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Assessing the Readiness of the Emerging Ecosystem (Actor) for the Pay-per-outcome Business Model

Prasanna Kumar Kukkamalla, Veli-Matti Uski, Olli Kuismanen, Hannu Kärkkäinen, Karan Menon

prasanna.kukkamalla@tuni.fi, veli-matti.uski@tuni.fi, hannu.karkkainen@tuni.fi,
olli.kuismanen@tuni.fi, karan.menon@tuni.fi
Tampere University, Tampere, Finland

Abstract. This study analyses the readiness of an emerging ecosystem for Pay-per-Outcome (PPO) business model. We adopted a qualitative exploratory research approach to assess the readiness of firms (as an individual firm) and the emerging ecosystem in the Indoor Environment Quality (IEQ) industry. The maturity model was used to assess the readiness of emerging ecosystem and individual companies. The study identifies 11 critical dimensions in readiness from an emerging ecosystem perspective. We follow a 4-step process 1) Individual companies' current readiness level, 2) Individual companies' target level, 3) Emerging ecosystem's current readiness level, and 4) Emerging ecosystem's target level. This is the first of its kind to the best of our knowledge that studied the emerging ecosystem readiness for the PPO business model.

Keywords: Readiness assessment, Pay-per-Outcome, PPO, Business model, Emerging ecosystem, Indoor Environment Quality, Manufacturing, Maturity model.

1 Introduction

Pay-per-Outcome (PPO) (customer pay for the achieved outcome or result) business models are gaining substantial attention from manufacturing industries and the academic community. Studies, for example [1–4] have discussed the economic and competitive advantages of these models. Due to the complexity (a collaboration between actors, activities and resources associated with the business portfolio) of these business models, any firm alone, cannot operationalise the service offering [5]. Operationalizing these business models involves key plans and activities which lead to a collaboration with other partners, possibly creating an alliance or network (Emerging ecosystem). The evolution and success of the ecosystem depend on the effective integration of actors based on their capabilities and skills. Prior to establishing an ecosystem firms need to assess their current level of readiness for a specific product or service offering.

Several readiness assessment tools have been developed to assess the readiness of firms for a particular phase of transformation [6–8]. Even though studies [8], [10], [11]

have discussed firms' readiness for Industry 4.0, digital transformation, circular economy, service design and business model emerging, the readiness of the emerging ecosystem (actors) to implement the PPO business model is not yet explored. To fill this gap, this study focused on four companies that have joined a firm ecosystem to offer Indoor Environment Quality (IEQ) as a service. IEQ [12] is defined as:

'A holistic concept, encompassing elements such as indoor lighting quality, acoustic comfort, and thermal comfort (temperature and relative humidity)'.

The indoor environment influences the health, well-being, and performance of the occupants [13]. A slight change in occupants' performance can produce a great impact on the operational cost of the company [14]. Studies [15, 16] have provided evidence on the impact of the indoor environment on an organisation's operational expenses. The rise in operational cost of building especially for good indoor environment quality maintenance pushes building maintenance companies to seek an alternative solution to keep the cost low. This situation has created an opportunity for IEQ companies to create a good indoor environment as a service than IEQ equipment sales without compromising indoor environment quality.

For this reason, the present study specifically focused IEQ industry to assess whether these companies are ready to adopt the PPO business model. We framed the following research question to solve above stated research gap:

RQ: How to assess the emerging ecosystem's readiness (through participant companies' readiness) to implement a Pay-per-outcome business model?

2 Theoretical Background

2.1 Readiness of Emerging Ecosystem

In recent years ecosystems have gained interest from the scientific community. The success of the company is not any more dependent on its internal capabilities but also on how well the company can acknowledge and utilize other actors within the ecosystem[9]. Even though all companies collaborate with other actors, a strategic ecosystem requires deeper collaboration with two or more companies[17]. Studies have discussed how well the ecosystem performs and how it should be developed[9].

Prior to establishing an ecosystem, firms need to assess partners' current level of readiness. The readiness of the ecosystem can be assessed through various models, e.g a study [9] developed a readiness model with five main dimensions, Culture, Ecosystem, Operations, Governance and Strategy, which each is divided into 5-6 sub-dimensions, such as Digital Culture and Business and IT synergy. Other readiness assessment models for ecosystems have been developed for industries such as the software industry[9], construction industry [9] and logistics[18].

