

Drivers of change impacting outcome-based business models in industrial production equipment

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Abstract. The objective of this paper is to explore the potential future changes on the value and feasibility of Outcome-Based Contracts (OBC) and Outcome Business Models (OBM) in the setting of industrial production equipment. As companies and industries are implementing these business models characterized by long value co-creation contracts, the impact of the world around changing is becoming both a risk as well as in other cases an opportunity for increased value creation. We conducted a futures research project with the emphasis in understanding the external changes impacting the value of the OBCs and OBMs for the contract parties. The paper contributes by highlighting the impact of Drivers of Change on OBCs for both parties as well as identifying a set of Drivers of Change for industrial equipment manufacturers and users.

Keywords: Outcome-based PSS, outcome-based contracting, Product-Service Systems, PSS, Servitization, Advanced Services, Pay-per-outcome, PPO, Pay-per-X, PPX, industrial production equipment, Drivers of Change.

1 Introduction

Outcome-based business models have become a topic of great interest in academic literature in the recent years [1]. New ways of sharing risk and benefits when offering and sourcing equipment have been taking shape in industries since 1970's [2]. Product-Service Systems (PSS), Advanced Services, Outcome-based Contracts (OBC) and Pay-per-X (PPX) business models have been researched in recent few decades [3]. Outcome- or Performance-based contracting can be limited to bonus/penalty schemes “on top” of traditional equipment sales or include the asset with which the outcome is achieved, depending on the field of study. The above research streams discuss different business models for delivering products with a business and revenue model that is based on the value that is co-created between the supplier and the customer [4].

Little emphasis has been put on investigating the impact of potential business changes that take place during these industrial PSS relationships, during the evolution of OBC-types of business models and during the lifetime of related equipment. This is especially relevant in industrial production equipment, one of the areas where these business models are utilized more and more, where there are large risks involved for

both customers and suppliers, and where the lifetime of the assets are often measured in decades. The aim of this paper is to dive into the potential business related changes that may take place during the life cycle of these industrial production equipment and impact the feasibility of the Outcome-Based Contracts (OBC) [1] in a setting where the equipment to deliver the outcomes is part of the contract.

Industrial production equipment have a long useful life, typically decades and are often critical within their usage process. This results in long OBC contracts where the supplier provides the equipment and services to keep the equipment running optimally. Consequently, the Outcome Business Model (OBM) through which the suppliers operate these machines is a long game – it needs to survive not only a few years but decades. This makes them susceptible to changes in the business environment which can impact the feasibility and value of the OBC and on a larger extent the OBM [5].

As we have seen in recent years through COVID-19, supply chain disruptions and Russia-Ukraine war, the world is volatile and uncertain [6]. Therefore, we need to better understand the life cycle perspective of the OBCs and OBMs. In this study we study the changes through Drivers of Change (DoC) studying how DoCs impact the feasibility of the OBCs and OBMs.

As individual OBC's success, and consequently success of the OBM is dependent on the dyadic value the contract and equipment deliver, changes in the external world may have an impact [4], [7]. The changes can happen on multiple levels from the production line or equipment levels to the global megatrend level and can have a compounding effect on the parties [8].

Futures studies literature shows that different environmental changes impact different industries differently [8]–[11]. Recent history also shows us that the impact of individual changes can have a compounding effect in the global supply chains – the component shortage caused by Covid-19 pandemic is an example of entire industries shaking due to a single ‘wild card’ event [12], [13]. On the other hand, changes can present new opportunities. The current global energy crisis is an opportunity for companies in energy generation and energy efficient equipment to their customers [14].

There is a significant gap in literature related to the futures studies and life cycle dimensions in OBCs and OBMs, especially regarding the industrial production equipment. Although many studies have identified the long life time of OBCs and a few individual risks that this may impose on the supplier-customer relationship, none to our knowledge have researched the themes and potential changes that may impact the feasibility of the OBCs and OBMs in the context of production equipment.

