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Li, S. orcid.org/0000-0002-0147-8888, Peng, G., Xing, F. et al. (2 more authors) (2021) Value co-creation in industrial AI: The interactive role of B2B supplier, customer and technology provider. Industrial Marketing Management, 98. pp. 105-114. ISSN 0019-8501

https://doi.org/10.1016/j.indmarman.2021.07.015

Value co-creation in industrial AI: the interactive role of B2B supplier, customer and technology provider

Highlights

- Simultaneous combination between value and stakeholder capability in industrial AI
- Categorization of five types of value is identified
- A set of capabilities are considered critical in value co-creation in industrial AI
- Applied value types and capabilities are dynamic, collective and interrelated

Abstract

This research explores the interactive role of supplier, customer and technology company in business-to-business (B2B) marketing in developing and using industrial artificial intelligence (AI). From a value co-creation perspective and following a service-dominant logic, the primary purpose of this study is to identify essential value types that are created collaboratively by B2B professionals (namely suppliers, customers and AI providers), and critical capabilities that contribute to their value co-creation practices. Nineteen in-depth semi-structured interviews were conducted with three groups of B2B stakeholders in six companies that involved in an industrial AI development and usage project. The data was then analysed using a thematic analysis approach. The results of this research contain a categorisation of four value types and three sets of capabilities, together with the interrelationships between them. This study contributes to the literature of value co-creation, information system and B2B marketing by bridging these three disciplines within the context of industrial AI development and usage.

Keywords: Industrial AI; B2B marketing; Value co-creation; Value type; Capability

1. Introduction

Dramatic changes in business environment, advances in information technology and the prevailing of networked economy have brought prominent changes to the business to business (B2B) commerce (Kohtamaki & Rajala, 2016). A new trend relying on the usage of artificial intelligence (AI) to drive industrial innovation is emerging, coined as industrial AI (Lee et al., 2018). Data mining and analytics utilising machine/deep learning provide the foundation of industrial AI, and turn large amount of industrial big data (including marketing, purchasing, manufacturing and supply chain big data) into useful insights, patterns and predictions to allow automated decision-making, new product development and effective marketing and supply chain management (Dwivedi et al., 2021a; Syam & Sharma, 2018; Zhang et al., 2019). In light of this, industrial AI is a key element to drive the development of business-to-business (B2B) marketing activities, and to reshape supplier and buyer relationships in the supply chain (Gordini & Veglio, 2017; Davenport et al., 2019).

Despite industrial AI's transformative potential and business value, there has been an increasing number of studies that investigate and highlight uncertainties, challenges and difficulties associated with AI technologies (e.g. Chen, 2017; Syam & Sharma, 2018), especially in terms of collaboration between B2B partners and joint creation of innovation and value (Wang et al., 2016). The current literature has focused on the technological understanding of AI whilst yet not addressed its strategic implications, managerial challenges and concerns from human workforce (Dwivedi et al., 2021a). Synergy between value and capabilities among marketing professionals, business partners and AI technology providers is crucial for B2B firms to make effective decisions and enhance supplier and customer relationships (Lin et al., 2020). Questions remain with regard to how AI technologies can be managed and used in a way that effectively assists B2B marketers, professionals and firms in fulfilling various business requirements and enhancing business collaboration (Berente et al., 2019; Dwivedi et al., 2021a).

On the other hand, value co-creation has been long rooted in marketing studies, and scholars have widely acknowledged the importance of the joint creation of value between firms in B2B settings. Prior research has studied sustainable stakeholder engagement (Lacoste, 2016), the precedents and conditions of value co-creation (Sales-Vivó et al., 2020), and the building of B2B ecosystems (Hein et al., 2019). Another research stream of studies particularly focuses on the role of networked and data-driven technologies in value co-creation from the human interaction perspective (Breidbach & Maglio, 2016; Komulainen, 2014). These studies have been conducted in the context of

manufacturing, retailing, finance, and more general marketing activities with complexities. However, scholarly attention on AI use in value co-creation remains limited. We argue that value co-creation in a supplier-customer relationship, also involving AI technology provider, is challenging and has significant impact on the overall collaboration and innovation outcomes. There is also very limited understanding of capabilities that create value for customers and suppliers, especially regarding essential types of capabilities for each marketing sector (Möller, 2006; Winkler & Wulf, 2019)..

Moreover, it is important to note that the endeavour of industrial AI in the manufacturing sector is conducted within a typical B2B setting and has a temporary nature at its development stage, i.e. supplying companies need to work with customer companies and temporarily employ consulting firms and IT vendors to design, develop and deploy the required technical solution (Gounaris, 2005). This involves partners and stakeholders from multiple parties with diverse interests and needs to collaboratively create different types of value. Advanced manufacturing, also considered as smart manufacturing, has been positioned as a top priority for economic growth in many countries, with breaking-through advances in technology and increasing competition in local and international markets (Chen, 2017). Prior research has confirmed that industrial AI will lead to more profound changes and transformations to manufacturing firms than previous information and digital technologies do (Ives et al., 2016). On the other hand, however, the manufacturing industry falls far behind other service sectors in regard to the extend of flexibility and the ways in which suppliers and buyers exchange information and make collaborative decisions (Ayala et al., 2017; Chang, 2017).

To shed light on the knowledge gap, this study follows a service dominant logic and explores how B2B marketing professionals, from both the supply and the demand sides, use industrial AI to co-create value, in order to fulfil customer needs and facilitate better organisational collaborations. Specifically, this research answers two research questions:
1) What types of value are co-created by B2B professionals in order to fulfil customer needs and enhance collaboration in the industrial AI context?
2) What are the critical capabilities to facilitate such value co-creation practice across organisational boundaries in the B2B setting?