However, all these studies are focusing on the assessment of established ecosystem readiness rather than an emerging ecosystem. Moreover, the knowledge about the

emerging ecosystem readiness and its actors' readiness assessment has not yet been revealed.

2.2 Pay-per-Outcome Business Model Readiness Analysis

Pay-per-X (PPX) business models, such as pay-per-use (PPU) and Pay-per-Outcome (PPO) business models have changed the logic of the equipment manufacturing companies' operations. PPO business model defined [1] as :

“a new business model of outcome-based contracts where the firm is tasked to achieve outcomes of equipment as a service contract instead of the traditional maintenance, repair and overhaul activities

In the PPO business model, the customers don't own the equipment but pay for the value received from the usage of the equipment [19]. The change in ownership and responsibilities from the customer to the product/service provider creates extra responsibilities for the provider, which requires the development of new capabilities and partaking in new activities[20]. In this kind of situation, the self-diagnosing capabilities and skills of firms would minimise the risk of failure of these business models. Few readiness models have been developed to understand the development of complex systems such as business model transformation [21], product-service systems[6], Industry 4.0 [22] and smart manufacturing[23, 24].

3 Methodology

Our study implemented an embedded single case study [25] of the emerging ecosystem comprising four individual companies, engaged in the IEQ industry, to understand their current level of readiness to implement a PPO business model. Yin [25] indicates the use of case studies when the goal is to analyse contemporary events. Therefore, a case-based approach was conducted with a series of workshops to collect data for assessing a set of conditions for PPO business model readiness. Case selection followed a meticulous process where an emerging ecosystem targeting to implement and roll out a PPO business was selected. The case ecosystem used in this study operates in the construction and building operation industry, providing an Indoor Environment Quality as-a-Service. Four companies that have already acquired some of the required competencies for the business model transformation were analysed. A short description of the case companies is presented in table 2.

Table 1: Case companies and participants' profile

Company	Description	Interviewee profile
C1	HVAC maintenance service provider	Chairman
C2	A technology company specializing in smart building automation	Chief operating officer
C3	An equipment manufacturing company specialising in intelligent and energy-efficient HVAC technology, air management solutions and fans for industrial processes	President and Business Director
C4	A consulting company specialising in construction, construction design, and community and environment design	Senior specialist

*HVAC: Heating, ventilation, and air conditioning

The research process was carried out in semi-structured interviews with the help of the PPX maturity model* which consists of 7 dimensions, 19 sub-dimensions, 5 maturity levels, and relevant boundary conditions (See Appendix). Each of the interviews was conducted using MS Teams and lasted 90 minutes. The interviewees were asked to analyse 1) the current PPO readiness of their company in the readiness model subdimensions and 2) the emerging ecosystem, and then 3) define target readiness levels for the ecosystem as well as 4) a target for their own company, as a part of the ecosystem. First, we explained the dimension of the readiness model and readiness levels. Then we asked participants to select appropriate statements that represent their current level (As an individual company) and emerging ecosystem. A set of the question was prepared to get participants' responses, for example, the question related to the business strategy dimension was framed like this:

Question:

Business strategy: Considering the business strategy for PPO business models, which of the following sentence best describes your company?

- *We have not defined any PPO business model strategy*
- *Business strategy for PPX business model(s) is experimented on, but strategic objectives are unclear, and decisions are reactive and ad hoc.*
- *Business strategy for PPO business model(s) is defined and documented*
- *PPO strategy is defined and continuously developed through defined key performance indicators*
- *PPO business strategy is fully integrated and vital part of the corporate strategy.*

We also asked participants for their target level for each dimension as an individual company and an emerging ecosystem. Then these results were transferred into Excel sheets for analysis.

*The maturity model (See Appendix) was adopted from the research paper *Pay-Per-X Business Models for Equipment Manufacturing Companies: A Maturity Model*. This paper is under review process. We will provide full citation details before the Pro-ve-2022 conference.