To answer the research gap, we formulate our research question to:

RQ: Which potential Drivers of Change impact the feasibility of the Outcome-Based Contracts and Outcome Business Models in industrial production equipment?

The purpose of this study is to understand:

- Which Drivers of Change may impact the feasibility of the OBCs or OBMs for the supplier or the customer of industrial production equipment?
- Which Drivers of Change are most critical for the long term feasibility of the business models of industrial production equipment?

- Why the Drivers of Change are relevant, what are some of the ways in which the changes might impact the OBC parties?

By identifying potential changes, we contribute to the development of these business models to be resilient to change and help practitioners design better business and sourcing models and contracts.

2 Literature review

To lay the foundation of our study we conducted a literature review to identify the potential changes as well as the potential ways to categorize these changes. We targeted our search to three distinct groups of extant literature: 1) Outcome-based business model -oriented literature (including Advanced Services, Servitization, outcome-based contracting, PSS, PPX and Product-as-a-Service literature), 2) generic business model and value delivery literature, 3) futures literature. Our target was to identify how literature deals with external changes [8] and to identify specific DoCs for these business models. We used here PESTLE model to categorize and describe the potential changes identified in literature, dividing them into political (P), economic (E), social (S), technological (T), legal (L) and environmental (E) changes.

Political and industry level changes. We identified from literature some political and industry-level DoCs that potentially have important effects on OBCs and OBM's. They range from geopolitical changes in markets and their impacts on industries [15], [16] to timely sustainability requirements and their impact on production facilities' modernization [17]–[19], changes in the operational strategies of manufacturing companies [8], [20] to the ever increasing volatility driving business decisions [21]–[23] to governmental restrictions on resource usage that govern businesses [3]. All of these have an impact the OBCs in the way companies collaborate to deliver value and to improve their internal efficiency.

Economic changes. Most of the relevant changes can ultimately be tracked down to the economical level, to impact either the cost or revenue of the party, but that is often a consequence of mitigating or exploiting the change, not a direct impact of it. From literature we found multiple DoCs that are purely operating on the economic level. Often these are a product of some other, often operational change, but were handled in our study as separate DoCs due to their immediate and clear impact on OBM's. Some of these were the changes in costs of materials, labor, taxes, [3], [24]–[26], financing [3], [17], transport and travel [15], [16] or new business opportunities increasing the revenues of either party [27].

Social changes. Due to our focus on the external changes [7], we did not find many relevant DoCs that affect mainly on the social level. Practically all major changes, including Black Swans, Wild Card events and big global or regional events have a social aspects [15], [16], and e.g. social unrest can arise even without them, but these events are difficult for actors to manage other than through market selection and insurance policies. Additionally, we included in our list the risk of discontinuous relationships either due to key persons changing companies or taking on new responsibili-

ties as it can have a significant impact on the long-term life cycle of the supplier-customer relationship [25].

Technological changes. Our literature study found an abundance of technological DoCs that may impact industries in general or particularly industrial production equipment, their design or usage. Technological changes can occur either through overall technology advancements that are migrated to new industries, or through technical problem-solving within an industry. There are many technological shifts visible that have already changed how businesses are managed, some at the very core of the OBM's. Generic technological advancements that impact many if not all OBMs include connectivity, cloud computing, digitalization, Artificial Intelligence (AI), Internet of Things (IoT) and other IT technologies [3], [8], [21], [28]–[30], new materials [31]. Some very specialized technologies like blockchain have already been discussed in business model literature as a component of OBM's [32].

Any technological changes in the customer's production facilities is both an opportunity and a risk for the other equipment suppliers as the new technologies can either hinder or support the feasibility of the other equipment [25]. Additionally, as the global sustainability requirements are putting pressure on industrial production, creating a need for change that can be addressed at least partially through the OBC's where the value (energy saving) is shared between the supplier and the customer [33].

