious to convince the data owner that providing and cleansing the data is worth the effort.

Indeed, data analysis does not work always economically or technically. In the DOB program, there was at least one case where the data quality was too poor to prepare and analyze it with reasonable cost. In another case, the data volume was too low to make enough observations for a reliable analysis. Supervised machine learning demands three unbiased datasets to be used. One dataset is used to train the model to predict the outcome, the second one is used to validate the model, and the third one is used to test the final model.

3. In service design, it pays to be a curious servant
Service design will succeed if undertaken in a humble and curious way with the right stakeholders. It is fruitful to admit that the organization does not know all. A curious attitude and interest in other people's business and ideas are critical. Established organizations may have well-functioning models and designs, and a change in the current business model may be seen as a threat to the current business. For new entrants, it is easier to be naive and straightforward, to think "outside of the box", and come up with ideas that destroy an existing design. However, not only the suppliers but also customers are often trapped in the current business models and dominant designs. Therefore, the right question to ask the customer is not: "What do you want?" or "What do you need?" Rather, it is better to ask: "What do you do, what is the aim, and what are the pain points?" In that way, it is possible to find totally new solutions rather than just extensions or modifications of current ones

4. Services-based business development – a tough transformation
Transforming business from a product-driven push mode to a services-driven pull mode is revolutionary. Push mode means producing a product or service and bringing it to the customer. The attitude is "where do we find customers to buy our products or services?" In contrast, pull mode means helping the customer use different solutions: "Where can we find products for the customer?" Service thinking is all about joint value creation together with the customer. No matter if the company is making products or services, service thinking applies in both cases. A product is no more than a platform to create added value and the value is measured by the customer (Vargo & Lusch, 2004). The change to a services-based business changes everything: offering, pricing, production, and competencies needed – the whole culture.

5. Management and communication
Resources are always scarce. In the DOB course, for some organizations, an important customer project coincided with DOB coaching course, which caused problems and delays for the coached DOB team. However, every organization that started the course completed the course. Only at an individual level did some participants have to withdraw for one reason or another. Overall, the closer the DOB case project was to the core of the business, the higher the priority and the better the results.

Some companies had a clear and pre-existing motive for their case project. They were determined and were usually able to create the intended service. Some companies were obliged to change their case project during the course but were still able to launch a new service. Some companies had a long-term goal and aimed for sustainable change. They were able to see beyond the short-term goal of just creating a new service or product to update their core competencies for the future.

Keys for Success

1. Loving the problem, not the solution
One company that took part in the DOB course decided to develop their help desk operation to improve the customer experience as part of an issue-management service. The goal was to solve problems reported by customers as quickly as possible. Plenty of ideas was developed together with customers to improve the user experience. Data analysis was used to better understand the customer point-of-view and a problem-solving process was used to find bottlenecks. After a while, the team went back to the ultimate goal and redesigned the challenge. The new goal was *not to fix* the problem as soon as possible but to *avoid the problem happening at all.* The challenge was no longer to develop a help desk but to understand why issues occur in the first place and to prevent them. How can the problems be identified and fixed before the customer comes across the issue as a problem? And, even better, how can the problems be predicted so that they do not happen at all? Predictive analysis was used to identify patterns in how issues arise and to mend them permanently. During the case project, the company became familiar with text analysis, and the case project became a reference to help win a customer project.

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2. Assembling the right team – with the customer
In the highly performing DOB teams, there were separate people for data analytics and service design and they had virtual team members from partners and customers, spanning over the whole value chain. The easiest and most straightforward way to get deep customer understanding into the team was to ask the customer to join the team. Value chains are often long, and it was valuable to also have the customer of the customer involved. Customers appreciated that their supplier was active and asked them to join. For example, a half-day service design workshop did not take much from the customer but it helped them better understand their own business as part of the value chain. A DOB team with a customer involved in an early phase landed a paying customer right away and created a service with a high likelihood of success based on a good fit to the market. Flat organization and direct access to relevant customer contacts were keys to get the right team gathered in a reasonable time.

3. Embracing all actors, large and small
In many DOB case projects, a fruitful consortium was created not by the dominant, established company as a driver but a small startup having a grand idea. For the startup, realizing the grand idea was a question of life and death, and it was willing to put in the lion's share of the effort needed to make the idea happen. Established companies are valuable in order to bring muscles and credibility to the consortium while the startup brings the brains and energy. The key lesson is that a small actor can take on a major role.

4. Understanding the domain
It helped to have the data scientist and domain specialist work in close cooperation to quickly evaluate the results of data analysis and their relevance for the business. The program showed that, even if the data is not rich enough to reveal any totally new, major findings for revolutionary change, statistical analysis and visualization of the data can bring valuable understanding to the business for evolution.

5. Recognizing that systemic problems need systemic solutions
It is important to have all the stakeholders of the value chain in place to solve complicated issues. One DOB case dealt with a construction business to build underground infrastructure (e.g., water pipes, drains, gas pipes, and telecommunication cables). The issue was to avoid an outage of services by not breaking pipes and cables when digging in the ground. One of the issues was that the maps, which the city provided to the construction companies, did not include data about how deep the telecommunications cables are buried. When operators assemble their telecommunication cables, they always assemble those above the rest of the infrastructure. So, telecommunications companies always find their cables without damaging other infrastructure. They have not had the incentive to store the depth data as part of their map information system, which they also provide to the city. The solution was simply to add the depth data to their information system. The cost to add the depth data was marginal compared to the benefit for the whole ecosystem – including also the telecommunications companies.

6. Trying "to help", not "to sell"
A good service designer forgets the earning models (for a while) but acts like a consultant to help the customer to create added value or to help the customer with their everyday issues. Once the customer is helped, the money and business will follow once the service designer comes up with a feasible earning model. When the supplier deals closely with the customer and understands how value is created together, the supplier can find totally new services and earning models together with the network.

7. Willingness to fail fast
One DOB coaching participant had already planned and prepared to augment their service assortment with a new service. The idea was evaluated in a DOB workshop with paying customers, and it proved right away that customers were not eager to pay for such a service. A new direction was chosen to further develop the whole assortment. Having a customer involved in the early phase of the development process helps to avoid false investments. In the DOB case mentioned, the intended service was actually decided to be developed but was offered free of charge to encourage expansion of the customer base.

8. Celebrating success
It is important to be loud and visible to encourage a positive spiral of success. For instance, Vincit has described in public how they developed the Leadership-as-a-Service concept first by asking employees what they wanted from human resources in terms of what kind of services they might need. As a result, they received rather traditional ideas for new services and add-ons to current ones. But, when Vincit went a bit deeper into the challenges the employees were facing in their everyday lives, they made the breakthrough. For ex-

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ample, they have turned the idea of the traditional development discussion upside down. The discussion is not done necessarily with the manager but with a person chosen by the employee, for instance, the CEO or a board member or a mentor outside the company. Vincit's human resources department offers many new services to help their employees work better and feel better. For example, if an employee has a baby who does not sleep well at night, Vincit arranges sleep training to help the family.

9. Realizing that building a services-based business involves more than just service design
It takes time to make the cultural change to customer-centric, services-based thinking in all activities in the organization and to have every employee internalize its principles. In the DOB coaching, helped to have several people from an organization participate in the course in order to spread the insight and new thinking in the whole organization. One DOB organization arranged an eye-opening presentation of service and design thinking for all employees in the company as part of their case project. After the company-wide session, it was much easier to "walk the talk" once everyone was familiarized with service thinking instead of only a small dedicated team.

Seeds for Failure

1. The wrong sponsor
A company having a risk-management software application for their insurance business participated in the DOB course in order to develop new services for the industry. A critical source of innovation was the application's database, which contained information about the insurance companies' customers. A service design workshop was arranged together with a customer represented by two risk management experts. The right sponsor from the customer's side would have been the business owner with an interest in developing new products and services – not the team who is running the current ones. In this case, the path to finding the right stakeholder seemed too long and the idea was abandoned.

2. The one-man band
Some organizations joined the course with a minimal team and ran the case phase as a "one-man band". However, a good data scientist is not necessarily a good service designer because the jobs differ in nature. It may happen that one talented person does have all the competencies needed to successfully run the data analysis and the service design. But, to make a cultural change in the organization from product-based business to a services-based business is a tough job for anyone to handle by themselves.

3. Poor data management
The data to be analyzed may be stored in many legacy systems with different conceptual models that have not been harmonized. It may happen that there has been "creative" misuse of data fields resulting in heterogeneous data gathered from different sources and from different geographical areas. As a result of poor data management, it can be too laborious and expensive to clean and transform the data to create a decent data matrix to be analyzed.

4. Reluctance to engage with customers
Some DOB participants wanted to "protect" their key customers from wasting their time and did not want to ask customers to get involved before they "had something real to show". When customers were asked to a "ready-made table", they often concentrated in finding faults and deficiencies in the solutions instead of finding amendments. Teams without early customer involvement could create a new service but tended not to create a perfect solution for the customer, at least not initially.

Conclusion

This article focused on the findings from the use of the DOB innovation platform and coaching course to adopt data analysis and service design as part of organization's competitive edge. Both disciplines proved to be fruitful when creating data-driven services. However, data analysis and service design do differ significantly in nature. Learning data analysis requires basic know-how in statistical science and mathematics. Also, applying data analysis does not work out every time. But, once successful, the benefit may be enormous. Insights from data analysis may be the core of a new service or product or a core for the whole business model. In contrast to data analysis, service design and service thinking do not require any preconditions, just common sense. Service design and service thinking will manage always bringing value added if not for a revolution but for evolution.

The DOB program ended in December 2017; however, the participants wanted to continue cooperation and to share ideas, experiences, and best practices in the future. A network called DOBit (tinyurl.com/y9ltpshq) was established for everyone who wants to promote data analysis and service thinking. The network decided to

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focus on two industrial themes: "health and welfare" and "the smart city". The network has currently 50 members and the first two meetings have enabled members to share best practices and plan new activities. In the health and welfare theme, the agenda is to exploit Kanta (kanta.fi/en/system-developers), the Finnish national health record, as a platform for new services to be developed by companies.

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Tread Carefully: Managing Identities and Expectations in High-Tech Industry–Academia Collaborations

Els De Maeijer, Tom Van Hout, Mathieu Weggeman, and Ger Post

> *"We will rapidly become accustomed to living in a constant present and our understanding of who we are will emerge through the context of the knowledges that are produced within it."*
>
> Robert Hassan (2003)
> Professor of Culture and Communication

Industry–academia collaborations are in continual flux. The changing role of academics is reflected in the interaction between industry and academia. In this article, we examine how meetings as a genre are used to establish and alter the roles and identities of participants. First, interactional analysis shows that a meeting set-up revolving around academic presentations confirms an old role division between collaborators where academic contributions are vulnerable to undervaluation. Second, we found that so called "leading individuals" show critical discourse awareness that allows partners to reposition themselves in relation to each other. They use interactional strategies to create a joint purpose, empower participants to jointly realign, and motivate them to openly share progress. This results in a power shift where academics feel free to pursue their agendas. With this article, we try to understand how the choice of linguistic features shapes social and interpersonal relations in industry–academia collaborations by focusing on open innovation as a socially contingent process.