Table 2: Readiness assessment of companies and emerging ecosystem

Dimension	Subdimension	Case companies Current level				Mean	Case companies target level				Mean	Emerging ecosystem Current level (Rating from case companies)				Mean	Emerging ecosystem target level (Rating from case companies)				Mean
		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4		C1	C2	C3	C4	
		OG	Operational Governance	2	2		3	2	2.25	4		3	4	3	3.5		3	1	1	1	
	People Governance	3	3	2	1	2.25	4	3	4	3	3.5	3	2	1	1	1.75	4	3	5	3	3.75
	Data & Information Governance	2	3	2	1	2	4	3	5	3	3.75	3	1	1	1	1.5	4	3	5	3	3.75
ST	Business Strategy	3	4	3	2	3	4	5	5	4	4.5	1	2	2	1	1.5	4	5	5	3	4.25
	Resource Allocation	3	3	2	2	2.5	4	3	4	4	3.75	2	2	1	2	1.75	4	3	4	4	3.75
	Strategic Alignment	4	3	3	2	3	4	4	3	4	3.75	2	3	2	2	2.25	4	4	4	4	4
RM	Business Risks	3	4	4	2	3.25	4	3	5	3	3.75	1	2	1	1	1.25	3	3	5	3	3.5
	Operational Risks	3	3	4	2	3	4	3	4	3	3.5	1	2	1	1	1.25	3	3	4	3	3.25
	Cybersecurity Risks	3	3	4	5	3.75	3	4	5	5	4.25	1	2	1	1	1.25	3	3	5	5	4
CC	Competences	3	2	3	2	2.5	4	4	4	3	3.75	3	2	2	2	2.25	4	4	4	3	3.75
	Culture	3	3	4	3	3.25	3	4	4	4	3.75	2	3	2	2	2.25	3	4	5	3	3.75
PLP	Beginning of Life Processes	3	3	3	2	2.75	4	4	5	4	4.25	2	2	1	2	1.75	4	4	5	3	4
	Middle of Life Processes	4	3	3	2	3	4	4	4	3	3.75	3	1	1	1	1.5	4	4	4	3	3.75
	End of Life Processes	2	3	1	2	2	3	3	3	4	3.25	2	1	1	2	1.5	3	3	3	4	3.25
PPT	Smart Product & factory	1	3	3	3	2.5	1	4	5	4	3.5	3	2	3	3	2.75	4	4	5	4	4.25
	Connectivity	2	3	3	3	2.75	3	5	5	3	4	3	2	2	3	2.5	4	5	5	3	4.25
DA	Data Access	4	3	3	2	3	4	3	5	3	3.75	3	2	1	2	2	4	3	5	3	3.75
	Data Analysis	4	3	3	3	3.25	4	4	5	3	4	1	3	2	2	2	4	4	5	3	4
	Data Utilization	4	2	3	2	2.75	4	3	5	3	3.75	1	2	1	2	1.5	3	3	5	3	3.5
Mean level						2.77					3.78					1.78					3.80

Dimensions: OG (Organizational Governance), ST (Strategy), RM (Risk Management), CC (Competences & Culture), PLP (Product Lifecycle processes), PPT (Product & Production Technology), DA (Data Analytics).

Levels: 1. Initial, 2. Experimenting 3. Defined 4. Advanced. 5. Optimized

4 Results

The summary of the case companies' current and target readiness levels and emerging ecosystem current and target readiness levels for the PPO business model is presented in table 2.

In the three subdimensions dealing with risk management, the majority of companies (C1, C2 and C3) were ranked between 3-4 for business risks, operational risks and cyber security risks. However, they ranked ecosystem readiness between 1-2. C4 ranked itself at level 5 for the cybersecurity risks dimension but ranked 1 for the ecosystem. The reason for the low level is explained by C4 as:

'...we don't have cyber security risk management because there are no protocols. On how we manage the data.'

Company C2 ranked themselves as level 4 and C4 ranked themselves as level 2 in the business strategy dimension. Even though individually the companies ranked themselves high they believed that the ecosystem level was at 1.5 (Mean level). One manager from C4 expressed:

'...at least I haven't seen any documents or files that would tell how we work, how we work together, and how we will go on from this point.'