Legal changes. Changes in the political and regulatory environment will naturally drive some changes in the legal frameworks in which businesses operate. We identified several DoCs that impact OBM's through the legislative or standardization routes. Due to the temporal nature of the OBCs these changes are not only possible, but even probable during the long life cycle of the equipment and contracts. These include more direct regulation, e.g. in the taxation, import/export regulation, financial accounting and e.g. depreciation [16], [24], industrial level legislation such as cyber security norms and legislation [20] and governmental actions to support or regulate certain types of businesses or certain types of business models [24], [33].

Environmental changes. The environmental changes identified from the literature were on the other hand related to environmental restrictions caused by the currently pressing ecological crises and the supply of material and energy resources, already mentioned from the economic perspective and on the other hand through accelerating transformations in the consumer and therefore the industrial production spaces. Additionally, we identified several DoCs related to industrial and competitive environment and trends within industries. These include competitive hostility [3] or completely new entrants (e.g. generalist maintenance suppliers, system integrators) entering the market [34], [35], changes in overall firm production strategy, e.g. Manufacturing-as-a-Service [16], [21], [36], changes in company strategies, decisions on core vs. outsourced operation [10], [37], [38], that are constantly evaluated by manufacturing and industrial production firms. Environmental risks also have been identified by many scholars as a source of inefficiencies in production or in the continuity of the production [21], [39].

3 Methodology

The study combines literature research with a process of expert workshops to identify and prioritize the Drivers of Change. After identification of a list of potential DoCs from literature the DoCs were evaluated and prioritized by expert groups in multiple workshops.

3.1 Identification of Drivers of Change

As described in the previous section we first researched academic and business literature to identify a list of potential DoCs that have been identified in the business model, industrial production, and futures literature. These potential changes functioned as a starting point for our quest to identify a representative set of DoCs that would ultimately enable discovering how future changes affect the feasibility of the outcome-based business models.

From the list of identified potential changes we formulated a set of possible DoCs that can impact the OBCs and OBMs. As we wanted the DoCs to cover all of the main aspects of the OBMs we mapped them PESTLE [11] and in several business, strategy and management frameworks [8], [40], [41] to make sure that changes on different abstraction and operational level were included. We used a holistic model adapted from Bokrantz [8] to categorize the DoCs according to their origin and scope. Contrary to Bokrantz we wanted to include some DoCs also from the individual company level for those changes that have a clear impact on the other company in the dyadic relationship. These are usually not controllable by the impacted party, so they fit the description of ‘external’ from the impacted party’s perspective.

Organizing the list of relevant DoCs was relatively straightforward by coding those sections of the articles. We also coded the accuracy or relevance of each DoC towards OBM’s with “impact markers” (direct impact, indirect impact). This way the research team identified 57 potential DoC. After a few rounds of iterations (removing duplicates, reformulating the wording of the DoCs) the number was limited to 35 to avoid research fatigue [42].

3.2 Evaluation of the initial Drivers of Change by expert panel

The list of DoCs was evaluated by a panel of 8 experts (industry and academia) in a 2-hour online workshop. They were asked to review and compliment the list with possibly missing DoCs that they thought would be relevant for OBCs or OBMs. The timescale for analysis was set at 10 years. The experts prioritized the DoCs based on the probability and impact of the change and provided qualitative reasoning. In addition to validating the identified DoCs the panel also identified 7 new DoCs that were in their view missing from the list derived from literature.

The experts also provided insights on how to improve the evaluation process for the next round. There were suggestions e.g. on how to deal with the dualistic direction of change (e.g. energy costs can either rise or lower within a timeframe, and both of these changes might be significant for one or both contract parties). As we didn’t want

to have duplicates for all DoCs which have a negative as well as a positive possible change direction this helped to eliminate some of the redundancy from the list.

3.3 Prescreening the Drivers of Change by researchers

Based on the expert panel discussion and initial evaluation of probability and impact the list of DoCs was restructured and prioritized. This helped reduce the list for the next, more comprehensive evaluation by a larger panel of experts. The number of DoCs after this round of analysis was 30.