This study makes important contributions to the literature of value co-creation, information system and B2B marketing, by bridging these three disciplines within the context of industrial AI development and use, and by extending the understanding of value co-creation in B2B marketing

from a socio-technical perspective. It also provides managerial implications to B2B professionals, manufacturing firms and AI solution providers by highlighting important co-created value types and capabilities required to achieve the value in industrial AI development, use and practices.

2. Literature review

2.1 Industrial AI and B2B marketing

With the rapid development of AI technology, enterprises are making use of machine and deep learning across a series of enterprise activities, from product development to manufacturing to supply chain and marketing activities (Wang et al., 2018), which is conceptualized as Industrial AI. It generally refers to AI technology that is harnessed to overcome issues within complex industrial operations, collaboratives and marketing activities (Li et al., 2017). AI, alongside other emerging technologies such as cyber physical systems (CPS), Internet of Things (IoT), cloud computing, and big data analytics, is widely discussed in the context of manufacturing industry, especially entwined with the notion of 'Industry 4.0' and smart manufacturing (Lee et al., 2018). Industrial AI is commonly recognized to have the potential to bring many benefits in the manufacturing field. For example, Kumar *et al.* (2019) explored how AI assists bespoke marketing activities in providing personalized services to customer. Rekha et al. (2016) discussed the use of Support Vector Data Description (SVDD) – one of AI technologies that help to identify customers' preferences – in directing companies towards the right customer and contacts via marketing analytics tools and machine learning techniques. Further, Dimitrieska et al. (2018) argue that the aim of industrial AI is to follow and predict the next purchasing decisions of the targeted customers, which in turn would improve consumer experience.

Rather than focusing on individual buyers (i.e. B2C marketing, Nairn et al., 2004), B2B marketing take into account all stakeholders who impose influence on business (Iankova et al., 2019). According to MIT Technology Review Insights (2018), more than 1400 B2B marketing executives argue that AI technology is critical in improving outcomes of business and professional services. AI can help B2B companies transform big data into useful information and knowledge, with which competitive advantages would emerge (Paschen et al., 2020). Moreover, it is said that there exist challenging tasks in B2B marketing; for example, B2B marketers have to pay equal attention to customers and those who make purchasing decisions. However, the outcome of AI operations is expected to achieve customisation so as to further improve marketing efficiency (Abrell et al., 2016). When Industrial AI is developed and used in B2B marketing, it is critical to understand the

requirements of supplier companies, AI technology companies and customer companies (Zhang et al., 2019). These three types of companies are regarded as three groups of stakeholders within the industrial AI development and initial usage stages. As such, questions regarding how they collaborate across organisational boundaries become critical.

2.2 Value co-creation in industrial AI

Value co-creation generally delineates an interactive business relationship amongst various market actors (e.g. IT firms, service system suppliers, and customers) who in concert create business value with the same goal. Here, value possibly refers to an intermediary that mediates the service system itself and its beneficiary ends (the extent to which its end users or customers are satisfied with) (Sales-Vivó et al., 2020). For decades, the questionings around where value comes from in B2B settings demonstrate a growing attention to using rather than manufacturing the involved service systems. This indicates the prominent role of customers in the value co-creation process, arguably, that value may whilst derive from the heterogeneous market field, is determined by customers. According to Payne et al. (2008), the fact that value co-creation takes place when customers consume or use the service systems or products, corresponds to the essential attributes of the service-dominant (S-D) logic. It provides broader views for market and increased connectivity among actors (Brodie et al., 2019), and particularly in the contemporary B2B setting it marks a fundamental shift of value from being created by companies' outputs in exchange towards a form of value in-use and in-context (Vargo et al., 2008).

The existing literature demonstrates a large range of studies concentrating on value co-creation from different marketing and business aspects. Rather than completely contradicting against one another, these constructs co-occur as technology is evolving. Lacoste (2016) investigates the sustainable mode of B2B value co-creation, emphasising green marketing (i.e. sustainable thinking by all market actors from manufacturing to post-purchasing services) embedded in the overall supply chain the service systems. As organisational boundaries are diminishing due to industrial revolution, marketing actors tend to develop capabilities for 'sustained purposeful engagement' (Marcos-Cuevas et al., 2016) in confronting complexities of industrial relationships. At a greater length, Sales-Vivó et al. (2020) untangle these relations in the manufacturing business by evaluating the precedents of value co-creation – trust, commitment and satisfaction. In response to the rapid changing business environment consisting of interdependent stakeholders and marketing dynamics, firms have tended to refashion their current business models in order to build platform-mediated

B2B ecosystems, which harness, and are also driven by, ICT-enabled value co-creation practices. Further, Hein et al. (2019) study how the emerging IoT platforms, highlighting on integration of demand-side assets, platform readiness, and servitisation, enable the standardised co-creation of value for marketing.

Such a platform-based and networked view of technology echoes the growing traction amongst business and marketing scholars in value (co-)creation by and of industrial AI. Despite certain research limitations that vary across different types of marketing activities, the current scholarship places much emphasis on the integration of AI-enabled manufacturing resources from across the industry (Kaartemo & Helkkula, 2018). Whilst a myriad of AI technologies proliferate in industry 4.0 smart manufacturing systems (Lee et al., 2018), such as service robots (Čaić et al., 2018), human beneficiary practices in especially human-to-non-human interactions (Kaartemo et al., 2018) are of vital importance. From this view, arguably, value is created, and in some cases, appropriated from AI on a basis of a combination of knowledge and innovation capabilities (Mishra & Pani, 2020), which are in turn likely to enhance customer (i.e. the beneficiary) engagement and co-creation of value with other stakeholders. The wide spread of technologies also requires firms and stakeholders to develop specific capabilities in enacting co-creation of value among stakeholders in both developing and using AI (Bag et al., 2020). For instance, AI service providers and users should be able to continuously assess and build customer-centric products and proactively react to changing and emerging needs (Lenka et al., 2017).