The majority of companies (C1, C2 and C3) ranked themselves between 3-4 levels in data analytics dimension but ranked lower level between 1-3 for the ecosystem. Company C1 ranked itself level 4 in data analysis and data utilization dimensions but ranked level 1 for the ecosystem. C1 expressed as:

'...we haven't done as an ecosystem. We haven't done any data analysis. We have buildings, but we haven't done it yet. There's no and then the data channel..., we haven't talked about it at all.'

For smart products and factory dimensions, C1 ranked 1 but 3 for ecosystem readiness.

C1 explained the reason for level 1 as:

'We don't produce machines. We produce services,...since we are not producing technology products..'

Concerning companies' readiness for connectivity, the majority of companies (C2, C3 and C4) ranked 3. Company C1 and C4 assessed the ecosystem at level 3. Regarding the companies' readiness for competence management, C1 and C3 ranked 3. C2, C3 and C4 ranked ecosystem at level 2. For smart product & factory dimensions, the majority of companies (C2, C3 and C4) agreed that they were at level 3, whereas the majority of companies (C1, C3 and C4) ranked the ecosystem's current at level 3.

Regarding the mean level of readiness, 11 out of 19 readiness dimensions, such as Operational Governance, People Governance, Data & Information Governance, Business Strategy, Resource Allocation, Business Risks Operational Risks,

Cybersecurity Risks, Middle Life Processes, End of Life Processes, and Data Utilization ranked below 2 (Table 2) for the emerging ecosystem.

Finally, it was observed from table 2, the mean current level of readiness of individual companies was 2.77, and the ecosystem was 1.78. The mean level of companies' target was 3.78 and the emerging ecosystem target level was 3.80.

5 Discussion and Conclusions

Our study answered the research question *How to assess the emerging ecosystem's readiness (through participant companies' readiness) to implement a Pay-per-outcome business model?* by assessing the current level and target level of readiness of companies and ecosystem through the readiness assessment model.

The contribution of this study is three-fold. First, as per our knowledge, individual companies (within the ecosystem) readiness for PPO business model adaptation was not discussed in earlier studies. A study [26] focused on ecosystem readiness for blockchain technology adaptation. Another study [27] focused on industrial ecosystem readiness in the circular economy. A study [28] discussed readiness and maturity assessment for the industry 4.0 ecosystem was studied. However, the emerging ecosystem's readiness to adopt the PPO business model has not yet been addressed. Our study fulfils the research gap by assessing emerging ecosystem and individual companies' readiness for PPO business model adaptation in the IEQ industry. This is first of its kind study, in our knowledge that assesses the readiness of individual companies (within the ecosystem)

Second, few studies have discussed the readiness assessment process, for example, in a study [22] simulation models were employed to assess the readiness of manufacturing firms before and after Industry 4.0 implementation. In another study [29] Industry 4.0 readiness online self-check was used to assess the readiness of companies. The results were validated with companies in a workshop. But in our study, we followed 4 steps process to assess the readiness of the ecosystem. In the first step, we assess individual companies' current readiness levels. Then we assess individual companies' target levels. In the third step we assess the ecosystem's current readiness level, and then the ecosystem target level. By following this 4-step process we identify differences between the readiness level of individual companies and their view on the current level of the emerging ecosystem. We identify the least and high ranked readiness levels from both individual companies and the ecosystem. These findings showed that the emerging ecosystem readiness is not the sum of individual companies' readiness for the PPO business model. For example, C3 ranked level 1 for an ecosystem for business risks, but they ranked themselves at level 4. A contradictory pattern was found in the smart product & factory subdimension. C1 ranked level 3 for the ecosystem but ranked level 1 for themselves. This kind of variation in levels indicates that even though individual companies' readiness is high, they believe that other partners in the emerging ecosystem's readiness is not high. One company expressed that they haven't seen any document or files that guides all partners on how to work together as an

ecosystem. So, based on this study findings, it is reasonable to say that ecosystem PPO readiness is not the sum of individual companies' readiness for the PPO business model.

The 4-steps process helps companies to assess capabilities first from their perspective and then from the ecosystem perspective, which creates buy-in for their role in the ecosystem – that it's not “the others” who create the readiness of the emerging ecosystem.