Introduction

Although it is widely recognized that collaborating with academia through open innovation is vital for the high-tech industry – "companies that don't innovate die" (Chesbrough, 2006) – such collaborations also influence the nature of academic work. The potential commercialization of academic knowledge is a key driver for its funding (McCray, 2005) but exposes universities and knowledge centres to market forces, which curtails the traditionally long time horizon valued in academic research (Perkmann et al., 2011). Moreover, due to the increasingly short time-to-market, academics can no longer just be data suppliers or provide "research services" (Schmoch, 1999). Industry needs strategic innovation partners who facilitate a swift decision-making process based on certainties rather than risks. Deciding whether something can be done and which research steps should be taken next can no longer be an academic endeavour; research has to consider return on investment rather than just being an exercise in serendipitous experimentation. With the shift of attention to concrete problem solving and applicability for production comes a change in the network role (Erickson, 2005) of academics. Consequently, academics find themselves "betwixt and between" (Eksner & Orellana, 2005) being scientists and managers.

We claim that such repositioning shapes the daily organization of joint innovation work between industry and academia. Academic and industrial partners inevitably have to meet up to discuss, align, and contest past achievements and future progress. It is thus "a process of joint spoken and written labor" (Urciuoli & LaDousa, 2013), with language as the central medium of work (Koller, 2017), and meetings are ways of getting things done (Lehtinen & Pälli, 2011) – of making innovation work. In line with previous research on meetings (e.g., Angouri & Marra, 2011; Drew & Heritage, 1992; Lehtinen & Pälli, 2011; Nielsen, 2013), we consider such meetings to be embedded in the social and organizational context of a group or team, and in the wider social or

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institutional order of the collaboration (Holmes & Stubbe, 2003). (Project) meetings are mostly prepared face-to-face encounters (Lehtinen & Pälli, 2011) at prearranged times and in set places such as academic or industrial campuses, industrial sites, and innovation hubs. Collaboration partners, who act as members of both the collaboration and the separate organizations to which they belong (Grant et al., 2005) bring context or discourse into those meetings. Under the current (western) phenomenon of acceleration (Brose, 2004), partners are tempted to fall back on instrumental thinking (Hassan, 2003). Instrumental thinking causes the "raw material of knowledge" to be only judged and processed through "abbreviated thinking", focusing on what knowledge is useful and useable in our own lives (Hassan, 2003). With such inflation of knowledge comes a transformation of universities into "skills centres" to maximize potential in the job market (McInnis, 2001; Schiller, 1999). Academic uncertainties can jeopardize the viability of industrial innovation projects and may be undesirable in industry–academia work.

Governmental research organizations promote industry–academia collaborations as examples of a healthy knowledge economy, but will these collaborations keep delivering under the current pressure of time? Uncertainty provides academia with a reason to exist; "not knowing things" acts as a catalyst for new experiments, further research, and fundamental knowledge creation. In this article, we examine to what extent industry–academia meetings are colonized by the instrumental logic of the high-tech industry and how these contextual elements are reconstituted within and by processes of interaction (Langley et al., 2013).

To find out more about the position of academia in industry–academia collaborations we need to find which discursive elements, relating to uncertainty and time pressure for example, are brought into the interactional process of knowledge creation. By looking at such interactional processes, we can learn how identities, roles, and relationships between open innovation partners are shaped in meetings.

The major research questions of this study are thus as follows:

1. *Which roles and identities do partners take in industry–academia meetings?*
2. *How are those identities managed in interaction?*
3. *How does this process shape the knowledge-creation process?*

Methodology

To answer the research questions, we use linguistic ethnography, which is the study of social practices through the lens of language and communication (Shaw et al., 2015). We draw on interactional analysis to unravel the meetings as examples of institutional interaction and connect the discursive patterns to the wider social context and structure of industry–academia open innovation.

With their specific rhetorical structures and distinctive lexico-grammatical features (Shaw et al., 2015), meetings constitute a specific genre, which makes them distinguishable from other events in a workplace context (Angouri & Marra, 2011). Studying meetings can thus reveal which dedicated organizational routines are in place and who has experience with – and understanding of – those routines (Drew & Heritage, 1992). Looking at the formal and sequential properties of talk – for example, word selection, topic selection, and ordering of sequences – allows us to make claims about the inferential order of interaction, such as the asymmetry in distribution of actors' rights and obligations (Drew & Heritage, 1992) within the genre of the meeting.

We used three kinds of data, which is typical of ethnographic research, which were gathered between February 2015 and September 2017 by the first author. First, we audio-recorded project meetings in three collaborative industrial–academic settings all serving the high-tech industry (mostly the semi-conductor field). For this article, we focus on two projects, anonymized as "Phi" and "Omicron". Both projects were set up with governmental support for fundamental research in physics and its commercialization, which means that partners are required to meet to at least once a year to evaluate the progress made in the project. Furthermore, projects are required to invite (potential) industrial users of the developing technologies to the meetings. In this setting, we gathered roughly 20 hours of meeting audio. In the Phi project, we also audio-recorded a bilateral work meeting between two of the three main partners. In the Omicron project, we extended our data to an over-arching program meeting in which Omicron was reviewed among all the other projects in the program. Second, we interviewed representative individuals of the partners involved in the projects (in semi-structured interviews), some previous employees, and the governmental intermediary of Omicron (and previously Phi) to gather a more complete understanding of the context of the collaborations. Furthermore, we had several informal conversations with various members of staff in the partnership, equally

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divided between both projects. The non-technical background of the first author made her into the so-called "acceptable incompetent" ethnographer (Lofland & Lofland, 1995) allowing for more incisive questions to reveal participants true beliefs and values. Finally, we added field notes taken during the non-participant direct observations, reflective notes on informal conversations, and secondary data such as emails, meeting agendas, and supporting PowerPoint presentations to create a "detailed tapestry" (Briguglio, 2016) of themes and patterns, which were cross-validated and triangulated in more follow-up interviews/feedback sessions with participants. The third partnership, extensively studied previously (De Maeijer, Van Hout, Weggeman, & Post, 2017), serves as a comparison by way of extension (Czarniawski, 2012) and validation. The research methodology is summarized in Figure 1.

Utterances were coded not only to guarantee grounding of the theoretical interpretation in linguistic empirical evidence but also to allow new phenomena to emerge and thereby sensitize researchers to concepts that previously have been excluded from the framework of existing open innovation theories. Linguistic ethnography can thus describe the discourse of these industry–academia collaborations with its beliefs, values, and motivations, and it can connect these descriptions to interactional patterns, thereby challenging or adding nuance to some of the presuppositions (Urban & Koh, 2013) about such collaborations.

In this article, we try to reach beyond the description of the processes as they happen (Langley et al., 2013) and to understand "how one's choice of linguistic features shapes social and interpersonal relations in communicative events" (Weninger & Kan, 2013). With the current stress on the instrumental validation of knowledge associated with an industrial paradigm, we can expect that these choices will shed light on how identities are managed in conversation and how they are reflected in the (presumably unequal) distribution of power (Koller, 2017).