3.4 Final evaluation of the Drivers of Change by expert panel

Five industry and 7 academia experts on OBMs were then invited to a second 2-hour workshop where the list of 30 DoCs were complimented and evaluated on probability and impact, much like the previous round. A summary of the panelists for both workshops is shown in Table 1. In this round only one new DoCs emerged.

Then the panelists evaluated each of the DoCs on probability and impact, similarly to the first evaluation round. Scale for evaluations was 0 to 10. After the evaluation the team discussed the highest scoring DoCs to identify some ways in which these changes impact the OBC parties.

Table 1. workshop panelists

| Category | Title | Description of background organization | Country |
|----------|----------------------|--|-------------|
| Industry | CEO | Globally operating company in industrial production equipment, rolling out OBC | Finland |
| Industry | CEO | Globally operating equipment manufacturer, working with multiple companies to enable OBMs | Finland |
| Industry | CCO | Globally operating company in industrial production equipment, 5+ years in OBM | Belgium |
| Industry | CEO | Leader of a financial institution providing financial services + capital for OBMs | Austria |
| Industry | Consultant | Several years of academic and industry experience on business models | Finland |
| Academia | Professor | Several years of experience in business models and knowledge management | Finland |
| Academia | Professor | Several years of experience in servitization, both in academia and industry | Switzerland |
| Academia | Professor | Several years of experience in research on smart manufacturing, business models | Mexico |
| Academia | Associate Professor | Several years of experience in research and industry on manufacturing, especially smart manufacturing, Internet of Things, product-service systems | USA |
| Academia | Associate Professor | Several years of experience in supply chain management research, manufacturing business model innovation | USA |
| Academia | Post Doctoral Fellow | Several years of experience working in industry projects in developing OBMs, special focus on connected equipment in industry | Finland |
| Academia | Post Doctoral Fellow | Several years of experience working in industry projects in developing OBMs, smart manufacturing | Finland |

4 Results

Identified and prioritized Drivers of Change. The validated and prioritized list of DoCs can be seen in Table 2. The list is organized according to the criticality of the DoC, which is calculated as the product of the probability and the impact of the DoC.

Table 2. List of prioritized Drivers of Change

| Driver of Change | Probability Mean | Impact Mean | Criticality |
|------------------|------------------|-------------|-------------|
| Changes in costs | 8,11 | 6,56 | 53,20 |

| | | | |
|---|------|------|-------|
| Product market price change | 8,11 | 6,33 | 51,34 |
| Technological disruption | 7,00 | 7,22 | 50,54 |
| Life cycle cost/value becoming customer decision criteria | 7,56 | 6,67 | 50,43 |
| Customer business strategy change | 7,67 | 6,56 | 50,32 |
| Changing customer expectations | 7,67 | 6,44 | 49,39 |
| Change in OBC related regulations and financial policies | 6,78 | 6,33 | 42,92 |
| Component supply problems | 7,44 | 5,67 | 42,18 |
| Sustainability goals driving modernization of equipment | 6,89 | 6,11 | 42,10 |
| Change in interest rates | 8,22 | 5,11 | 42,00 |
| Country/region incentives for local production and sourcing | 7,33 | 5,67 | 41,56 |
| Supplier's competitors adopting OBC business models | 7,11 | 5,67 | 40,31 |
| Scarcity of skilled labor | 6,56 | 5,89 | 38,64 |
| Wild card events (e.g. war) | 5,89 | 6,56 | 38,64 |
| Customer's production line related problems | 6,67 | 5,56 | 37,09 |
| Increase in OBM financing opportunities | 7,11 | 5,00 | 35,55 |
| Energy and material shortage | 6,33 | 5,56 | 35,19 |
| Shortening of product life cycles | 5,33 | 6,00 | 31,98 |
| Changes to Import/Export Rules | 5,89 | 5,22 | 30,75 |
| Restrictions on usage of natural resources | 5,89 | 5,22 | 30,75 |
| Digital platforms emergence | 6,89 | 4,11 | 28,32 |
| Changing customer IT needs | 6,78 | 4,11 | 27,87 |
| Political situation impacting the equipment and data flows | 5,22 | 5,11 | 26,67 |
| Digitalization leads to centralization of maintenance | 6,44 | 4,00 | 25,76 |
| Customers wanting to insource equipment competence | 5,22 | 4,89 | 25,53 |
| Cyber security affecting remote monitoring | 5,11 | 4,78 | 24,43 |
| Changes in safe data sharing (e.g. blockchain) | 5,33 | 4,33 | 23,08 |
| Change of ownership of companies | 5,78 | 3,89 | 22,48 |
| Social unrest creating uncertainty | 5,33 | 4,11 | 21,91 |
| Change in union rules | 4,22 | 4,89 | 20,64 |
| Personal relationship change | 5,44 | 3,11 | 16,92 |