Third, we identify dimensions that ranked low level and high level from emerging ecosystems and individual companies' perspectives. Eleven out of 19 readiness dimensions, such as Operational Governance, People Governance, Data & Information Governance, Business Strategy, Resource Allocation, Business Risks Operational Risks, Cybersecurity Risks, Middle Life Processes, End of Life Processes, and Data Utilization ranked below 2 levels (Table 2) from an emerging ecosystem perspective. No dimension was ranked at level 3 or above 3. This finding suggests that the emerging ecosystem is away from being ready for PPO business model adaptation. However, individual companies were ranked high in these 11 dimensions. The overall readiness for emerging ecosystem readiness can be levelled up by transferring the knowledge and skills across the ecosystem from an actor who is dominant in a specific dimension.

In the next step, we will use this study's findings to identify needed resources and skills and actors to establish an ecosystem to implement the PPO business model. This study specifically focused on companies engaged in the IEQ industry, so this study's findings cannot be generalized to all types of industries. Another limitation is the phase of the emerging ecosystem. The ecosystem is not fully established, and the roles of actors are not defined. The research setting was another limitation, as we have assessed ecosystem readiness first from each case firm's perspective.

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Appendix

Dimension	Subdimension	Maturity Level				
		1.Initial	2.Experimenting	3.Defined	4.Advanced	5.Optimized
Organizational Governance	Operational Governance	No PPX-specific operational governance	Operational PPX architecture requirements identified with ad hoc implementation and development.	Necessary operational PPX architecture requirements are documented and related governance measures are standardized.	Operational PPX architecture requirements are defined and compliance is systematically monitored through related key performance indicators.	Operational PPX governance is integrated across company with best practices in place.
	People Governance	No PPX-specific roles or responsibilities related to PPX business model(s) defined.	Responsibilities related to PPX are identified with ad hoc implementation and development.	Necessary roles and responsibilities for PPX business model(s) are documented, defined and systematically governed.	PPX-related roles and responsibilities are defined with systematic performance monitoring through defined standards and key performance indicators.	Roles and responsibilities related to PPX are optimized and defined with respect to all company activities.
	Data & Information Governance	No set rules for PPX data & information governance.	PPX data & information governance requirements are identified with ad hoc implementation and development.	Necessary data governance requirements are documented and standardized, with data storage infrastructure defined in production.	Data & information governance requirements are defined, with compliance systematically monitored and developed through defined key performance indicators.	Data & information governance measures are optimized and integrated across company.
Strategy	Business Strategy	No defined business strategy for PPX business model(s).	Strategy for PPX business model(s) is experimental with ad hoc implementation and development.	Strategy for PPX business model(s) is defined and documented.	PPX strategy is defined and continuously developed through defined key performance indicators.	PPX business strategy is fully developed and integral part of the corporate strategy.
	Resource Allocation	No plan for allocating resources towards PPX business model(s).	Basic PPX resource requirements are identified with ad hoc assignment.	Procedures for allocating resources towards PPX business model(s) are standardized, allowing systematic resource	PPX resource requirements are identified and documented across company, allowing systematic resource management and prioritization at an organizational level.	PPX resource allocation follows best practices and is optimized across company.

				allocation for specific PPX activities.		
	Strategic Alignment	No strategic alignment between PPX and other strategic objectives.	Limited understanding of PPX and its relationship to other strategic objectives with ad hoc alignment practices.	Strategic understanding and objectives are shared between relevant business.	Strategic objectives are shared across company with compliance and performance monitored through common key performance indicators.	Full strategic alignment allowing optimization and development of common strategic goals across company.
Risk Management	Business Risks	No PPX-related business risk management.	PPX-related business risks are acknowledged with ad hoc management practices.	PPX-related business risk are documented, with systematic and defined risk management practices in place.	PPX-related business risk management is systematic and monitored, allowing predictive risk management.	PPX-related business risk management is proactive, with continuous improvement and optimization of risk management practices.
	Operational Risks	No PPX-related operational risk management.	PPX-related operational risks are acknowledged with ad hoc management practices.	PPX-related operational risk are documented, with systematic and defined risk management practices in place.	PPX-related operational risk management is systematic and monitored, allowing predictive risk management.	PPX-related operational risk management is proactive, with continuous improvement and optimization of risk management practices.
	Cybersecurity Risks	No PPX-related cybersecurity risk management.	PPX-related cybersecurity risks are acknowledged, with ad hoc management practices.	PPX-related cybersecurity risk are documented, with systematic and defined risk management practices in place.	PPX-related cybersecurity risk management is systematic and monitored, allowing predictive risk management.	PPX-related cybersecurity risk management is proactive, with continuous improvement and optimization of risk management practices.
Competences & Culture	Competences	No identified any PPX-related competences.	PPX-related competences are acknowledged with ad hoc acquisition.	Basic PPX-related competence requirements are defined and documented,	PPX-related competences are acquired as well as developed systematically.	All PPX-related competences can be acquired and managed proactively.