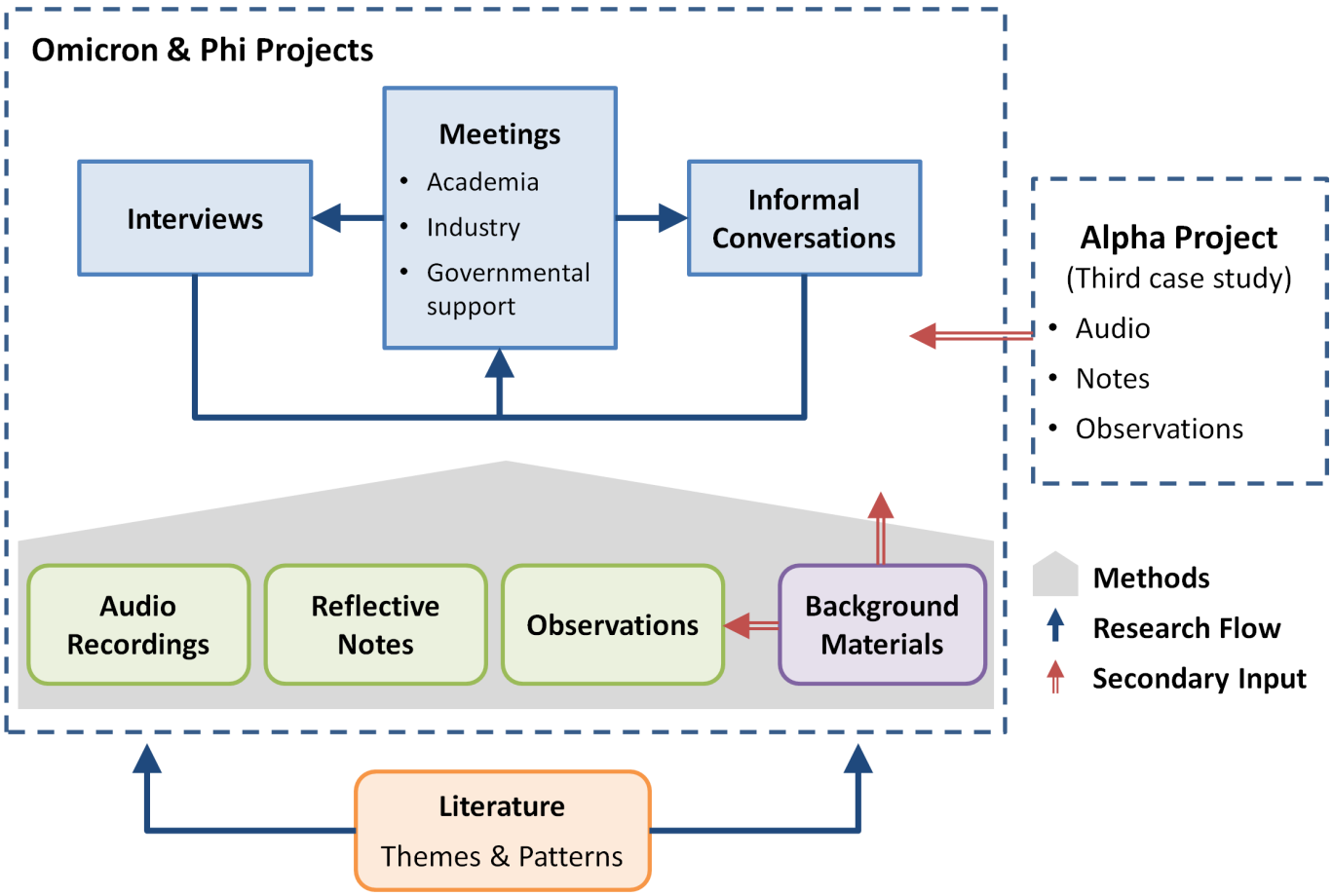

Figure 1. Research set-up showing sources and methods used for data gathering

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Analytical Framework

We propose to approach open innovation as a social process where openness is an observable linguistic practice rather than a collection of intentions and attitudes (Potter & Wetherell, 1987). This approach is in line with Costas and Grey's (2014) approach to secrecy (as opposed to transparency); in the same way as people are engaged in the practice of secrecy to keep something a secret (Costas & Grey, 2014), people are actively engaged in "being open". Secrecy is related to (group) identity and power (Moore, 1962), as knowing or not knowing things puts people in a group of insiders or outsiders. However, literature on open innovation takes an informational approach (Dufresne & Offstein, 2008) to openness as it considers it as the *preparedness* to share information with others and the *preparedness* to get information from others, with the assumption that such information is of high tactical or strategic value (Dufresne & Offstein, 2008). With the value of information comes, perhaps ironically, attention to how, in such an open climate, innovations can be protected, on appropriability, intellectual property rights, and patenting. Other research focuses on which conditions on the front side of open innovation stimulate an "effective knowledge sharing process". Simard and West (2006), for example, have paid considerable attention to the role of relationships or ties between open innovation partners. For instance, they distinguish between wide and deep ties and relate these ties to trust levels and thus openness in the collaboration. They argue that the heterogeneity of partners creates room for different perspectives and more "out of the box" solutions to problems, but also that sustained collaboration over time creates more trust and reduces the risks in a collaboration. This idea of a "pay-off between trust and novelty and safety and flexibility" (Gargiulo & Benassi, 2000) has been further elaborated on by research on how employee diversity can affect openness to external sources (Bogers, Foss, & Lyngsie, 2018). Such research assumes that, when the right conditions are created at the front side of collaborations with sufficient real-life interaction (Agrawal & Cockburn, 2003), the right personal networks (MacDonald & Piekkari, 2005), and suitable legal security, an open flow of knowledge is established.

Our approach to openness does not dismiss the organizational dilemmas and strategies described above, but considers them given discourse. Focusing on the conditions, intentions, and attitudes as key factors for successful open innovation outcomes goes at the expense of paying attention to how innovation happens *between* these heterogeneous partners. There is an overwhelming emphasis in most management research on the importance of outcomes (Langley et al., 2013). Research on open innovation is no different, with the exception of a few studies such as Van Oortmerssen's (2014) study on the effect of turn-taking in collaborations or the recent attention that intermediaries have received for their role in bridging the cognitive, geographic and social distance between industrials and academics (e.g., Villani et al., 2016) and in establishing a creative climate with room for new ideas (Agogué et al., 2013). Although these studies offer a valuable glimpse on the interactional aspects of collaborations, there is very little room for the processes of collaboration that happen right under our nose, for the patterns in the interaction, what they signal nor how such patterns shape the future of industry–academia work. In that respect, we would like to refer to earlier research (De Maeijer et al., 2017) where we connected openness to the use of an interactional strategy called *facework* (Goffman, 1967). Due to the liminal or in-between position of partners (being neither academics nor industrials), collaborating parties fear to be granted attributes that do not match their preferred network role (old or new one) and thus also refrain from putting *their partners* in a position where they have to confess on their ability and willingness or lack of it to perform certain activities within a limited time-frame. This dynamic, which is "keeping face" (Spencer-Oaty, 2009), is an integral part of everyday interaction aimed at not damaging individuals perceived self-image. With liminality comes uncertainty about how others want to be seen in their capabilities, values, and beliefs. To prevent face-threats, research purposes, activities, and deliverables are often quietly assumed rather than openly debated. This, in turn, makes expectation management in the collaborations harder, and this lack of transparency can kill the trust between the parties. The focus on the interactional process adds empirical evidence to Erikson (2005) who concluded that trust built on previous interaction may be reduced through changes in network roles (Simard & West, 2006).

The focus on the process of openness hence shows that the reality of open innovation is a result of context continually being reconstituted within and by processes of interaction over time and that actors, environments, and organizations are all in constant and mutually interacting flux (Langley et al., 2013). Hence, with this article, we contribute to distinguishing the myths of open innovation, constructed in managerial talk, governmental policies, and regional marketing strategies from the *reality* of open innovation collaborations, and more specifically of the role of academia in the latter.

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Analysis of the Interaction

Investigating meetings as platforms where open innovation "works", we focus on two aspects that help participants to identify the roles and identities that are taken in the collaboration and to act accordingly to the expectations that these identities imply. The very fact that participants gather in "formal" meetings helps to create certainty about what expectations to have of each other. First, the recognition of genres, such as meetings and presentations, supports sense-making as it clarifies who is in charge, how to interpret certain behaviour, and what positions, and accordingly what actions, should be taken in the meeting and hence in the project itself. Second, we show how participants rely on "leading" individuals to further tease out what roles and identities are and should be taken up during the meeting and which interactional step is the most "appropriate" one to take. Figure 2 provides a basic overview of the organization of the meetings and which strategies are applied. We will relate genre recognition (based on organizational features in the left column) and the observed interactional interventions (in the right column) to management and leadership discourse. Finally, we will explain how mixing both discourses can benefit the knowledge-creation process.

The Meeting as a Management Genre

The interaction between industry and academia in both the Phi and Omicron projects is organized in work and in user meetings. It is the sheer recognition of the meeting as a genre by the participants that provides safe boundaries of what can be expected to happen. By genre recognition, we mean that participants recognize the rhetorical structure and the distinctive lexico-grammatical features contingent on the social norms and embedded practices of recurring situations (Lehtinen &

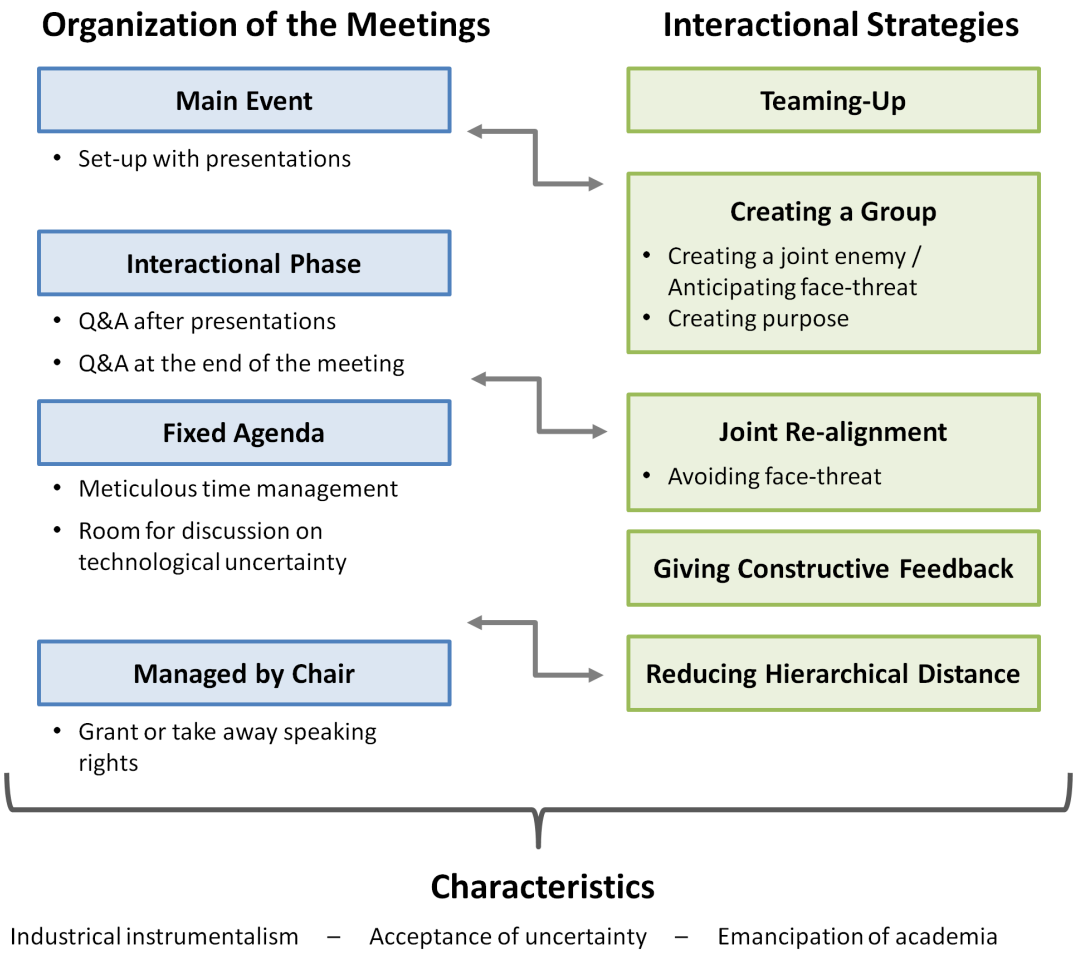

Figure 2. Summary of the organization of the meetings between industrials and academics and the interactional strategies they use

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Pälli, 2011). This knowledge is implicit as participants comply with the norms, standards, and routines of meetings without having to explicate the meaning of the genre. So, when participants have a project meeting scheduled, they know for example that, in contrast to a "normal" day at the office or in the lab, they will be seated in a room with delegates from external organizations and that the interaction will be regulated by a chair. Those assumptions are based on the participants' knowledge of and experience with what a meeting constitutes. When the project-leader sends out the agenda of the meeting via email, assumptions about who will be participating, role division, and allocated speaking turns (Angouri & Marra, 2011) can already become confirmed. The agendas indicate who should be actively involved in the meeting (i.e., who will be doing most of the talking), when, and for how long (Figure 3). The agendas of Phi and particularly of Omicron show that meticulous time management is expected of the participants (Figure 4).

Even the actual gathering of participants, which Kunda (1992) calls the "transitional phase during which participants gather and jointly shift from routine to ritual" is taken up in the agenda of the program meeting as a dedicated timeslot for "Coffee", which gives the chair the procedural back-up to open the meeting. Such a formal approach to the meeting fits a management discourse reflecting the importance of "the smooth running of the business" (Norlyk, 2012). The chair manages

Phi Project – Agenda

Subtitle [description of scientific technique for commercialization]

Date & location [University building]
Time 10:00 – 13:30 with lunch
Building and room number

10:00	**Introduction and Welcome** [Project leader] University
10:15	**Project Planning, Status and Outlook** [Project leader & representative institute], University & Research Centre
10:30	**[Technical Subject 1]** (15 min. talk + 15 min. discussion) [PhD-student], University
11:00	**[Technical Subject 2]** (15 min. talk + 15 min. discussion) [Researcher], Research Centre
11:30	**Title** (15 min. talk + 15 min. discussion) [Researcher], Research Centre
12:00	**Feedback from User Committee** Discussion & Lunch
12:30	End

Notes

- The agenda of the meeting is sent out to invitees in advance.
- The meeting is chaired by the project leader of the university and takes place at the university itself. The project leader opens the meeting. The Phi meeting analyzed in this study was opened by the industrial representative as it is hosted by the company.
- The name of the person presenting would be listed in place of text in square brackets [ ], followed by their organization name.
- On the agenda, Q&A is strictly organized after each "main event". In reality, the speaker is interrupted for questions during their talk. Q&A and the feedback of the user committee are not distinguishable as separate activities.