The evaluation of the panel of the DoCs was quite unanimous, the standard deviations in probability evaluations was between 0,07 and 0,31 (average 0,17) and in impact evaluations between 0,17 and 0,34 (average 0,24), even though the backgrounds of the panelists were quite varied and the future outlook at the time of the evaluation (July 2022) was particularly uncertain due to recent disruptions that were fresh on the minds of panelists (COVID-19 pandemic, supply chain disruptions, RUS-UKR war).

Most critical Drivers of Change. Based on the evaluation of 12 experts the list of DoCs was prioritized based on probability and impact. The most critical DoCs and their evaluations were related to the cost and therefore the profitability of the OBC's in the long run, disruptions related to technologies, changes in the customer needs in the long life cycle of the equipment and OBC as well as more general disruptions that can shake the foundations of industries.

Discussion on most critical Drivers of Change. The most severe DoCs were then discussed by the panelists to discover why they felt that they are critical for OBCs or OBMs.

5 Discussion and Conclusions

The identified and evaluated list of potential DoCs impacting the feasibility of OBCs and OBMs shed light into the life cycle feasibility of these business models both from the perspective of suppliers and the customers of industrial production equipment by identifying external changes that may impact the feasibility and providing reasoning

of how this impact might take place. The prioritized list provides a starting point for future research on OBC and OBMs, the design and implementation of these business models as well as shed light into the type of external changes that impact the resilience of these business models.

As the world is constantly changing and industries evolving to find better and more profitable ways of operating, we can estimate that the identified DoCs are only a tip of the iceberg in the wider scheme of things. There will be new Drivers of Change and consequently new ways to cope with the changes. The results of this study will surely provide insights into this process in the future.

This study selected and analyzed the DoCs from the perspective of OBCs and OBMs. However, the same changes likely also impact the traditional business models as well. The same impacts with different weights can be seen even wider than for the scope of this study.

Through this study, through the results and summarized commentary in Appendix 1 we have shown that understanding major external environment Drivers of Change is important for the implementation of outcome-based PSS and outcome-based business models, either from the suppliers' or the customers' point of view, or both.

5.1 Drivers of Change with the highest probability and impact on feasibility

The DoCs most probable to take place, based on the expert evaluations were 1) changes in interest rates, 2) changes in costs, 3) product market price change, 4) customer business strategy change and 5) changing customer expectations. The DoCs with the highest impact, based on the evaluations were 1) technological disruption, 2) life cycle cost/value becoming customer decision criteria, 3) changes in costs, 4) customer business strategy change, and 5) wild card events. Put together, the DoCs with the highest criticality, calculated as a product of the probability and impact, based on the evaluations were 1) changes in costs, 2) product market price change, 3) technological disruption, 4) life cycle cost/value becoming customer decision criteria, and 5) customer business strategy change.