				allowing systematic competence acquisition.		
	Culture	Culture is product-oriented, with no cooperation between different business units.	Organizational culture supports experimentation with limited & ad hoc cooperation between some business units.	Organizational culture supports innovation and is open towards PPX, with frequent collaboration between some business units.	Organizational culture is committed to PPX business model(s) with common incentives, with frequent collaboration across all related business units.	Organizational culture fully supports PPX, with complete trust and open communication at all organizational levels and relevant business units.
Product Lifecycle Processes	Beginning of Life Processes	No identified beginning of life processes for PPX business model(s).	PPX-related beginning of life processes are identified with ad hoc implementation.	PPX-related beginning of life processes are defined and systematically implemented for specific project(s).	PPX-related beginning of life processes are defined and implemented across company with systematic management through defined metrics.	PPX-related beginning of life processes are optimized and continuously improved across company.
	Middle of Life Processes	No identified middle of life processes for PPX business model(s).	PPX-related middle of life processes are identified with ad hoc implementation.	PPX-related middle of life processes are defined and systematically implemented for specific project(s).	PPX-related middle of life processes are defined and implemented across company with systematic management through defined metrics.	PPX-related middle of life processes are optimized and continuously improved across company.
	End of Life Processes	No identified end of life processes for PPX business model(s).	PPX-related end of life processes are identified with ad hoc implementation.	PPX-related end of life processes are defined and systematically implemented for specific project(s).	PPX-related end of life processes are defined and implemented across company, with systematic management through defined metrics.	PPX-related end of life processes are optimized and continuously improved across company.
Product & Production Technology	Smart Product & Factory	No machine data collection capabilities for PPX business model(s).	PPX data collection capabilities are tested in machine(s), allowing contract-specific, ad hoc	PPX data collection technologies are standardized, with systematic data	PPX data collection capabilities is integrated in all machines, with performance	Production technology fully supports data-based products for PPX, with performance

			data collection from customer(s).	collection from customer machine.	monitored through defined key performance indicators.	optimized through cost minimization and efficiency.
	Connectivity	No connectivity between machines or production processes for PPX business model(s).	PPX product- and production-related connectivity technologies are experimental and non-standardized.	PPX product- and production-related connectivity technologies are standardized and we have access to customer(s)' machine.	PPX product- and production-related connectivity technologies are standardized and monitored through defined quality control measurements for development needs.	PPX product- and production-related connectivity technologies are optimized and continuously improved, allowing 2-way/remote connection and control of machines.
Data Analytics	Data Access	No access to PPX data.	PPX data is identified, but siloed and accessed manually & ad hoc.	PPX data is defined, enabling continuous data flow and basic automation with online access.	PPX data is systematically accessed, with related key performance indicators defined and utilized in quality control.	All PPX data can be accessed, with cost-efficient, high-performing and optimized best practices in place.
	Data Analysis	No PPX data analysis.	PPX data analysis is unstructured, allowing descriptive analysis and basic monitoring.	PPX data analysis capabilities are defined, enabling diagnostic analysis & recommendations and manual machine tuning.	PPX data analysis is systematic and predictive, with performance monitored through defined key performance indicators.	PPX data analysis is prescriptive/self-learning, with automation and self-adjusting capabilities.
	Data Utilization	PPX data not utilized in decision-making.	PPX data utilized for awareness purposes in basic reporting with ad hoc utilization in decision-making.	PPX data established as an asset and utilized to support decision-making.	PPX data utilized broadly in the development of overall company strategy, with performance monitored through defined key performance indicators.	PPX data is considered as central to company strategy and operations development.