Figure 3. Annotated example agenda from a Phi program meeting

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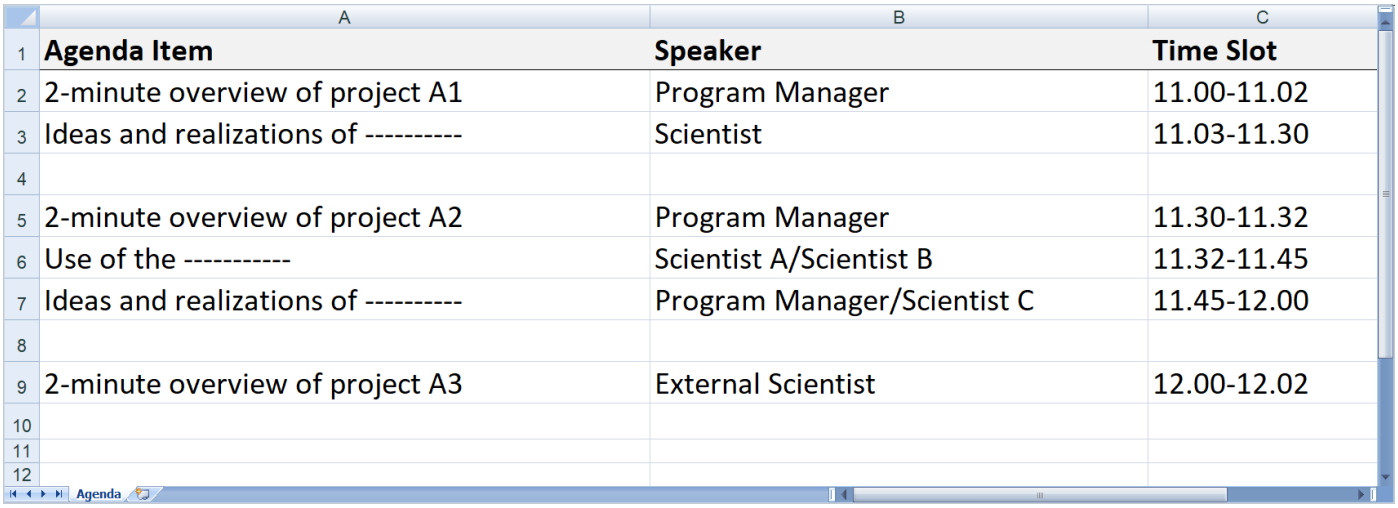

	A	B	C
1	**Agenda Item**	**Speaker**	**Time Slot**
2	2-minute overview of project A1	Program Manager	11.00-11.02
3	Ideas and realizations of ----------	Scientist	11.03-11.30
4			
5	2-minute overview of project A2	Program Manager	11.30-11.32
6	Use of the ----------	Scientist A/Scientist B	11.32-11.45
7	Ideas and realizations of ----------	Program Manager/Scientist C	11.45-12.00
8			
9	2-minute overview of project A3	External Scientist	12.00-12.02
10			
11			
12			

Agenda

Figure 4. Example partial agenda from an Omicron program meeting showing very detailed timing and topics. The full agenda was sent out as an Excel file with 26 items with time slots ranging from 2 to 30 minutes.

the meeting and hence is held responsible for its planning, structure, and productivity. The focus on procedures brings efficiency. Such an approach is appreciated by the industrial partners who frequently apply a management discourse of timelines and deadlines (De Maeijer et al., 2017) setting the norms for the appropriate timing for action (Garud et al., 2014).

Presentations

In Phi and Omicron, about 70% of the items on the agenda are given to academics. In fact, most of the "the main event" (Kunda, 1992), or the actual meeting, is made up of separate "talks" by academic researchers (often PhD students) who are given the opportunity to show what they have achieved up to that point. Although the agendas never use the word "presentation", we can clearly distinguish the activity type of a presentation; speakers' turns are about 12 to 20 minutes of uninterrupted talk and are supported with PowerPoint slides. Although it is perhaps counterintuitive that this specific organization of "speaking turns" provides the listener rather than the speaker with power, observations of the meetings teach us that this unequal distribution of speaking rights (or obligations) has perhaps unintended and status determining implications for the academics in the meeting:

> *"The meeting was bad because there was no engagement and passion in the presentations and the quality of the stories... **well, there was just nothing new.** Also, no vision was put down, nothing like 'this is what we are going to do in the next coming months'."* (Industrial CEO and user at Omicron program meeting; emphasis added)

First of all, giving a presentation implies that you have something to show, something of value, something new, or something that whoever is listening did not know already (Merriam Webster, 2018). Second, this implies that, as a presenter, you expect the listener to have an opinion. The listener has the privilege to evaluate, vote on, or judge the presentation. On the agenda, we can see that this takes shape in Q&A sessions by fellow academics, industrial fellow project members, and industrial users. Kunda (1992) calls this the interactive phase "in which different individuals engage and even resist the speaker". This interactive phase can be organized at the end of a meeting, or take place straight after each short presentation (see the Phi agenda example in Figure 3). In this case, the meeting is actually made up of cycles of main events and interactive phases. Even when the agenda offers no explicit space for Q&A (as we have seen in the third case studied), presenters have to be on guard for reactions from the public. Sometimes a reaction is explicitly asked for by the chair ("Are there any more questions?") or implicitly through the use of the discourse marker "Ok", silence, and intonation to mark the end of a presentation, simultaneously serving as cue for applause, critique, or questions. Previous experience and genre knowledge provide both presenters and public with knowledge to infer what is expected of them in this interaction phase. However, this cycle of

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phases also puts the presenter under pressure to bring across something of value within their allocated speaking turn. The presenter furthermore knows that speaking rights can be taken away by the chair when a presentation goes overtime. Moreover, under perceived time pressure, the chair can decide to cancel a presentation when the news value is *assumed* to be low:

> *"So let's have a look at the presentations actually, because the presentation that Jan is going to give, for the people that are interested in it are the academic guys,* ***but they've already seen it.*** *So Jan's presentation is not essential for seeing the progress of this project. So, we skip that one. You are allowed to do it next time."* (Project leader Omicron at user meeting Omicron; emphasis added)

Presenters thus always find themselves in a vulnerable position as it is up to others to decide if the information is valuable enough for the presenter to make it to the stage. When the presenter does present here, he makes extra efforts to make the public see the value of his message or to help the public pick out the most valuable takeaways. He does so by adding discourse markers (***"So, what is interesting here,*** *is that you can see this as an example of..."*) and by teaming-up (Lerner, 1987):

> *"So that is what we need to figure out.* ***So Hank*** [the chair and program leader] ***and I*** *got the idea to add this new item to the machine. And once we have that we have maybe we do the measuring and then we can do the analysis."* (Researcher Omicron at Omicron program meeting; emphasis added)

In teaming up, the researcher uses the authority of the program leader to back up the value of his proposal. When a senior researcher in the public subsequently starts asking the presenter questions, inferring doubt about the correctness of the research, the program leader jumps in: *"So what you are saying is that..."*. He paraphrases the senior researcher, eliminating the question and then adds some clarification to the presentation. The presenter, with his initial referral to the program leader (*"Hank and I got the idea..."*), prepared this opportunity for the program leader to offer him additional support during Q&A. Presenter and program leader, both academics, stand united, which adds weight to the presentation. Of course, this is an add-on for the program leader, as a better valuation rubs off on him as it is his responsibility as a chair to enable an interesting meeting. In Phi, the same dynamics happen between supervisors and their PhD students as it is of course in the interest of the supervisor that the work of their PhD student is valued by the public.

Implication

The routines, or "knowable" organizational activities (Lehtinen & Pälli, 2011) described above shape the discourse of these open innovation meetings. The set-up of the meeting with academic presentations suits the "traditional" view of academia as a service or data provider: academics are invited to the stage to show what it is that "they" can do for "us" as efficiently as possible. It is symptomatic of an industry–academia relation where the university or research centre mainly provides research services and where contractual obligations determine what the supplier should deliver (Schmoch, 1999). It seems strange though that such a formal agenda mainly constituted of presentations is always set up by the academic project leader or by the governmental intermediary. However, old habits die hard; if meetings were always organized in this way, it can be convenient and self-evident to keep doing what has always been done. Habits are grounded in history, which is, in turn, an important part of identity. The meeting set-up allows academia to "act in character" (Goia, 2013) and carry out those actions that are grounded in the old role division. This brings us to a second explanation for this set-up; it is custom for academia to take up a critical role. *"In academia you always look at what is wrong, that's how science becomes better",* one of the interviewees remarked. So, with this meeting set-up academics act upon their core values (Goia, 2013) and do what they know best; trying to prove the solidity of scientific research by enabling questions and critique. However, in such an interdisciplinary, interorganizational setting, where academic value is measured by its commercial perspective, this set-up puts academics in a position where the value can be yanked out from underneath their contribution to the collaboration.

Towards a Partnership

There is also a different dynamic at play that allows a transformation of identity of the academic partner or at least accommodates a stage of liminality. Participants use the institutional characteristics of meetings as an opportunity to manage how they want to be perceived in relationship to one another, in other words, to manage their identities. We argue that the ability to use these characteristics requires a sense of critical discourse. By this, we mean that the speaker not only recognizes certain linguistic features as characteristics of the discourse, including relations of unequal power

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(Koller, 2017), but also knows how to use those linguistic features to mold the social relationship of the collaboration. We will discuss three interactional patterns – providing purpose, joint alignment, and motivation – that occur during the meetings and explain how and why these patterns further shape the identity of academic partners by giving them a sense of empowerment.

