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THE IMPACT OF REGULATION READINESS AND COLLABORATION IN EMPOWERING BUSINESS MODEL INNOVATION IN IOT COMPANIES

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ABSTRACT

This study investigates the influence of perceive regulation readiness and collaboration on business model innovation and business performance in the Internet of Things (IoT) Companies. With IoT's rapid growth, companies face the challenge of continually adapting their business models to evolving customer needs and regulatory frameworks. Drawing on contingency theory, the study emphasizes that no single strategy fits all organizations and that constant innovation is essential for sustainable success. Data was collected from 75 IoT companies in Indonesia, analyzed using SmartPLS to assess relationships among the variables. Findings reveal that regulatory readiness positively influences collaboration, which in turn significantly enhances business model innovation. Business model innovation is shown to directly impact business performance, highlighting its critical role in achieving competitive advantage. However, the study finds no significant moderating effects of regulatory readiness or collaboration on the relationship between business model innovation and performance, suggesting that these factors act independently rather than as moderators. Additionally, the study underscores the importance of IoT security standards, particularly in balancing technical and non-technical considerations such as data privacy. The findings provide insights into the strategic importance of adaptable business models and the need for regulatory frameworks to support IoT innovation effectively

KEYWORDS *Regulation, Internet of Things, collaboration, business model innovation*

INTRODUCTION

Today, various devices, including the Internet of Things (IoT), are interconnected, enabling seamless data exchange through the internet. IoT technology is seen as a transformative innovation, poised to reshape human life and revolutionize the industries (Matta and Bant, 2019). The Internet of Things (IoT), a pillar of Industry 4.0, holds substantial promise and has garnered significant attention from practitioners and academics alike (Eddine et al., 2018). The rapid evolution of IoT across nearly every country has sparked an increased interest in exploring its potential. The Fourth Industrial Revolution, characterized by the

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integration of IoT in cyber-physical systems, is expected to have a profound impact on global economic performance (Seeger et al., 2022). However, reports by McKinsey (2016) and the World Economic Forum (2018) highlight that Indonesia remains in the early stages of digitalization, with low productivity levels reflecting its nascent digital landscape. Despite these challenges, Indonesia has an estimated potential GDP growth impact of USD 150 billion by 2025 if it succeeds in advancing its digitalization efforts (Global Insight, 2015). Looking ahead, the Indonesian government has set ambitious targets for the digital economy. Former President Joko Widodo projected that by 2030, the digital economy could reach USD 356 billion, with digital payments expanding 2.5 times to 793 billion. This optimistic outlook is supported by Indonesia's demographic dividend, with 68% of the population in productive age groups, including Gen Y, Gen Z, and Gen Alpha (Google, Temasek, & Bain & Company, 2023). These developments underscore the critical role of the digital economy in Indonesia's overall economic growth and its potential to significantly enhance the nation's GDP in the coming years.

IoT can be viewed from two key perspectives: the user and the provider. The business model framework serves as an essential approach to understanding how technology providers deliver IoT solutions to customers (Baden-Fuller & Haefliger, 2013). Yet, developing a sustainable IoT business is far from straightforward; even established IT giants like Microsoft have faced setbacks in transitioning to cloud and IoT due to gaps in concept understanding and experience (Fugl, 2015). A nuanced grasp of IoT's complexities and its business model dynamics is critical for competitive advantage. An effective IoT business model framework must reflect the intricacies of IoT, encompassing organizational factors, industry demands, and the broader ecosystem. Organizations face not only internal challenges in innovating business models but also external challenges within their interconnected ecosystems (Adner & Kapoor, 2010).

In Indonesia, the IoT ecosystem lags behind other digital sectors like e-commerce and fintech, with notable growth barriers such as limited local equipment providers, low technical competency, and inadequate government policy support. IoT providers look to the government for active roles in frequency regulation, standardization, certification, and the development of infrastructure, like national IoT labs, to foster domestic IoT advancements (Prasetya, 2018). However, Bujari (2017) identifies four major challenges limiting IoT adoption: security, interoperability, privacy, and business model issues. Governments globally face similar struggles as they take preliminary regulatory steps to enable IoT deployments, focusing particularly on security, interoperability, and privacy. IoT’s vast potential for big data analytics offers improved services and faster decision-making, yet it also presents security vulnerabilities, as illustrated by risks in smart homes and buildings. The government recognizes the need to efficiently manage and regulate the rapid advancements in internet technology that support production activities (Hakim et al, 2023).