A review of existing studies on value-creating activities and industrial AI is presented in Table 1. Notwithstanding diversity in research scope, little attention has been given to its application in B2B marketing activities, especially in terms of the conceptualisation for dimensions of value and the capabilities different B2B stakeholders could have to reach this goal. The inherent complexity and multiplicity of B2B settings complicate how value and capabilities are normally created and applied. Existing studies continue to report limited evidence of how AI shapes, changes and is impacted by different B2B stakeholders (Dwivedi et al., 2021b; Paschen et al., 2020). More importantly, many research regognised that value co-creation barriers in such B2B settings are people and stakeholders oriented, rather than merely technology oriented (Bag et al., 2021). There is therefore a need to investigate how B2B stakeholders engage in their value co-creation practices through applying AI related capabilities.

Topic	Study	Context and focus	Method	Key findings
AI and business process in B2B	Farrokhia et al., 2020	AI for decision making for detecting crisis.	Model test by using secondary data.	Proposes a structural model composed of a statistical and sentimental big data analytics approach.
	Bag et al., 2021	How AI enables knowledge creation among customer, user and external market.	partial least square-based structural equation modelling (PLS-SEM) based on survey data.	Customer, user and external market knowledge creation have significant impact on the B2B marketing-rational decision making.
	Paschen et al., 2020	AI enables value co-creation in B2B sales.	Semi-structured interviews with a North American start-up AI company.	Three crucial factors of value co-creation with AI in B2B sales: actors, activities and resources. Value co-creation is heavily relied on human activities and resources.
	Mishra et al., 2020	Knowledge and innovation strategies to appropriate value from AI technologies.	Theoretical paper	Presented an ambidextrous approach towards AI innovations (exploration and exploitation) and highlighted the cruciality of developing and using resources.
	Russo-Spena et al., 2019	Value innovation by AI with the focus on innovation as an outcome to human practices of value co-creation.	Semi-structured interviews with IBM; Secondary sources from official company's	AI is crucial to foster networking and knowing practices (socio-material) for sustaining value creating and innovating.

			documents	
Human and AI joint value co-creation	Upadhyay et al., 2018	The role AI technology and its application for value creation in the recruitment industry	Literature review	Strategic insights into AI-driven the automated recruitment process.
	Caic et al., 2018	In the healthcare context, potential roles for service robots in elderly care's value networks.	In-depth phenomenographic interviews and generative cards activities	Identified six roles of service robots in value networks of elderly people and how robots' health-supporting functionality can be beneficial or detrimental.
	Kaartemo et al., 2018	Understanding how AI and robots are used in value co-creation and mediates individual experience of value.	Systemic literature review	Identified four primary themes of literature on AI and robots in value co-creation.
	Kokuryo et al., 2016	Value co-creative design and manufacturing in chemical shoe industry	Design study	Proposed a framework of the value co-creation loop for mass customisation scenarios.
Value co-creation in	Lenka et al., 2017	Developing digitalisation capabilities to interaction and	Case study by interviews with four large industrial	Highlighted the importance of perceptive and responsive mechanisms that enable digitalisation capabilities to

AI design and development		value co-creation with customers.	manufacturing firms	co-create value with customers.

Table 1. Summary of key studies linking value co-creation and industrial AI

3. Research method

3.1 Data collection in the selected case study

Given the nature of this study and its predefined research questions, an inductive and qualitative approach is adopted. To investigate value co-creation practices among business partners including service and product provider, industrial AI technology provider, and customer in the B2B setting, a case study methodology is followed for research design and data collection. As highlighted by Yin (2017), a case study is an in-depth inquiry into the study of a social phenomenon in its real-life setting (Yin, 2017). It is particularly useful in understanding the dynamics and complexity of the issue under investigation, especially when the boundary between the issue and its specific context is not clear (Saunders et al., 2016).

With consideration of the research questions, our selection of case study followed certain criteria: i) companies collaborate in a B2B mode as suppliers and customers, and ii) companies have adopted industrial AI technologies in their marketing activities and business operations. We selected the industrial AI development and use initiated by Huanuo Manufacturing Ltd and its business partners as the empirical context for this study. Huanuo is a local market leader in the materials industry and locates in Southern China. Over years of effort, the company has made substantial achievements in digitally transforming (i.e. CPS transformation, digital transformation, and big data transformation) its business and modes of collaboration with business partners. In the beginning of 2019, Huanuo initiated a new pioneering industrial AI project with the aims to break organisational boundary and build better collaboration with their business customers and this project was in trial usage by the time of data collection in June 2020. Within developing and using industrial AI, three types of organisations were involved, namely, Huanuo as the investor and material products supplier; PX Consulting (anonymised name for privacy reasons) performing AI solution consulting service together with its three IT solution companies (IoT devices, cloud data warehouse, and analytics/AI software as further illustrated in Figure 1) as the industrial AI provider; and HW (Initials of the

company) Ltd, a customer company that regularly purchase products from Huanuo.

The collaboration between Huanuo Manufacturing Ltd, PX and three IT solution providers, and HW Ltd provides an appropriate research setting for two reasons. First, they recently transformed their B2B collaboration by using industrial AI technologies. Therefore, researchers can investigate their value co-creation activities in developing and using the industrial AI technologies and identify different capabilities that are applied to facilitate their value co-creation practices. Second, the use of industrial AI technologies is the case setting is still at the trail stage, which means apart from the supplier Huanuo and the customer HW, AI providing companies are also in close contact with the supplier and customer. This enables the researchers to investigate different roles of supplier, AI provider and business customer in the value co-creation process. Figure 1 presents the participating companies and their relationships in the research setting.