Providing purpose

We have already discussed the relative power of the chair when we talked about teaming-up among academics in the previous section. Here, we describe how the chair uses their role to play with the relative power of industry and academia in the meeting. We focus on the opening sequence of a Phi user meeting hosted by Rick, the industrial partner, at the home industrial site:

> Rick: *"First of all, wishing you welcome here. And, you already found the refreshments in the back. Okay... well thank you...* [1.2 seconds pause]*... ehm, so I want to... eh, to kick off... eh, this meeting...* [1.4 seconds pause]*... ehm, and Bernard and, eh, Jeff... eh, asked me to, to also give a short, sort of introduction, into, as to why our company again was interested in this... eh, so why are we doing this together."*

Although we may expect the academic project manager to be the chair of the meeting, Rick takes the pivotal role (Levinson, 1992) of opening the meeting – a position that grants him with fundamental rights to the floor (Nielsen, 2010). In his hesitation (pauses and "ehms"), and by him adding that he was asked to do so, he shows *awareness* about the unconventionality of his role at this particular moment. Rick tries to avoid the impression that he is out of place taking the lead and thereby recognizes his academic partner. Rick goes on to remind the attendees about the purpose of the collaboration:

> Rick: *"And the reason obviously comes from our customers in the semi-conductor industry. We have two... road maps towards serving our business unit electronics customers. So that is our prime direction, the second direction is... suppose this won't work, what do we do then?"*

Explicating the "why" is an important way to haul in the academic party as a partner, without whom the goals cannot be met. Expressing (ethical) commitment and the importance of making a difference in society contributes to building a relationship with internal and external stakeholders (Norlyk, 2012). Although perhaps it is too far-fetched to label Rick's introduction as showing ethical commitment, he does show how the group (internally the industrial partner and externally the research institutes) can make a difference:

> Rick: *"Currently this technique in semi-conductor, even in research labs, is hardly ever conducted. The main reason for that is that the technique is difficult and time-consuming, so if we can alleviate that and make it easy and quick then it becomes a much more viable technique to be used in practice in the semi-conductor industry as a more routine tool rather than a specialized tool."*

Rick takes leadership as he identifies and communicates the corporate and organizational purpose (Norlyk, 2012). This creates *a group* of the attendees, as he implicitly says that making this possible is the responsibility of the project team. However, he uses reported speech rather than paraphrasing what it is that the customer wants, thereby distancing himself somewhat from the purpose of the collaboration. By clearly stating that it is the *customer's* wish, he avoids being seen as laying down the law himself:

> Rick: *"So the data has to adhere to certain requirements. But it is something that they say: 'Well, actually, we are not that interested in this technology per se. It would for us already be sufficient if we have the other method available.'"*

He is not the one who set up the criteria and created the difficulties for academic participants:

> Rick: *"We need to feed the semiconductor industry with a constant flow of innovations and while still of course keeping this end goal in mind. So that also means that we* [the company] *will collaborate with you guys more directly than we normally do.* [1.4 seconds pause] *for instance... eh, the institute is already feeling the pain from that you know with me telling Chass* [a PhD student] *not to use a certain toolbox* [laughter] *because it* [laughter] *makes it more* [laughter] *difficult for* [laughter] *me to change it in our commercial software, but that is, yeah, that is the way we really want to work now eh... together."*

Rick expresses his understanding for things not being ideal, but reminds everyone that it is *"the way we really*

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want to work now". Note the fact that Rick adds *"together"* at the end of the sentence (while grammatically we would have expected this word before *"now"*), and it is as if, by adding this, he wants to make sure that everybody feels included. His apologetic tone, marked by the interjected laughs and him distancing himself from the customer's demands, compensates for the elements of strong definitory power held by a leadership discourse (Norlyk, 2012). He anticipates the possibility of resistance or face-threat and gives voice to the power relation in place (*"you know with me telling Chass not to use a certain toolbox"*), thereby recognizing the possibility that academia may find it hard to collaborate like that. It gives recognition to academia as a partner rather than a service provider in the sense that a partner has equal rights to agree with or protest against a certain way of working.

Joint realignment

Having examined the openings of the meetings, we presumed that the closings of the meeting provided equally important opportunities to recapitulate the value and purpose of the collaboration. Such "morals" or "lessons" (Schegloff & Sacks, 1973) frequently appear in closing sections and could provide the attendees with a sense of satisfaction or purpose. However, all of the observed "closings" of meetings went rather abruptly with the chair thanking attendees for their presence. Instead, we observed a frequent reassurance and realignment of the goals and direction of the project throughout the meetings of Phi. During, but also outside Q&A, participants are allowed plenty of time for exploration and "if-then" thought experiments. Users are explicitly given the opportunity to explore further technical possibilities (*"I think even further, this might also help you to find the other measurement."*) and project members think out loud about alternatives for currently presented techniques (*"So, let's say that this is the case, would it be possible to find another way to get the same result?"*) or consider why there might be a lack of solutions (*"Oh, so I guess that this is the reason that you are not able to get rid of the defect."*). Based on the discussion and following this kind of input, participants jointly decide if a different path should be taken in the research project (*"This is interesting, so we could also consider to go with that. This could be a winner!"*), or try to clarify the initial path taken:

> *"I have another question, because, if we do it that way, we need some software, but I'm kind of missing that here, and I am not so sure. I thought that would be a part of this project, so I'm not sure who is going to tackle that problem. Because I entirely agree, at the end of the day, that's the only way we will get to our goal."* (Director of Research & Technology – responsible for innovation strategies at the industrial partner of Phi – at user meeting Phi)

This form of realignment stands in sharp contrast to what we have witnessed in the third case where realignment was the result of a one-sided expression of control by the industrials in the meetings. Questions about responsibility and tasks were more often than not met with silence from the academic partner and led to frustration about the dominant style of the industrials (De Maeijer et al., 2017). Here, however, such points are often well received (*"I do – it's a very good point. It was very implicitly originally in what we've discussed and it's sort of not explicit anymore."*) and representing project members jointly realign by stipulating who takes responsibility (*"I think that's definitely something that is on, let's say, on our desk in Amsterdam."*) and how progress should be maintained (*"So, hey, if you feel there is a constraint at this moment, just raise a flag and say we feel this is a constraint, but don't stop thinking about solutions on your side because you think there might be constraints on my side."*).

This dynamic in the meeting is remarkable for two reasons. First of all, when people have to achieve things quickly (e.g., because of a short time to market), they may feel the need to get on with the task and to postpone discussions (Perlow & Repenning, 2009). Furthermore, openly doubting the correctness, plausibility, or effectiveness of a solution, or pushing an agenda that "isn't yours" increases the risk of face-threats to other participants. However, conditionality (i.e., if-then constructions) and hedges (*"Now, I'm brainstorming, so if I say nonsense, please correct me."*) are used to avoid such face-threats. Secondly, this dynamic shows that there is room for uncertainty while it is the presumed enemy of commercial viability. Uncertainty about the extent of the technical possibilities, about whether something can be done or not, is not accounted to the academic partner. It seems to be accepted that there is simply no certain evaluation of results possible. Hence, the decision-making process about the next step to take can only be done in joint discussion.

Motivation

The safety to have an open discussion provided in the meeting confirms that when team members are more agreeable and extraverted in their communication style that they are more likely to exhibit a willingness and

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eagerness to share knowledge (De Vries et al., 2006). To maintain such willingness, motivation plays an important role. In a concurring engineering process, small steps are made. This means that the bigger picture can disappear under pressure of technological uncertainty:

> *"There is a mismatch between what you would want, and what reasonably speaking is achievable. Of course, that is always the case in research, but that makes it harder to create enthusiasm with each other. Owing to the fact that we are dealing with such small blocks of work, we could lose some enthusiasm."* (Project leader Phi)

Such conditions, described in research on creative work environments as dynamic "full speed", "go", and "breakneck" (Ekvall, 1996) create a need for leaders to energize their employees to be able to thrive. We distinguished the presence of "leading individuals" who apply a leadership discourse – combined with power-reducing strategies to assure that project members experience positive interaction with others – essential for staying motivated:

> *"Thank you for coming. I thought you had a very nice presentation. Now it has suddenly become clear what we want to look at. Nice, nice."* (Partner from research centre in Phi at user meeting Phi)

> *"Maria spent four days fine-tuning results. We've seen them – they are really excellent. Spot on for us.*" (Industrial partner in Omicron at user meeting Omicron)

Leaders show openness to new ideas (as we have seen in the paragraph on joint alignment), value individual contribution to the work task, show confidence in those individuals, and provide constructive feedback (Amabile et al., 2004). When Eric, the industrial partner in Omicron, was asked for the motivation behind his contribution, he said: *"I try to make contact, regardless of the direct or indirect relevance of the input for me."* In a setting where getting results is not a nine-to-five business, and where *"academics get stressed when they get asked 'how are things going?'",* one can imagine that confidence and approval for efforts, rather than for results can be essential to keep people motivated to contribute.

It has to be noted that this analysis seems hard to rhyme with analysis of the speaker–listener dynamic typical for a meeting set-up with presentations as a means to maintain the old hierarchical role division between industrials and academia. However, Eric is found to engage in status-reducing interactional strategies such as the use of self-deprecating humour (Angouri & Marra, 2011) in combination with expressions of confirmation and appraisal:

> Eric: *"In fact, that's one of the reasons we hired Maria, to understand ourselves what's happening* [Laughs]. *No offense to the people we have already but it is – it should bring it on a higher level."*

Hierarchy is implicit and accepted, but played down in the interaction to emphasize a sense of a team (Angouri & Marra, 2011):

> Eric: *"This is what the alpha system looked like yesterday.* [Shows slide of dismantled equipment] *Any scientist would say that looks pretty good. You see some aluminum foil. Some measurement equipment. Some heating stuff. It's working."*

Eric seems to mock or stereotype academia, but by showing the slide, he bridges the gap between science and industry; the dismantled tool is not a slick, commercial product, but resembles the scientific experiment on the scientist's desk. In the recognition of the image, Eric playfully triggers interest, which can increase individuals' capacity to think and act in the moment. (Dutton & Heaphy, 2003). Positive emotions of joy and interest, in turn, facilitate more open, resourceful, and flexible cognitive processing as well as a more complex cognitive context, both which are essential for problem solving and creativity (Isen, 1999, 2004). It takes critical discourse awareness to be able to create such a positive, yet nuanced leader–member connection.

Conclusion and Practical Implications

The strictly managed set-up of the investigated meetings is grounded in the historical relationship between industry and academia. The set-up brings expectations about the roles and identities that partners take in relation to each other; academics are service providers who are allowed to provide value on the benevolence of the industrial. However, we found leading individuals with a sense of critical discourse awareness who are able to employ the institutional roles of the meeting to manage the dynamics of the collaboration by providing the attendees with a joint purpose, empowering them to think along, and motivating them to openly share pro-

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gress. This results in a power shift: academics and industrials jointly (re)determine the course of the project and academics no longer solely bear the burden of technological uncertainty. This also means that academics are now free to pursue their own agenda. Both project leaders from Omicron and Phi can be found, for example, to ask for assurance that students have enough real-life material to work with or machine time available. Joint publications are pushed by the project leaders and, in both projects, this academic assertiveness can count on the explicit approval of the governmental intermediary during the meeting. Exemplary for the emancipation of academia is the project leader of Omicron, who explicitly limits the industrial partner advertising his product in the Omicron program meeting ("*This feature is not on this machine, but in the future we will...* [cut off by project leader]") as this does not match the "academic" setting of the meeting (*"Yeah, yeah, yeah, so the future will be much nicer."*)

Our findings suggest that the practice of industry–academia open innovation cannot be described as a simple dichotomy between industry and academia as much of the literature seems to suggest. On the one hand, there is still the tight grip of a relationship dominated by industrial instrumentalism. The acceleration of the market favours an instrumental, quick "thumbs-up, thumbs-down" approach, and meticulous time management allows for a smooth running of the collaborative process, but it does not necessarily stimulate open and fearless sharing of ideas. On the other hand, we have seen academia (re)claim the floor, facilitated by the presence of leading individuals. Their rhetorical choices, which we associated with a leadership discourse, provide a framework in which there is both the time and preparedness to discuss technological uncertainties. We argue that this relative ignorance allows for a process of serendipity to take place (MacDonald & Piekkari, 2005). In the process of thinking along (Berends et al., 2011), ideas can emerge to further investigate unexpected applications or theoretical insights. If necessary, such discussions are followed up with joint realignment. This emancipatory process can benefit the knowledge-creation process.