Collaboration emerges as a vital driver of innovation, as companies often lack the comprehensive capabilities needed to foster breakthroughs independently (Chesbrough, 2012; Ramírez-Montoya & García-Peñalvo, 2018). By pooling core

and complementary strengths across the value chain, collaboration accelerates the innovation process (Al-Debei, 2010).

Government regulation will affect the innovation of strategyc industries (Gao et al., 2021). In regulatory economics, Stigler's (1971) foundational theory explores how regulations affect industries, determining who benefits or bears the cost, the nature of regulatory measures, and their impact on resource allocation. He argued that government holds the power to support or "burden" industry players, impacting both established and emerging companies across sectors (Posner, 1974). Companies must adapt their business models in response to government regulations. They can also engage in creating industry interest groups, like associations and communities, to provide feedback and influence regulatory frameworks (Shaffer, 1995). The ability to align business practices with regulatory changes is increasingly critical, impacting the strategic business models that companies adopt.

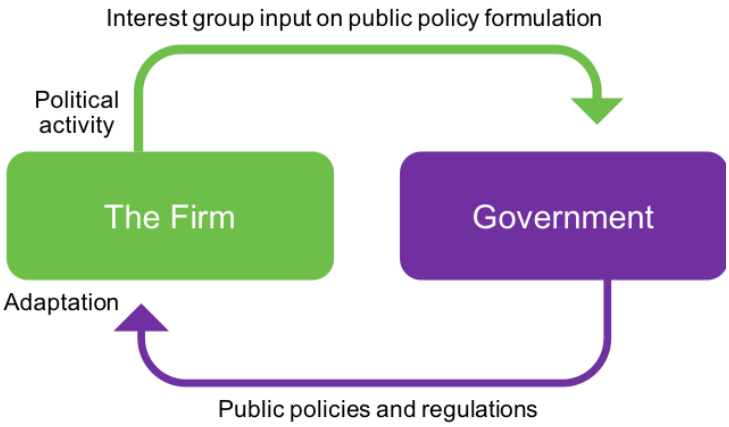

Figure 1. The relationship between the firm and government
Source: Shaffer (1995)

Figure 1 provides a simple illustration of how companies adapt to government regulations. At the same time, companies can also form interest groups, such as communities and associations, based on factors like industry, scale, or geography, to provide input and influence the government as a regulator (Shaffer, 1995). The ability of a company to align its business with regulations is crucial, as this can significantly impact the business model it adopts.

RESEARCH METHOD

The study sample comprises 75 IoT companies operating in Indonesia. A questionnaire was created using the premium version of SurveyMonkey and distributed to 153 respondents, yielding 75 valid responses—a response rate of 48%. Data analysis was conducted primarily using SmartPLS to assess construct reliability and perform bootstrapping analysis.

Regulations affect both new and established companies across industries of various sizes and types (Posner, 1974). In the IoT ecosystem, collaboration among companies is essential to deliver effective solutions for customers. Regulatory

readiness enables IoT companies to collaborate more seamlessly. For instance, a clear regulation on the frequency spectrum for IoT LoRa technology provides certainty for relevant stakeholders—such as LoRa network providers, telecom operators, and system integrators—to work together in delivering IoT solutions for customers. The more prepared the regulatory framework, the greater the potential for IoT companies to engage in collaboration. H1: Perceived regulatory readiness is positively related to collaboration.

Collaboration facilitates co-creation, leading to business model innovation (Berman, 2012; Kodama, 2018). According to Afuah (2013), one of the key external environments influencing business model success is the ecosystem. The complex nature of IoT solutions requires ecosystem-wide collaboration to provide integrated offerings. Collaboration is critical, as it allows companies to access external resources that may not be available internally. Small or new companies often focus on specific technologies or core competencies, making it beneficial to form partnerships rather than developing internal capabilities (Hui, 2014). As technology-driven business models in IoT continuously evolve, companies need partners who can support ongoing transformation and adaptation. These partnerships provide insights into market changes and innovations that a company might otherwise overlook. IoT business models include several essential elements, some of which can only be fulfilled through collaboration within the ecosystem. Working with other companies increases opportunities for each organization to innovate its business model. H2: Collaboration is positively related to business model innovation.