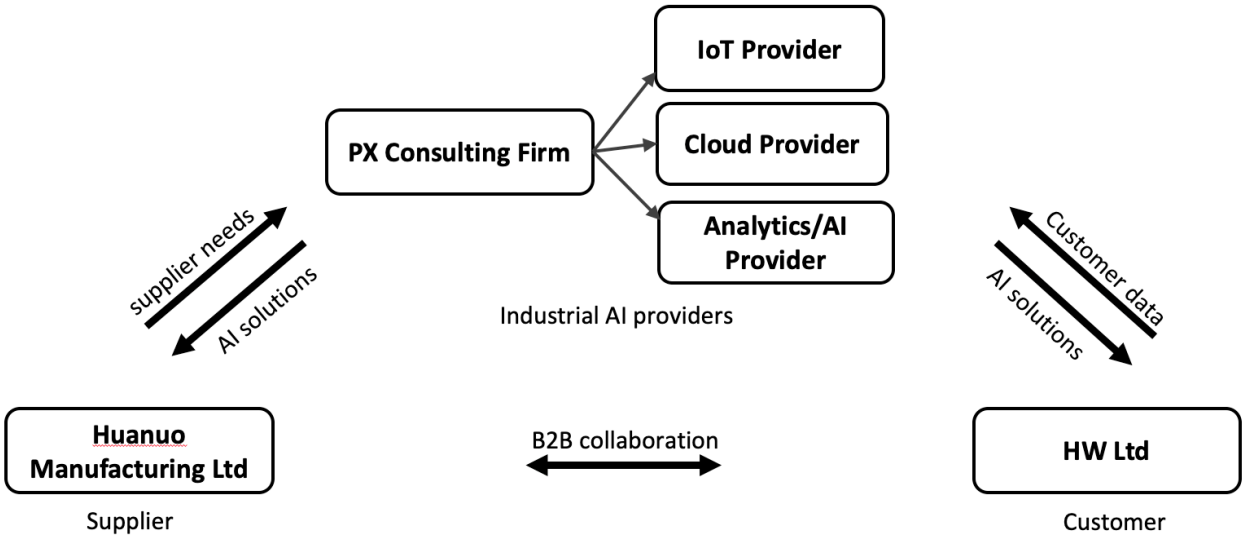

Figure 1. Multiple parties involved in Huanuo's business using industrial AI services and solutions

Semi-structured interview was adopted to gather in-depth insights from stakeholders of the six organizations participated in Huanuo's industrial AI implementation. The interview questions were elaborated with the research questions and thus structured into four parts: 1) introducing current role, duties and backgrounds; 2) different types of value that they shared or created in developing and using industrial AI; 3) capabilities and activities used during the value co-creation practice; and 4) perceived relationships in terms of which and how the capabilities assisted in facilitating co-creation practices. Nineteen interviews were undertaken with participants shown in Table 2. Each interview

lasted between 50 minutes to 1.5 hours and was recorded in a digital recorder; a total number of 20 hours and 34 minutes of interview recording was collected and analysed as the research data.

Participating Organisation			Professional Position	Area of Expertise	Years of Experience
Huanuo Material Manufacturing Ltd			CEO	Business and project management	30
			CTO	Production and ICT technologies	20
			IT Manager (H-ITM)	IS implementation and usage	15
			Operations Manager (OM)	Operation management and and new product development	20
			Marketing Manager (H-MM)	Sales management and new product development	17
Industrail AI Provider	**PX Consulting Firm**		Chief Consultant (CC)	Smart manufacturing strategic planning and roadmap design	15
			Junior Consultant (JC)	Industrial big data and AI usage	6
			Project Assistant (PA)	Smart manufacturing and project administration	4
	IT Providers	**IoT Device Supplier**	IoT Engineer (IoT-E)	IoT development and deployment	10
			IoT Technician (IoT-T)	IoT development and deployment	4
		Cloud Vendor	Cloud Engineer (CE)	Cloud security and cloud data warehouse	10
			Cloud Technician (CT)	Hybrid cloud development	5
		Big Data & AI Solution Provider	AI System Analyst (AI-SA)	Analysis of industrial AI usage requirements	12
			AI System Designer (AI-SD)	Design of industrial AI systems	7
			AI System Programmer (AI-SP)	Programming and system development	5

			Algorithm Engineer (AE)	Data analytics and algorithm development	11
HW Ltd			Marketing manager (HW-MM)	Sales management and new product development	10
			Stock manager (SM)	Supply and purchasing management	6
			IT manager (HW-ITM)	IS implementation and usage	4

Table 2. Profile of interview participants in the case study

3.2 Data analysis

The data was analysed following a thematic analysis approach (Boyatzis, 1998; Guest et al., 2011) through which the data was coded as 'concepts' and then derived into patterns and themes. Our analysis began with 'contextualisation' and 'familiarisation' that involves transcribing the digital recording data into texts, reading and re-reading the data, and noting down self-memos (Ritchie et al., 2003). The purpose of this stage is to obtain an initial understanding of the three groups of stakeholders i.e. the supplier company, AI providing companies and the customer company, and of the narratives for value co-creation among these three groups of stakeholders. The second stage started by theorising and comparing the incident from the data into codes and labelling the codes in a way that represents a particular meaning relevant to the phenomena being studied (Tuckett, 2005). The data and emerged codes were constantly and systematically examined and compared by researchers until a full list of codes was generated. This process also allowed us to discover possible patterns and relationships in the data, and recorded these insights in memos. Quotations herein were also collocated relevant to each code.