Our research hence adds nuance to the idea that it is useful to have strong and senior industrials on board that know the company very well to understand its business needs, know how to access and assimilate external knowledge, and build partnerships with various partners (Vanhaverbeke et al., 2017). When we want to stimulate industry–academia open innovation, the presence of strong individuals, academic or industrial, who understand the discourse of joint knowledge creation with its inevitable relational dynamics grounded in presuppositions, fears, norms, and values of the participants is equally if not more important. We thus suggest a focus on the process rather than the conditions, on creation rather than assimilation, and on leadership rather than management, both in practice and in literature.

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...continued from previous page.

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When a New Platform Enters a Market, What Is the Impact on Incumbents?

Andreas J. Steur

> *"Platforms beat pipelines because platforms unlock new sources of value creation and supply."*
>
> G. G. Parker, M. W. Van Alstyne, and S. P. Choudary
> In *Platform Revolution* (2016)

Digital platforms enable new forms of business models with the potential to disrupt and transform many industries. However, the impact of a platform's market entry on incumbents has not been taken into account. In this article, our objective is to provide evidence of the impact that a platform's market entry could have on incumbents. We proposed several hypotheses based on a literature review and then evaluated them using a large dataset from the taxi industry in New York City. Our analysis showed several changes after a platform's market entry. In contrast to previous understanding, the results indicate that the winner-takes-it-all-effect does not generally apply to the competition between new platforms and incumbents. Regarding the date of changes following a platform's market entry, we observed a chicken-or-egg problem in the competition between a platform and incumbents. Consequently, our results indicate that incumbents have at least one year to react to the market entry and to make adjustments.

Introduction

Increasingly, digital platforms are being introduced into existing markets to complement product customization, digitization, the embedding of software into existing business activities, the Internet of Things, and the ubiquitous availability of the Internet (Tiwana, 2014). Indeed, most companies with a large market capitalization, such as Apple and Alphabet, run platform business models (Parker et al., 2016). These business models are often eliminating existing market entry barriers and, due to unleashing network effects, are changing the existing business environment as well as the competition in these markets as a result of rapid growth (Choudary, 2015; Tiwana, 2014). Some impacts of a platform's market entry on established companies are known based on case studies. However, there is no general understanding of these effects in current literature and practice.

Currently, there is no generally accepted definition of digital platforms. One definition characterizes platforms as "products and services that bring together groups of users in two-sided networks" (Eisenmann et al., 2006). In contrast, another definition focuses on the interactions of platforms: "a platform is a business based on enabling value-creating interactions between external producers and consumers" (Parker et al., 2016). Platforms are based on the idea of an ecosystem in which the participants of individual market sides can interact (Gawer & Cusumano, 2014; Tiwana, 2014, Van Alstyne et al., 2016). Platforms have to be differentiated from pipelines and business ecosystems (Adner, 2017; Muegge, 2011; Van Alstyne et al., 2016). A pipeline controls and optimizes its internal resources and is characterized by a material flow towards the customer (Van Alstyne et al., 2016). In contrast, business ecosystems are the organization of external actors (Muegge, 2013). These actors interact and have a defined position and functions within the ecosystem (Adner, 2017). Platforms are defined by the organization of things (Muegge, 2013) that are characterized by mutuality, interaction via the digital infrastructure, network effects, and the coordination of external resources (Armstrong, 2006; Brousseau & Penard, 2007; Rochet & Tirole, 2003; Tiwana, 2014; Van Alstyne et al., 2016)

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So far, the literature has focused on the above-mentioned characteristics. The impact of a platform's market entry on incumbents, which are companies established in the market without any platform-based business models, has not been taken into account. In addition, it is well known that network effects do not occur until reaching critical mass, but it is not clear whether the impacts within the competition are delayed. Here, we aim to develop an understanding of the platform business model and its environment by asking two questions: What are the effects of a platform's market entry on incumbents? Do these effects occur immediately or with a time delay?

The article proceeds as follows. First, we examine the literature to identify what is known about the impacts of a platform's market entry on incumbents. Our literature review focuses on selected cases, its effects on incumbents after a platform's market entry, and explanatory approaches from the field of industrial economics. Based on the results of the literature review, we deduce hypotheses. Then, we describe the analysis methods to identify changes following a platform's market entry. Finally, we verify the hypotheses and discuss the results to analyze the impacts of a platform's market entry on incumbents.

Impacts of a Platform's Market Entry on Incumbents

A platform's market entry is associated with many effects on the incumbents. The winner-takes-it-all effect is one impact that is discussed in the literature regarding competition between platforms. This effect implies that, due to unleashed network effects acting over time, only one platform survives and the other competing platforms are pushed out of the market. Consequently, the surviving platform occupies a position similar to a monopoly. This type of dominance is commonly observed in markets where suppliers and customers each only tend to participate in one platform – so-called single-home markets. However, first-mover advantage is not of great importance in achieving this market position (Eisenmann et al., 2006; Sun & Tse, 2007). This displacement only refers to the competition between platforms, but it can be observed in competition between a platform and non-platform incumbents. For example, following Amazon's (amazon.com) and eBay's (ebay.com) market entry, non-platform incumbents were displaced by the platform-based newcomers (Hotz & Fost, 2017; Täuscher et al., 2017). Due to network effects and the coordination of external resources, platforms have advantages in competition with linear value-creation models, which are also called "pipes". Therefore, we assume that, over the long term, the platform will succeed in the competition between platforms and non-platform incumbents. Consequently, we introduce our first hypothesis.

> ***Hypothesis 1:*** *The winner-takes-it-all effect occurs in the competition between a new platform and incumbents.*

To identify further impacts, we use models from industrial economics. Therefore, we consider basic models and state strategic possibilities to react to after a platform's market entry. Before the platform enters the market, the incumbent has a market position similar to that of a monopoly and occupies the entire market. In this case, the price set by the incumbent is higher than its variable costs. When the platform enters the market, the competition changes. In general, a platform does not have a capacity restriction. Therefore, we assume that a platform and incumbents are in a price war. For reasons of practicability, we expect that, after a platform's market entry, there will be two symmetric companies. This implies that both competitors have identical variable costs c and fixed costs F. The cost structure, which depends on the sales volume q, can be approximated with the following function: $K(q) = c \cdot q - F$. Both companies choose an equilibrium price equal to the variable costs and achieve losses equal to the fixed costs (Bertrand, 1883; Tirole, 1999). This equilibrium price is lower than the price of the basic model. The lower price can be seen in the example of the market entry of Craigslist (craigslist.org), an online classified advertisement platform that competes with newspapers. The price of newspaper advertisements declined following the market entry (Seamans & Zhu, 2010). Consequently, we introduce our second hypothesis.

> ***Hypothesis 2:*** *A platform's market entry causes a price decrease among incumbents.*

Considering the competition of two symmetrical companies, the platform and the incumbent share market demand equally. Before the platform's market entry, there was a monopoly and the incumbent satisfied the entire market demand. Therefore, the incumbent's sales volume decreases after a platform's market entry (Tirole, 1999). This effect was recognizable after Uber's (uber.com) ride-sharing market entry in Chicago, where the taxi industry (i.e., the non-platform incumbents) suffered a decrease in trip volume following the platform's market

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entry (Wallsten, 2015). Similarly, a decrease in sales volume occurred in the competition between Craigslist and newspapers (Seamans & Zhu, 2010). As a consequence of the described effect, we introduce the next hypothesis.

> ***Hypothesis 3:*** *A platform's market entry causes a decrease in incumbents' sales volume.*

A platform's market entry changes the situation from a monopoly to competition between two symmetrical companies. Due to lower price and sales volume, the revenue and profit of the incumbent decrease (Tirole, 1999). Airbnb's (airbnb.com) market entry in Texas is an example of this effect: the revenue of hotel businesses declined following the market entry of Airbnb's online marketplace and hospitality service (Oskam & Boswijk, 2016; Zervas, 2017). Consequently, we introduce our fourth hypothesis.

> ***Hypothesis 4:*** *A platform's market entry causes a decrease in incumbents' revenue.*

Eventually, the competition between a platform and an incumbent will no longer fit with the model of two symmetric companies. Due to the coordination of external resources and the unleashing of network effects, a platform has almost no variable costs (Evans & Schmalensee, 2016; Van Alstyne et al., 2016). Consequently, the competition would be better approximated to a model of two asymmetric companies. The only difference between this model and the model of two symmetrical companies is the diverging variable costs. In this kind of competition, a platform sets a price higher than its variable costs and lower than the incumbent's variable costs. It is not profitable for the incumbent to set a price lower than its own variable costs, as the incumbent's losses would be higher with each unit sold. In the equilibrium, the platform serves the entire market, while the incumbent no longer sells anything. As a result, the platform has a higher equilibrium sales volume and a higher profit, while the incumbent continues to make losses in terms of fixed costs (Tirole, 1999). These changes support the effects introduced in hypotheses 3 and 4.

In addition to discussed models, incumbents can react by choosing the strategies of cost leadership or differentiation (Porter, 1998). If an incumbent reacts by choosing cost leadership, it will reduce their variable costs. On the basis of competition between symmetric companies, the incumbent would try to achieve lower variable costs through higher quantities. To achieve this, the incumbent would set lower prices than in the basic model and try to satisfy the entire market. This type of competition is comparable to the model described between two asymmetric companies. In this case, however, the incumbent has lower variable costs (Tirole, 1999). This strategic choice supports hypothesis 2. Another strategic possibility for incumbents is differentiation, which can be vertical or horizontal (Shy, 2010). Horizontal differentiation implies divergent features or locations. The hotelling model is an approach from industrial economics declaring horizontal differentiation. In the case of differentiation, both companies choose a higher equilibrium price and gain higher profit (Hotelling, 1929; Tirole, 1999). Based on a positive effect of horizontal differentiation on incumbent's profit, we introduce hypothesis 5.

> ***Hypothesis 5:*** *A platform's market entry causes horizontal differentiation as a strategic reaction.*

Within vertical differentiation, incumbents react by choosing higher product or service quality. Therefore, incumbents can set higher prices. The hotelling model can be used with adjustments for vertical differentiation. This model also illustrates higher equilibrium prices and higher profits (Shy, 2010; Tirole, 1999). Due to the positive effect of the choice of vertical differentiation, we introduce hypothesis 6.