Regulation can both hinder and facilitate business model innovation (Hall & Roelich, 2016). Regulatory readiness significantly influences business model choices, enabling companies to build effective, innovative business models (Association, 2008). Innovation, in this context, involves selecting and integrating diverse elements to create the right business model. H3: Perceived regulatory readiness is positively related to business model innovation.

A business model acts as a framework outlining how companies generate, deliver, and retain value. Clauss (2016) identifies three core elements within a business model: value creation, value proposition, and value capture. The value proposition highlights the advantages provided to customers, value creation focuses on the mechanisms enabling these benefits, and value capture emphasizes the process of deriving revenue from the model. H4: Innovation in the business model has a positive impact on business performance.

Afuah (2013) emphasizes the importance of the ecosystem as a determinant of business model success. IoT, as a complex solution, relies on ecosystem cooperation to deliver integrated offerings. No single provider can enable a comprehensive IoT solution independently (Intel, 2019). Ecosystem readiness greatly affects the performance of business models, as companies work together to create mutually beneficial products and services, enhance customer satisfaction, and foster continuous innovation (Moore, 1993). IoT operates as a global, interconnected network of devices with self-configuring capabilities, connecting through standardized protocols (Mazhelis et al., 2012). This level of complexity requires a supportive and cohesive ecosystem.

Collaboration is instrumental in providing external resources that companies may not have internally. Small and new companies, in particular, focus on specialized technologies or core competencies, so collaboration becomes preferable to developing in-house capabilities (Hui, 2014). For tech startups, partnerships are essential for accessing broader resources and knowledge (Del Giudice et al., 2013). Maintaining partnerships with suppliers, customers, and even competitors is crucial for creating value. Given the dynamic nature of IoT, companies must consistently seek partners aligned with technological developments. Partners can share insights into transformations that may go unnoticed internally. H5: Collaboration moderates the relationship between business model innovation and company performance.

IoT regulations address frequency allocation, data privacy, and security. The government, acting as a regulator, plays a key role in establishing frameworks for new technologies in Industry 4.0, including IoT, Cloud, and Big Data. Recently, the government released a draft regulation for IoT to ensure that devices comply with Indonesian standards. However, the Ministry of Communication and Information Technology (Kominfo) and other relevant institutions face challenges regarding IoT regulation, specifically in frequency standards, device standards, and domestic component levels (TKDN). Regulations must keep pace with global technological advancements, as various vendors develop products with differing standards and protocols. The government is expected to balance these considerations to formulate adaptable regulations.

One critical regulatory issue involves deciding whether IoT frequency bands should require licensing. Licensed frequencies would require IoT providers to purchase a license, whereas unlicensed frequencies could leave Indonesia vulnerable to foreign devices potentially introduced without proper authorization (Ismail, 2017). Thus, while regulation can have positive impacts, it also carries potential drawbacks. This research explores whether regulatory readiness as a moderator influences the relationship between business model innovation and company performance. H6: Perceived regulatory readiness moderates the relationship between business model innovation and company performance. All hypotheses are revealed in Figure 2.