The third stage of analysis was concerned with generating themes and relationships between codes and themes, by comparing and exploring the underlying meanings for each code, theme and the relationships between them. When the potential themes were generated, we continued to carry out an evaluation of whether the themes are meaningful in relation to one another and the entire data set (Ritchie et al., 2003). This is an important step that allowed us to identify what composes different types of value that are co-created among the three groups of stakeholders, capabilities contributing to the co-creation of value, and their interactions. Finally, after the emergence of all codes and themes, the principle of 'suspicion' was followed to avoid potential biases of the narratives and ensure consistency between the quotations and the labels for codes and themes.

It is worthy of noting that the whole coding process was undertaken by one researcher in order to keep consistency for the interpretations and coding procedures. To ensure the validity of coding and the researcher kept a record of code definition list with supporting definitions and quotations, and presented regularly with the research team members to discuss the conceptual refinement, labelling and relabelling for codes and themes, and the degree of integration and 'fit' between labels and data.

4. Findings and theoretical framing

4.1 Types of co-created value among B2B stakeholders in industrial AI

This section responds to the first research question of value types that are co-created among the three main business partners (i.e. Huanuo as the materials supplier, technological companies as the AI provider, and HW as the materials customer) during the industrial AI development and usage. The thematic analysis of the interview data led to the emergence of four types of value, namely strategic co-planning value, functional value, value of joint organisational learning, and customer experience value. Table 3 provides a further summary of the value types with associated dimensions of each type.

Value types	Dimension of each value
Value of strategic co-planning	Aligning industrial AI technologies to business objectives
	Integration of customers' requirements for new product development
	Contextual knowledge for the industry
	Awareness of potential risk
Functional value	Data integration between supplier and customer
	Sales prediction
	Automation and problem-solving for supply chain system
Value of intra- and inter- organisational learning	Awareness of inter-organisational conflict between supplier and customer
	Understanding of departmental conflicts
	Collaborative solutions
Customer experience value	Creation of comprehensive customer profiles
	Understanding of customer preferences and personalities
	Understanding of customer concerns

Table 3. Findings for co-creation value types

Value of strategic co-planning

Value of strategic co-planning, emerging from the research data, refers to the understanding of customer requirements and the awareness of the supplying company's business needs, and then transferring these into feasible industrial AI design and holistic use of AI to develop new products that meet the customer's requirements. This type of value is co-created among various companies involved in the industrial AI efforts, and is reflected in i) the stage of developing industrial AI systems and ii) the stage of using industrial AI in new product development.

In particular, the roles, objectives and requirements of Huanuo (as the supplier) and HW (as the customer) were systematically analysed and synthesised since the strategic planning stage of the AI use. These were then transformed (by AI consultants and technical vendors) into a holistic technological plan that contained a set of possible AI use cases with risk and resource considerations, and communicated this plan with Huanuo and HW. Industrial AI technologies also assist Huanuo and HW in collaboratively developing new products. As streessed by CC (shown in Table 2), "*Before using AI, Huanuo acted as the 'brain' in all decision making process to develop new products. After using AI, the system can automatically collect, store, process and analyse industrial and marketing data from not just Huanuo but also HW, and makes machine suggestions on new product research, design and development. This does not just bring HW into the co-planning and co-decision making process of product research, but can potentially lead to the development of new products that better suit HW's strategic needs.*"

Functional value

Functional value is achieved by industrial AI in the daily operation and corporation between the supplier and customer. Primary functional value that is achieved by using industrial AI includes data integration between suppliers and customers, sales prediction via analysing unstructured and structured marketing data, and automation and problem-solving for the supply chain system. In this study, functional value is mostly shared and used between Huanuo and HW. Functional value is reflected in the automation of supply chain routine work such as scheduling orders, automating following-up tasks and answering frequently-asked questions via chatbots.

Despite that manual and repetitive work can be largely reduced after the realisation of functional value, achieving and enabling functional value of AI is a dynamic process that requires intensive communication and collaboration among Huanuo, PX Consulting and different IT providers, and HW, in order to resolve any disagreements and distinguish each party's responsibility. Particularly, interviews carried out with HW illustrated that the sales and requirements from the customer side

contributes to achieving the AI's functional value that the process always involved reciprocal or two-way rather than linear direction of communication: "*This is never a linear or straightforward process. After providing Huanuo the information of our requirements and expectations, they need to come back to us for many times and we test how the AI application performs in answering our queries, predicting demands and scheduling orders"* (HW-MM).

Value of intra- and inter- organisational learning

Value of intra- and inter- organisational learning refers to the growing understanding of mutual goals and awareness of common clash of interests both inside each participating organisation (i.e. intra-organisational conflicts) and among different organisations (i.e. inter-organisational conflicts), and the process of finding solutions and achieving mutual agreements. As a typical intra-organisational conflict that occurred within the supplying company, the IT manager of Huanuo highlighted that "*functional departments may raise some AI requirements that they consider to be important to improve operational performance, but these not be feasible to achieve from a technical perspective*" (H-ITM). Gaining an awareness and value of such situations plays a crucial role in avoiding internal conflicts. The emphasis during the value co-creation and communication process should be placed on the mutual interests among different participants and the efforts in reaching mutual understanding and agreements.