> ***Hypothesis 6:*** *A platform's market entry causes vertical differentiation as a strategic reaction.*

Network effects are propagated as an essential advantage of platforms. However, these effects only occur after reaching a critical mass or tipping point, which means that this is a chicken-or-egg-problem (Chaillaud & Jullien, 2003; Evans & Schmalensee, 2016; Tiwana, 2014). Since there are no network effects within the incumbent's business model, they can represent a kind of competitive advantage of the platform. Due to the influence of the network effects after reaching critical mass, the changes caused by the platform's market entry on incumbents only appear after successful scaling. Therefore, there is a time delay in the occurrence of the changes, which leads us to introduce hypothesis 7.

> ***Hypothesis 7:*** *The impacts of a platform's market entry on incumbents occur with a time delay.*

Summarizing, there are several effects following a platform's market entry. In the next section, we describe the methodology for testing our hypotheses using the example of the taxi business in New York City.

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Method

After developing hypotheses regarding the expected changes caused by a platform's market entry, we now illustrate the data preparation and analysis method.

We analyze the taxi market in New York City for changes after Uber's market entry. For the empirical analysis, we use an open dataset of yellow and green cabs from January 2009 to June 2016, which is provided by the New York City Taxi and Limousine Commission. The dataset includes a population of approximately 1.3 billion taxi trips with a database size of 210 gigabytes. Consequently, we developed a Java program to aggregate and analyze the dataset. The program aggregates the values of a single trip on a daily basis. For a detailed analysis and for more accurate results, the pickup locations of single trips are assigned to district boundaries. Polygons are used to approximate these boundaries. For more information about the trips in the downtown area, we divide Manhattan into the North of Manhattan and downtown. Our partitioning is similar to that of the taxi and limousine commission between yellow and green cabs. To the West, the border runs along the 110th street North of Central Park, to the East along the 96th street (TLC, 2017). In addition to the individual districts, we consider both airports. The borders of the districts are illustrated in Figure 1.

The empirical analysis is performed by means of a time series analysis. With regard to our analysis, we ignore seasonal and cyclical trends. Therefore, the considered model of time series analysis is only depending on temporal changes. We verify changes after Uber's market entry in New York City and the time of change utilizing structural breakage test. If there is any impact following Uber's market entry into the individual endogenous variables, there should be a structural break since the market entry. Therefore, two different splines within the same model with different coefficients would fit the actual development better than a regression line (Hackl, 2013). There are many statistical tests for structural breaks. Due to the propagated chicken-or-egg problem, changes can occur with a time delay (Caillaud

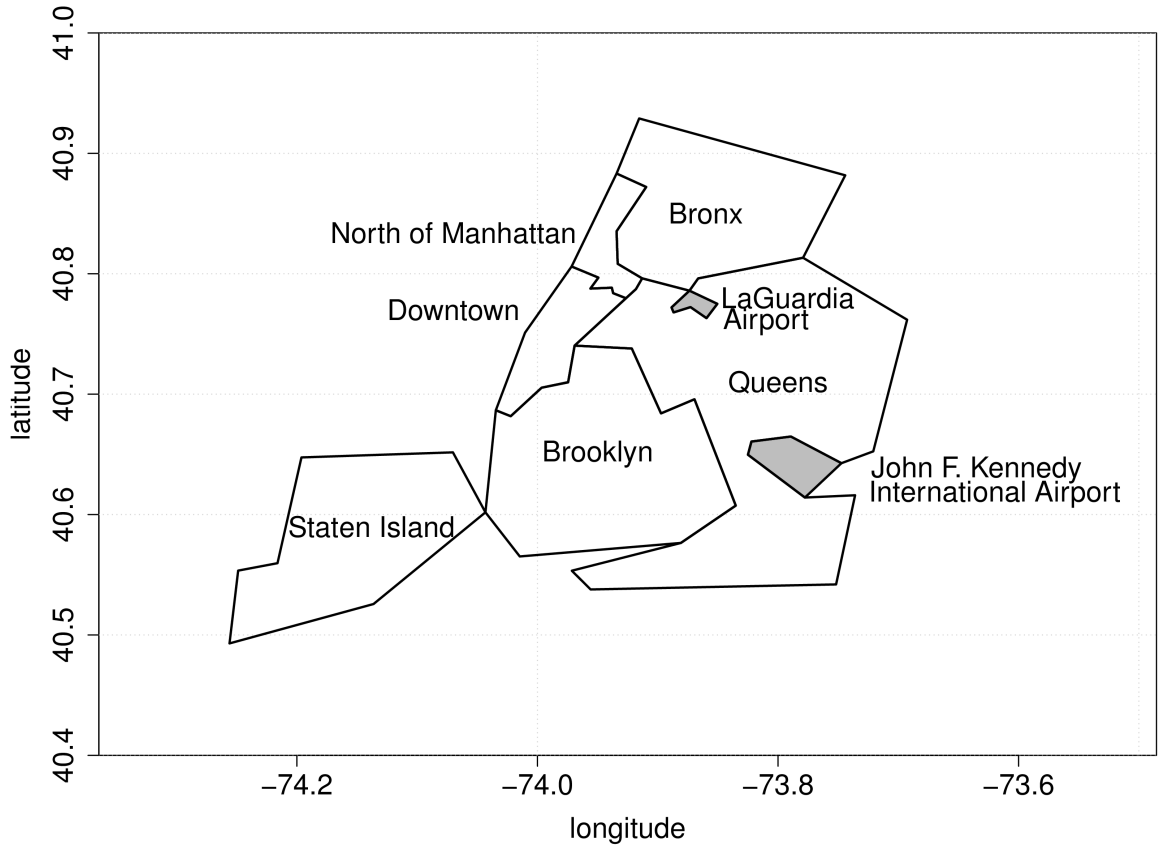

Figure 1. Polygons of New York City's districts

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& Jullien, 2003; Tiwana 2014). Due to an unknown change point, we use a method based on Bai (1994) to identify the optimal breakpoint. The method is a special case for determining unknown structural breaks and a test procedure such as the Quandt-Andrews test (Bai, 1994), which is used for a limited time interval of 15% to 85% of the entire observation period (Andrews, 1993). In addition, we use the Chow test to check whether the true values can be better approximated using two linear regressions than with one regression line at the identified breakpoints (Chow, 1960). Following the structural breakage tests, we identify the two splines and address the changes between both splines. The changes are assessed as follows. If there is a significant positive or negative shift of the spline after the structural break, the change is evaluated according to the shift direction. In addition, we consider the gradients of the splines. If the gradient of the splines changes from a positive to a negative value or the gradient of the splines decreases significantly, there is a negative effect after the market entry. If the gradient of the splines changes from a negative to a positive value or the gradient of the splines increases significantly, there is a positive effect after the market entry.

Due to the data basis, the variables sales volume, horizontal and vertical differentiation cannot be extracted and analyzed directly. For the approximation, we use the following variables. The sales volume is tested by using the number of trips and the total distance. We approximate the vertical differentiation by using paid tips, thus the quality of the trip, the condition of the car, and the safety of the trip influence the paid tip. In order to investigate the horizontal differentiation, we examine all districts of New York City for changes in price, sales volume, and revenue. In order to examine the validity of the winner-takes-it-all effect, the results of hypotheses 2–6 are considered. If there are negative impacts on price, sales volume, and revenue, as well as no strategic reaction such as horizontal and vertical differentiation after a platform's market entry, the winner-takes-it-all-effect occurs in the competition between a platform and incumbents.

Results

In order to analyze the effects of a platform's market entry on incumbents, we carried out a structural breaks analysis in accordance with Bai (1994) and Chow (1960). In addition, we verified the date of structural breaks and the type of changes.

Within our analysis, we identified structural breaks for all variables. Using the Chow test, the null hypothesis at a significance level of $\alpha = 0.001$ was rejected for all variables within all districts, so that a structural break exists at the identified breakpoints. Breakpoints of trips in John F. Kennedy International Airport and Staten Island, total distance in John F. Kennedy International Airport and LaGuardia Airport and trip distance in John F. Kennedy International Airport and LaGuardia Airport occurred before Uber's market entry. Using the described approach, there were positive effects on the price recognizable in downtown, LaGuardia Airport, and Staten Island. In the other districts, there were negative changes of the price following the structural breaks. Across the entire city, we observed positive effects on price. The analysis of the number of trips showed negative effects for downtown and La Guardia Airport, while there were positive changes after the market entry in the Bronx, Brooklyn, the north of Manhattan, and Queens. Regarding the total distance per day, there were negative effects for downtown. For all other districts, there were positive changes on the total distance. We saw negative effects for the number of trips and the total distance for the entire city. In Brooklyn, the Bronx, the north of Manhattan, Queens, and Staten Island, there were positive changes in revenue following the breakpoint. For trips starting in downtown and both airports, there were negative effects on revenue. The same applies to the entire city. In Brooklyn, the Bronx, the north of Manhattan, and Queens negative effects appeared on paid tip following the market entry. In downtown, Staten Island, and both airports, there were positive changes recognizable. For the entire city, there were positive effects on paid tips. With regard to single trip distance, we observed negative changes following the breakpoint. Table 1 summarizes the results of our analysis.

Discussion

Our analysis of prices after Uber's market entry showed obvious changes. For all districts, apart from the Bronx, there was a structural break at September 2012. In the Bronx, the breakpoint was observable one year later. Since September 2012, taxi drivers in New York City can charge a higher price to their passengers. The price of a single trip is fixed on several parameters such as the travelled distance and the duration of the trip. Therefore, the price changes indicated a change in those parameters. In general, an increase in price could be assumed. This increase took place after Uber's market

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Table 1. Overview of results

	Price	Trips	Total Distance	Revenue	Paid Tip	Trip Distance
Bronx	negative	positive	positive	positive	negative	negative
Brooklyn	negative	positive	positive	positive	negative	negative
Downtown	positive	negative	negative	negative	positive	negative
JFK Int. Airport	negative			negative	positive	
LaGuardia Airport	positive	negative		negative	positive	
North of Manhattan	negative	positive	positive	positive	negative	negative
Queens	negative	positive	positive	positive	negative	negative
Staten Island	positive		positive	positive	positive	negative
New York City	positive	negative	negative	negative	positive	negative

entry. Official reasons for the price increase were higher cost of living and increased gasoline prices (TLC, 2012). These might not be all the reasons for the price increase. Due to Uber's market entry, the competition in the transportation business could be harder. Consequently, the taxi and limousine commission decided to introduce higher prices. In summary, we identified decreases and increases of prices following Uber's market entry. Therefore, hypothesis 2, which implies a price decrease following a platform's market entry, was rejected.