We can note that many of the most critical DoCs are related to the future economic feasibility or profitability of the OBC. Most critical DoCs have to do with the costs, both from the perspective of cost of operating the OBC for the long life cycle profitably, as well as from the perspective of changing prices on the markets, both from the business model comparison perspective as well as from the operating cost perspective. This is logical, especially at the time of the study when a lot of changes have been recently seen in the cost and availability of different production inputs and volatility of markets, as can see in many of the highest criticality DoCs in Table 2. Some of the critical changes are stemming from the customers' interest to 'buy' flexibility for their operations, which in turn poses somewhat of a risk for the suppliers.

Interestingly, the impacts of truly external big changes (e.g., legislation changes, wild cards, social unrest, etc.) were not seen very high by the experts. In the discussion these were mentioned, but the experts saw them as less transformational than some of the 'closer' changes. Even with the abundance of recent historical data about

these types of disruptions the experts saw them as not having an especially big impact, compared to the impact they have on the traditional business models.

Different DoCs and the underlying changes impact the OBC contract parties differently. Most of the DoCs were seen to impact the suppliers more, which is logical since the suppliers are taking a bigger role in the relationship compared to the traditional sell & service-business models. By becoming partners to their customers production outcome, they of course hope to gain benefits in many ways, but at the same time expose themselves to the effects of these type of external changes. In the traditional business model, the customers would have felt most of the impacts of the changes, but now they share that risk with the supplier. And at the same time the parties share the opportunities that changes introduce.

5.2 Theoretical contribution

This paper contributes by firstly highlighting the importance of futures thinking and foresight when designing and operating OBCs and OBMs. For the first time we have practically attempted to forecast the changes that may happen during the life cycle of these contracts in the industrial production equipment setting, adding a systematic temporal dimension to the study of outcome-based business models in industrial production equipment PSS [3]. Although similar futures studies have previously been done in different arenas, for example the future of Industry 4.0 [20], additive manufacturing [28], future maintenance [8] and some other technical and operational fields, market and strategy-related studies, to our knowledge this study is the first from the outcome-based business model perspective. Therefore, it contributes by extending the view of OBC and OBM to a wider futures perspective [1]. This extension of the view expands the theory of PSS business models to be more extensively time-based instead of studying them primarily in one time instance and mostly noting the long life cycle dimension of the business [3]. We feel that this is an important contribution to the field.

Secondly, the study contributes by identifying specific current potential DoC that may have an impact on the feasibility of the OBCs and OBMs in industrial production equipment within a 10-year time frame. Thirdly, the study contributes by describing a process which can be used by researchers and practitioners to identify and prioritize the potential DoCs in their respective industries or settings.

5.3 Managerial contribution

This study contributes to the practical application of the OBCs and OBMs by indicating an initial list of different DoCs impacting OBM's. These DoCs include a multitude of different sources of the possible changes that should help practitioners identify the changes that are most relevant to their industry and OBC type(s). The same identified DoCs also can be used to better understand the future changes within the wider realm of industrial production equipment, regardless of the business models used as the same changes may impact the operations and value. The list of prioritized DoCs

should help practitioners dealing with industrial production equipment to better understand the future risks and opportunities, increasing their futures understanding.

5.4 Limitations and future research

Some of the most prevalent limitations of this study have to do with the limited geographical coverage of the experts (mainly Europe and North America), limited representation from the customer organization of the OBC as well as from the timing of the study in the time of turmoil (post Covid-19, during a global security crisis) that might influence the views of the participants (experts and researchers alike).

As for future research, there is clearly a need to better understand the life cycle feasibility and value of the OBCs and OBMs. Despite the growing trend of these contracting and business models there is still limited knowledge about the best practices to make these business models, contracts, and cooperation resilient to the changing world. Especially there is a need to understand in more detail the mechanisms through which these changes impact the parties, the direct and indirect, even systemic changes they invoke, prohibit or support. By understanding the temporal aspects of these business models better we would improve their value and feasibility for all parties involved and would enable their adoption at a faster pace. Furthermore, it would give us insights into the elements which are at the core of these business models – the risk and value and risk and value sharing as well as the decisions and alternatives necessary to design these business models to be resilient.

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