In the collaboration via industrial AI, the learning of inter-organisational goals and common conflicts occurs more frequently. For the supplier Huanuo and customer HW for instance, the conflicts are mainly due to the facts that " *the customer tends to be over-expected after participating and using AI technologies"* (H-MM). From the supplier perspective, "*it is difficult to adopt and use industrial AI technologies in B2B modes in the first place. Unlike B2C where there are always bigger companies that we can follow as examples, using industrial AI in B2B is like a process from zero to one that we can barely duplicate or follow any example because this is still very new in our industry"* (CEO). This initiates communications and discussions between Huanuo and HW regarding their own business goals and expectations towards the other. Throughout the discussion and with longer use of AI, these two companies can achieve more mutual understanding, as indicated by the manager from HW: "*We firstly rely on AI technologies for further collaboration, and gradually we understand our counterpart company well enough that sometimes we feel the emphasis on AI starts to vanish. The overall purpose here is to build stronger relationships and collaborations, and AI technologies are only ways to achieve these*" (HW-MM).

Customer experience value

Positive experience from customer can be considered as a collaboration output from the supplier, AI provider and the customers themselves. To create positive customer experience, the supplier and AI providers need to analyse customer preferences, market trends, and changes in national and international environments. As noted by the AI solution provider, "*we need to input in our AI system and share among the company regarding our B2B customers, especially regarding what, how and reasons for their purchasing decisions. This helps to analyse customer preferences and create better customer experience in our future collaboration*"(AI-SD). Industrial AI also assists Huanuo in building sufficient B2B sales funnel by using the predictive functionality and carrying out requirement elicitation: "*Our AI system can store both unstructured and structured data regarding purchase history, and use machine learning, algorithms and customer profiles to match sales to customised make-to-order needs"* (H-MM).

Another dimension of consume experience value focuses on the understanding of concerns inside of the customer company. As suggested by the findings, staff and workers from diverse parties were very different in terms of areas of expertise, education, previous experience, personalities, behaviours, and motivations. Interviews with HW revealed that with the adoption of AI technologies, fear of losing jobs especially from purchasing professionals appeared. The round of transformation enabled by industrial AI will have profound impacts on the sales and managerial levels by "*reducing the hitherto needs of human decision making, changing the roles of purchasing professionals and managers, and reshaping current power structure*" (SM). Understanding and addressing such awareness and the understanding of concerns are critically important to smoother transition and use of industrial AI technologies.

4.2 Capabilities facilitating industrial AI-related value co-creation practice

This section presents capabilities that are needed for creating value and for facilitating value co-creation practices in developing and using industrial AI technologies. Four categories of capabilities that are applied by different parties i.e. supplier, customer and AI providers and that contribute to value co-creation practices emerged from the data analysis, as summarised in Table 4.

Themes	**Capabilities**
System Management Capabilities	AI system integration and operation with multiple data sources
	Technology reflection and re-application

	Simplifying interpretation of technical knowledge
	Innovative technology solution
	Clear technical demonstration
	Being able to adhere to standards
Commercialisation - based Capabilities	Supplier-customer-AI technology joint product life-cycle
	Negotiation
	New business creation via AI
	Marketing
	R&D collaboration with assistance from AI
Interpersonal Capabilities	Effective communication
	Network mobilisation
	Positive and quick responses
	Building trust and long-term relationship
	Balancing hard and soft approach

Table 4. Findings for Capabilities and their relationships with the identified value types

System management capabilities

System management capabilities focus on applying the technical knowledge and 'hard' skills required to collaboratively address practical and technological problems that take place in developing, using and managing industrial AI. In particular, PX Consulting and IT provider need to have the capability to reflect and re-use the technological knowledge that they already possess from previous experience, in order to propose suitable solutions for the current AI development and usage. This helps to create the functional value of AI more efficiently.

Moreover, system management capabilities also focus on providing innovative technological solutions for long-term collaboration between the supplier and customer, facilitating to create common visions and the value with regard to incorporating AI into supplier-customer relationships and business activities. The capability of being able to adhere to standards assists the sharing of holistic design of industrial AI, and thus facilitates the creation of functional value. Additionally, as revealed by the Junior Consultant of PX Consulting, "*as several different parties were involved in the AI development, being able to simplify technical interpretations and demonstrate technical solutions clearly are important capabilities for essential technical knowledge exchange among the participating stakeholders*" (JC).

Commercialisation-based capabilities

Commercialisation-based capabilities refer to the application of knowledge, skills and available resources to perform commercial activities for marketing and production purposes. R&D capability is a critical indicator of the innovation level of the supplier-customer collaboration. In the investigated site, both Huanuo and HW rely on AI technologies to generate insights of the industry's current situations and future trends; based on these insights, they use R&D capability to drive new product developments that fulfil HW as customer's changing needs. As indicated by H-MM, "*sensitive to the value such as service uniqueness, industrial trends and competitive advantage becomes very important to our company and also to our collaboration with HW. Using AI tools can provide us these insights and thus can help us to create business value, and also co-develop products with higher commercial potential.*"

Commercialisation-based capability also involves being able to negotiate with the overall goal of reaching agreements. In the research site, negotiation was found to be indispensable to the participating parties to mitigate inter-organisational conflicts and reach reciprocal benefits. Negotiation inside the organisation is also critical for Huanuo to deal with cross-departmental conflicts (e.g. managerial power reduction and changes of working conditions) led by the adoption and use of industrial AI. Furthermore, the capability of expanding market and creating new business opportunities are essential to facilitate the creation of the value of strategic co-planning, especially "*when identifying market opportunities, we need to consider how to add value to our current products. For instance, there has been increased demand for high-purity iron materials in the industrial market, and we work collaboratively inside the company and with HW to better commercialise the high-purity iron that we possess*" (H-MM).

Interpersonal capabilities

Interpersonal capability is used to establish and maintain good relationships with cooperating companies for the intention to build trust, easily communicate, retain long-term relationships, and finally achieve marketing and business goals. Effective communication with considerations regarding people's concerns and feelings, would help to "*create a positive environment where value creation takes place in a smooth manner and participating members are more encouraged to contribute*" (CEO). The skill of balancing hard and soft approaches to provide corrective messages and criticisms at appropriate moments, is particularly critical to addressing "*departmental and inter-organisational conflicts*" (OM), and thus it helps suppliers and customers to jointly create the value of strategic planning.