Another propagated effect is a decrease in sales volume. To analyze this effect, we considered the number of trips per day and the total distance per day. Within the number of trips and the total distance, there were structural breaks for all districts. Breakpoints of the number of trips occurred before Uber entered into the market at John F. Kennedy International Airport and Staten Island. For trips starting from John F. Kennedy International Airport and LaGuardia Airport, the breakpoints of the total distance appeared before Uber's market entry. For all other districts, changes were obvious after more than after more than two years and seven months following Uber's market entry. In summary, there were positive, negative, and no changes of sales volume following Uber's market entry. Consequently, hypothesis 3 was rejected.

Regarding revenue, changes occurred between one year and four months and two years and ten months. Since there were negative changes in downtown and at both airports compared to positive changes in the other parts of the city and there were negative changes in turnover across the entire city, this indicates the importance of trips starting downtown. The dates of the structural breaks in the revenue of the trips departing from John F. Kennedy International Airports, LaGuardia Airports and downtown were the same as the dates of the price adjustment. The dates of the structural breaks in the revenue of the entire city and the districts of the Bronx, Brooklyn, the north of Manhattan, Queens, and Staten Island were the same as those of the changes of sales volume. This was not surprising, as revenue is based on the product of sales volume and price. Due to positive changes in most districts, hypothesis 4 was rejected.

Following a platform's market entry, vertical differentiation is a possible reaction by the incumbent. We used paid tips to approximate this potential effect. In the Bronx, changes were recognizable in November 2013, and in Staten Island, they occurred in May 2015. For all other districts, structural breaks appeared in September 2012. The breakpoints were similar to those points of the price change. This indicates that the paid tip was dependent on the regular price per trip. Thus, there

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were positive and negative changes as well as the positive effects depended on price changes, so hypothesis 5 was rejected.

Another strategic reaction could be horizontal differentiation, which we analyzed using the single trip distance and the previously examined variables. Within these variables, we paid attention to common differences between individual districts. The changes of the single trip distance of both airports were negative, but the structural breaks occurred in 2010 and 2011 – before Uber's market entry. In summary, there was a shorter trip distance after Uber's market entry. Next, we took a close look at the variables price, number of trips, total distance, revenue, and paid tips. For most variables, we identified different changes in two categories of districts. In the first category, nearly all variables showed positive effects, whereas they were negative in the second category. Components of the first category were Brooklyn, the Bronx, the north of Manhattan, and Queens. Both airports and downtown are components of the second category. The different categories, as well as the changes in trip distance, indicated a horizontal differentiation after the market entry. Therefore, hypothesis 6 was not rejected.

To verify whether the winner-takes-it-all effect applies to the competition between a platform and incumbents, we analyzed changes in the entire city and those in each district following Uber's market entry. For the entire city, there were mainly negative changes observable. This indicated that incumbents were pushed out of the market. With regard to the individual districts, there were positive and negative changes for the analyzed variables. In particular, the horizontal differentiation and the positive changes in the Bronx, Brooklyn, the north of Manhattan, and Queens showed that some drivers focused more on those areas. Therefore, these incumbents focused on a market niche. Due to the methodology, we could not generally determine whether the negative effects of the whole city were equivalent to a positive development of Uber. However, as the company has grown to $50 billion USD in sales and distribution in more than 200 cities since its founding, it still points to this change (Parker et al., 2016). In summary, the winner-takes-it-all effect does not occur in the competition between a platform and incumbents in general, according to our results. Rather, incumbents are focusing on a market niche after a platform's market entry. Consequently, hypothesis 1 was rejected.

As a last effect, we considered the timing of changes, which are shown in Figure 2. The price changes varied between districts and variables and showed a range between almost one year and over four years following Uber's market entry. Price changes occurred one year and four months after the market entry. The breakpoints of the number of trips and the total distance were distributed approximately after two years and nine months. With regard to revenue, there was a higher variation in the timing of breakpoints. Some breakpoints occurred after approximately one year and four months (e.g., John F. Kennedy International Airport, Downtown, the north of Manhattan and Staten Island) and others occurred after approximately two years and nine months (e.g., the Bronx, Brooklyn, LaGuardia Airport, Queens, and the entire city). The breakpoints of paid tips occurred in almost all districts after one year and four months. Only the districts the Bronx (two years and six months) and Staten Island (more than four years) differ. The strongest variations of the breakpoints' timing exist in trip distance. The breakpoints occurred between almost one year (e.g., Brooklyn) and three years and six months (e.g., Downtown). The distribution of the breakpoints of the considered variables showed that the effects appeared with a time delay of almost one year. Consequently, there were also scaling problems after Uber's market entry. The scaling problem was solvable after reaching a critical mass. Thus, the platform grows independently (Chaillaud & Jullien, 2003; Tiwana 2014). Once a critical mass is achieved, the impact on incumbents becomes apparent. In the case of the taxi market in New York City, the impacts occurred with a delay of more than one year. Consequently, the practical implication is that incumbents have at least one year to react following the platform's market entry. The incumbents also have options in terms of how they react. For example, their business model can be transferred to a platform or further legal changes could be effected. Therefore, hypothesis 7 was not rejected.

In summary, we examined several hypotheses, and the results are summarized in Table 2. Hypotheses relating to horizontal differentiation as a strategic reaction and a time delay of changes were not rejected. The winner-takes-it-all effect was not proven. Rather, due to the horizontal differentiation, a displacement took place in a niche. We could not prove the reduction of price, sales volume, turnover, and vertical differentiation as a strategic reaction.

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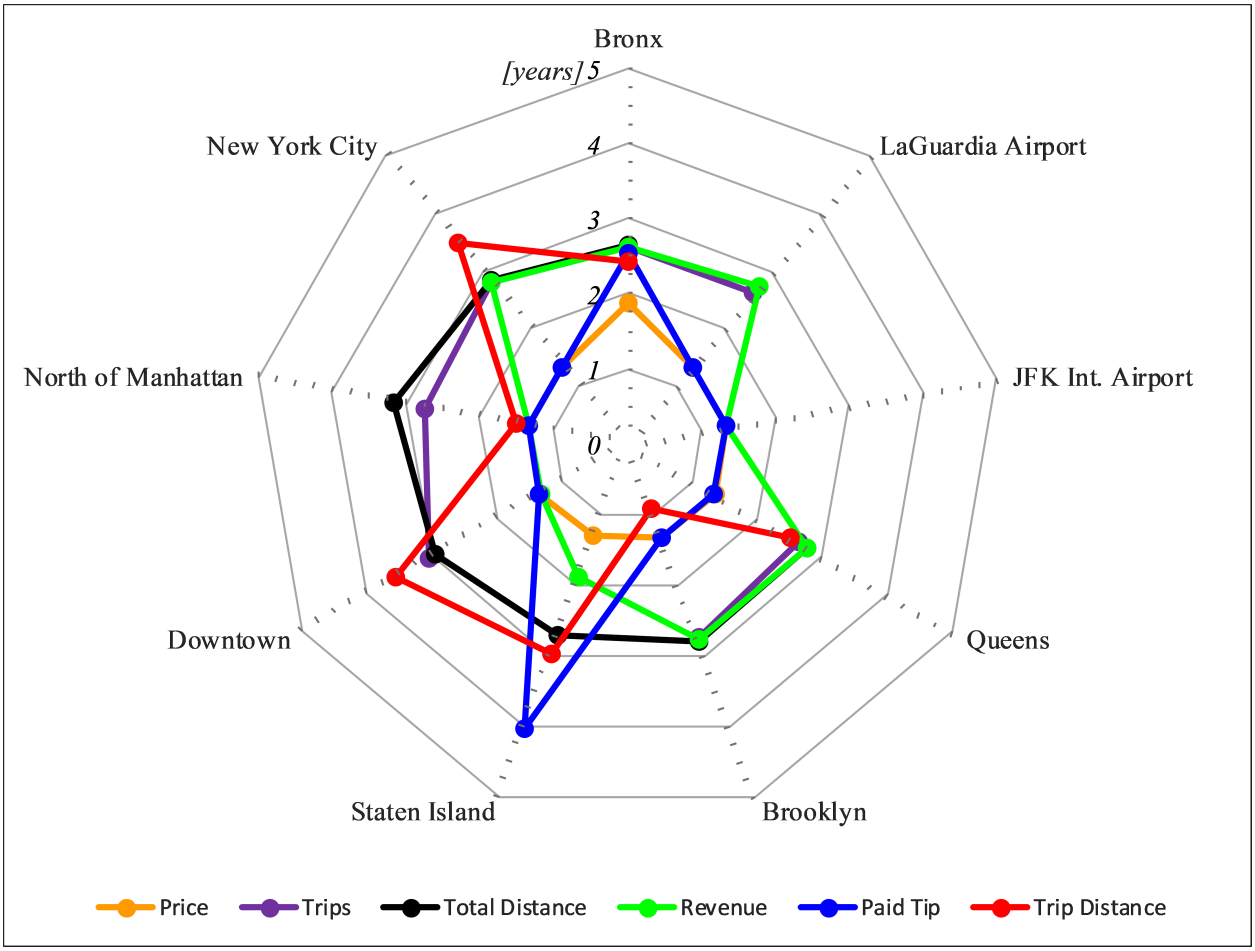

Figure 2. Number of days until breakpoints

Table 2. Measured impacts of a platform's market entry on incumbents

Hypothesis	Predicted Effect	Result
H1	Winner-takes-it-all	Rejected
H2	Price decrease	Rejected
H3	Decrease in sales volume	Rejected
H4	Decrease in revenue	Rejected
H5	Vertical differentiation	Rejected
H6	Horizontal differentiation	Not rejected
H7	Change time	Not rejected

Conclusion

The impacts of a new digital platform's market entry on incumbents are rarely considered in the literature. Our study adds a framework of impacts following a platform's market entry on incumbents and provides a detailed example using a large dataset. Additionally, we validate theories from the literature using time series analysis and structural breakage test.

The time series analysis showed changes after Uber's market entry. Within the study, the following hypotheses were not rejected. A platform's market entry causes a horizontal differentiation of the incumbents. The impact of a platform's market entry occurs with a time delay of more than one year. The following impacts were not verifiable. The winner-takes-it-all effect was not proven. Instead, the existing companies are focusing

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on a market niche. Hypotheses relating to declines in price, sales volume, and revenue as well as vertical differentiation were rejected.

The empirical results can be useful for companies that are afraid of a platform's market entry in their industry. For example, these companies can use the results of the changes identified for their strategic planning in order to react after a platform's market entry. For instance, the evidence about positive impacts after a platform's market entry can be useful for incumbents. Moreover, the established companies can profit from these results, which imply that there is a delay of at least one year.

Limitations include the practicable assumptions of the time series analysis and the structural breakage test. The calculated effects were tested in a city and within a business-to-customer context. In a business-to-business context, there could be higher market entry barriers and a greater need for technical know-how. As a result, scaling could further delay the impact in other areas and the extent of change may be different. For future research, we suggest an approach for predicting platform's tipping point to predict the timing of the changes after a platform's market entry. Furthermore, there is a need for research within industrial economics. More precisely, a game theoretical model for the competition between platforms and incumbents could be developed that takes into account multi-sidedness and the impact of network effects.

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