Positive and quick responding is also an important aspect of this type of capability. As highlighted by the Operations Manager of Huanuo, "*due to unexpected issues, we and HW may need to change certain technical AI requirements in the middle of the project, but our IT vendors may not always be happy about this*". In such circumstances, it is important for leaders in Huanuo, and ideally also HW, to have good and trusted relationships with the IT providers; as such, they are persuaded to understand and accept the changes. In sum, the application of interpersonal capability always involves two-way interactions. Building trust and interpersonal relationship is the key to engage business partners and mitigate intra- and inter-organisational conflicts.

5. Discussion and implications

This study, underpinned by service dominant logic, investigates how firms jointly create value in developing and using industrial AI technologies in a B2B marketing context. Literature has acknowledged the significant impact of AI in reshaping marketing activities and relevant industrial partners (Davenport et al., 2019; Dwivedi et al., 2021b), and has emphasised on the necessity of studying knowledge, value and workforce skills in such AI adoption (Bag et al., 2021). This research responses to such gap, and the findings lead to the emergence of a typology of value that is co-created among supplier, customer and AI provider in B2B marketing context, and a categorisation of capabilities that contributes to their value co-creation practices. Our findings reveal a dynamic and inter-related nature of value types and capabilities within the industrial AI development and usage. These demonstrate how B2B companies and stakeholders may need to change their relevant patterns and strategies for industrial AI adoption and usage. Consequently, we derive two key propositions which we argue to be crucial in shaping value co-creation practice in industrial AI among B2B stakeholders, and in serving as a foundation for future empirical research.

First, there is no fixed relationship between these identified value types and capabilities given their dynamic nature. Digital technologies in broad constantly change and reshape marketing activities in the B2B context (Dwivedi et al., 2021b). A number of studies highlighted challenges of gaining tangible resources enabled by AI, enabling automated intensive interactions in the sales process, and acquiring relevant workforce skills in order to cope with the dynamic business environment (Bag et al., 2021; Davenport et al., 2019). To address such challenges, value co-creation among stakeholders should follow a holistic and flexible manner (Leone et al., 2021). In principle, management system capabilities are most useful in generating functional value and customer experience value, whereas

commercialisation-based capabilities and interpersonal capabilities are much needed to facilitate the co-creation of strategic co-planning value and organisational learning value. This is because functional value and customer experience value tend to be more procedural that they depend on AI users (i.e. employees in the B2B context) in coordination with experts who possesses in-depth knowledge to understand and explain the entire process (Bag et al., 2021 a). On the other hand, strategic co-planning and organisational learning are considered as more socially complex and tactical resources that depending on the interpersonal and commercial related capabilities to be achieved, in order to embed these into AI design and use for efficient decision making (Bag et al., 2021, b). As illustrated by the findings, the industrial AI development and usage is a collective and interactive process that involves dynamic co-creation of different value types and dynamic application of capabilities. The interconnections between the capabilities and value types reflects in such a way that the application of the former needs to be considered with the sharing of the latter, i.e. certain capabilities are more in conjunction with certain types of value and the need to collaboratively create a particular type of value triggers the application of particular capabilities. They should be understood as interrelated, overlapping and intersecting through specific situations and activities.

Proposition 1: The dynamic intersections between different types of value and capabilities are crucial in implementing and using industrial AI in the B2B context.

The second argument is that the application of capabilities and the creation of value do not operate independently of each other, but overlap and interact over the duration of the development and usage of industrial AI. Prior research suggests that AI service provider and user jointly co-create value in a way that characteristics of user can feed back to the AI design and adoption (Davenport et al., 2019; Lenka et al., 2017). Throughout such a merged interactive process, the quality of accumulative learning and communication is the key to efficient value co-creation practice (Mustak et al., 2021). A collective and relational nature exists both in and between value types and capabilities that contribute to the co-creation of value. In organisational studies, dependence is considered as a condition where two entities, in order to meet their goals, need to take each other into account (Carlile, 2004). The creation of different types of value cannot be separated from one another; more importantly, the interrelations between value and capabilities cannot be isolated. Industrial AI practitioners and B2B professionals need to apply different capabilities to facilitate and enable their value co-creation practices.

Proposition 2: Value co-creation in industrial AI is a collective and inter-related process that value and capabilities are accumulative with the AI project evolvement and continuous usage.

5.1 Theoretical implication

This study responds to calls to investigate and harness the use of AI for B2B marketing research from a supplier-customer collaboration perspective (Dwivedi et al., 2021a), and to improve understanding towards capabilities in value (co-)creation literature (Wilden et al., 2019). This research has expanded the current literature in three meaningful aspects.

First, this study contributes to AI related research regarding key stakeholders and organisations in AI for B2B marketing purposes. We address gaps in knowledge regarding stakeholder participation in AI for B2B marketing (Dwivedi et al., 2021a) and how they collaborate in a supplier-technology provider-customer relationship across organisational boundaries (Taylor et al., 2020). The findings provide new insights of how value it is jointly created among three groups of stakeholders (i.e. supplier firm, AI vendor, and customer company) within AI technology in the integrated supply chain. The findings also contribute to the marketing and information systems literature by bridging them within the context of industrial AI development and usage, and revealing how value creation among suppliers, customers and technology companies can support and facilitate AI initiation, conceptualisation, analysis, and delivery.

Second, within the growing body of marketing literature regarding value co-creation between suppliers and customers, this study builds upon previous research of a service dominant logic and contributes to theory by providing a typology of value and a categorisation of capabilities. Based on a case study of a B2B supplier-customer relationship in the context of industrial AI, we address the gap in B2B marketing literature that there is a lack of investigation into value co-creation practices especially grounded from work experience (Lilien, 2016). Findings in this research have demonstrated how suppliers, customers and technology providers co-create different types of value in their daily operations in developing and using AI technologies. Four types of value together with different dimensions within each value are identified from experienced B2B professionals in reflection of their industrial AI experience. Our results also extend the understanding regarding experience of customer companies participating in the development and usage of industrial AI technologies, and creating value collaboratively with suppliers in the industrial AI context.

Finally, this study provides new insights into capability related literature by adopting an integrative approach and identifying dynamic relationships between particular capabilities and value types. Despite the growing literature on individual and firm capabilities, there is a lack of studies consider capabilities for value co-creation especially within particular industry context. In line with a few existing empirical studies that emphasise the importance of capabilities in creating value for firms and customers (e.g. Raddats et al., 2015; Wilden et al., 2019), our research demonstrates that value co-creation practice is significantly facilitated and impacted by the combination and application of individual capabilities in the manufacturing industry. Furthermore, this study introduces an innovative integrative approach to firstly identify what types of value are being created among stakeholders and then subsequently explore what capabilities are applied to facilitate such value creation. This approach enables us to identify how a particular set of capabilities can be related to and facilitate the creation of a particular type of value across organisational boundaries.

5.2 Managerial implication

Incorporating AI technologies into business operation and B2B activities has become an increasingly crucial strategy for firms to create competitive advantages. The increasing adoption of AI reflects the importance of understanding the value generated in the AI context in order to make efficient strategic decisions. Our findings provide several important implications for managerial practices, especially considering that the AI application in B2B marketing is still at an initial stage of development.

First, the responsibility for B2B professionals encompasses many scopes, and expectations for these roles and capabilities continue to grow especially with the advance of technology. Our study has identified three critical categories of capabilities that would benefit B2B marketing professionals (i.e. both suppliers and customers) in using AI technologies to collaborate with business partners and to create business value. Particularly, our findings suggest that 'soft' capabilities such as commercialisation capabilities and interpersonal capabilities still play an important role in the AI context, and thus practitioners could develop and incorporate these capabilities as they collaborate with counterparts across organisational boundaries. Furthermore, the management system capability in the AI context emphasises more on being able to interpret and use the analytical results. As the solution provider and product promoter, marketing professionals especially from the supplier companies would need to engage with customers in a comprehensive manner and flexibly apply the capabilities identified in section 4.2. This also sets the future orientation of training that top

management teams in organisations should have.

Second, our case study, which involved suppliers, customers and AI technology providers, can provide insights to managers operating in similar B2B settings. Particularly, the typology of co-created value identified in section 4.1 provides useful guidance and a clear vision for managers and companies when they carry out strategic planning and decision making in using industrial AI technologies. The value types and capabilities have profound implications to be learned by supplier companies, AI consultants and vendors, and customer companies involved in jointly developing and using AI in their business. These findings can help these three sides in this B2B setting to create business and marketing value more effectively, reach mutual understanding more easily, and eventually increase competitive advantages.

Third, this study also provides insights to AI technology companies, especially those providing services to the smart manufacturing industry. AI offers the transformative potential for the manufacturing industry to climb higher in automation, and therefore AI companies serving this industrial sector can expect an increasing number of business opportunities. Our findings provide practical insights to AI technology providers regarding what the value expectations are from their customers, i.e. the supplier company and the customer company in the B2B context.

5.3 Limitations, future research and conclusions

Despite its contributions, this research also has some limitations and there are several opportunities for future research to deepen the understanding of value co-creation in industrial AI and in B2B marketing context. First, it should be acknowledged that the study presents limitations in relation to its scope. In particular, only one representative case project (with one supplier company, one customer company and four AI service providers) was chosen to generate in-depth understanding for the phenomena under investigation. This single case study was also rooted in the context of the materials industry in China. This will raise concerns about transferability of the findings in other contexts. Therefore, taking the results of this research as the theoretical basis, fellow researchers can adopt a multiple-case approach in future studies on this topic to enable better cross-case comparison.

Another limitation is that we only investigated the AI technologies in its development and initial usage stage in our fieldwork, other than the large-scale use of AI in B2B marketing at a mature level. Insights into the mature use of AI technologies would substantially advance the supplier, customer

and technology provider relationship and value co-creation in AI context. Given that our findings suggest 'soft' capabilities such as interpersonal capabilities and commercialisation-based capabilities still play important roles in incorporating AI into business, future research could consider test and validate these in a more mature AI use context.

Furthermore, as our study only uses interview data to answer the research question, future research can consider exploring this issue by expanding research data types and including survey data and secondary data from different companies in similar B2B settings. This would benefit the study by revealing additional details about practitioners' conceptions regarding the value typology and capability categories. Quantitative data may also be conducted in future research to validate the list of value types and capabilities, as well as to test the dynamic relationships between them, in different industrial, national and cultural contexts.

6. Conclusion

This study is focused on the value co-creation among different groups of B2B stakeholders in developing and using industrial AI. Via in-depth interview with nineteen stakeholders from six B2B companies, the findings of this research suggest four types of value that is co-created among B2B professionals including , and three sets of capabilities that facilitate the value co-creation practices associated with industrial AI adoption and use. The research also highlights the dynamic, collective and inter-related nature between the value types and capabilities. This paper extends the understanding of value co-creation in AI development and use, and also provides useful guidance for practitioners considering adopting and advancing industrial AI technologies as part of their business and marketing activities.

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