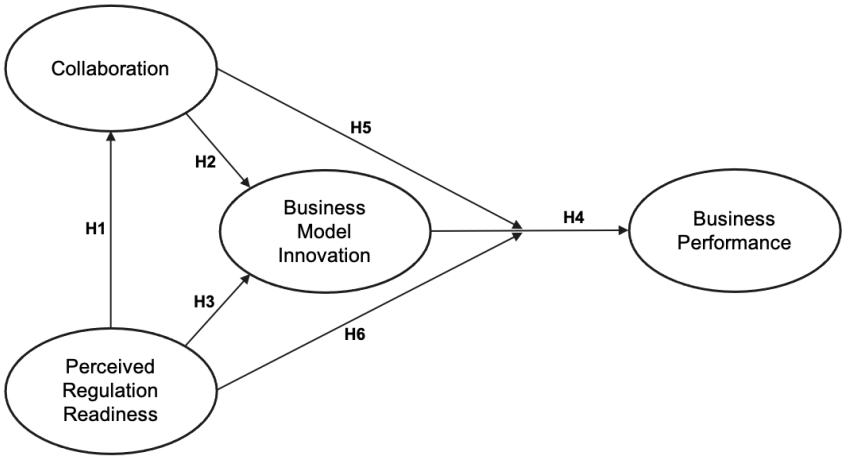

Figure 2. Research framework

RESULT AND DISCUSSION

The respondent demographics indicate that 5% are female, while 95% are male. In terms of IoT company types, 31% deliver end-to-end IoT solutions, 9% concentrate on IoT hardware, 4% specialize in IoT software development, and 56% operate as IoT system integrators. The majority of these companies are located in the Greater Jakarta area (Jabodetabek), Indonesia's central economic hub. Additional locations include three companies in Bandung, and others in Cilacap, Magetan, Medan, and Pekalongan. In total, nearly 90% of respondents are based in Jabodetabek. Regarding roles, 33% of respondents are founders or owners, 28% serve as Directors, 24% as Managers, and 15% as General Managers or VPs. Most respondents are associated with product development (39%), sales (38%), with the remaining 23% focused on technical sales. Table 1 provides an overview of the respondent profile.

Table 1. Respondent's Profile

Demographic Variables	Categories	Frequency	Percentage
Gender	Male	71	94.7
	Female	4	5.3
Location	Outside Jakarta	9	12.0
	Jakarta & the surrounding area	69	92.0
Job functions	Sales	29	38.7
	Technical Sales	17	22.7
	Product	29	38.7
Job title	Manager	18	24.0
	General Manager/VP	11	14.7
	Director	21	28.0
	Founder	25	33.3
Type of company	IoT hardware	7	9.3
	IoT software development	3	4.0
	IoT system Integrator	42	56.0
	End to end IoT solution	23	30.7

This study focuses on four main variables: Collaboration, Perceived Regulatory Readiness, Business Model Innovation, and Business Performance. The descriptive statistics, including the means and standard deviations for each variable, are summarized in Table 2. Among the variables, Collaboration has the highest average score (M = 5.18), reflecting strong respondent consensus, whereas Business Performance has the lowest average (M = 4.24). Collaboration also exhibits the least variability, suggesting a more consistent response pattern, whereas Business Performance has the highest variability, reflecting diverse perceptions among respondents. Overall, respondents rated all variables positively, with mean scores above 5, except for Perceived Regulatory Readiness and Business Performance, which scored slightly lower. These insights suggest a generally favorable view on

collaboration and business model innovation but highlight potential areas for improvement in regulatory readiness and business performance.

Table 2. Descriptive Analysis of Variables

Variable	Mean	Standard Deviation
Collaboration	5.18	0.53
Perceived Regulation Readiness	4.29	1.02
Business Model Innovation	5.16	0.62
Business Performance	4.24	1.07

A detailed measurement model encompassing all key variables was analyzed to confirm its reliability and validity. Two psychometric evaluations were performed: convergent validity and discriminant validity. Convergent validity was determined using Composite Reliability (CR), outer loadings, and the Average Variance Extracted (AVE). The detailed results are presented in Table 3.

Table 3. Measurement Model

Constructs	Cronbach's alpha	CR	AVE
Collaboration	0.851	0.890	0.576
Perceived Regulation Readiness	0.815	0.870	0.551
Business Model Innovation	0.892	0.912	0.513
Business Performance	0.995	0.968	0.882

All Cronbach's Alpha coefficients were above the recommended threshold of 0.70 (Nunnally, 1978), with values ranging from 0.851 to 0.995. Similarly, the Composite Reliability (CR) for all items exceeded the minimum recommended value of 0.7 (Hair, Black, Babin, & Anderson, 2010), ranging from 0.870 to 0.968. Furthermore, the Average Variance Extracted (AVE) values, which ranged from 0.513 to 0.882, surpassed the suggested benchmark of 0.5 (Hair et al., 2010; Fornell & Larcker, 1981). These findings confirm that the measurement model satisfies the criteria for convergent validity. Furthermore, each indicator's loading was greater than its loading on other latent variables, affirming discriminant validity. The detailed loading values are presented in Table 4.

Table 4. Discriminant Validity. Fornell-Larcker's Criterion

	Business Model Innovation	Business Performance	Collaboration	Perceived Regulation Readiness
Business Model Innovation	**0.716**			
Business Performance	0.524	**0.939**		
Collaboration	0.704	0.420	**0.759**	

Perceived Regulation Readiness	0.369	0.223	0.337	**0.742**

The table reveals that the square roots of the AVE values were greater than the squared correlations between each latent variable and the others, affirming discriminant validity. Henseler et al. (2015) recommend a threshold of 0.90 for the HTMT ratio, with values exceeding this limit suggesting potential issues with discriminant validity. As shown in Table 5, all variables in this study met the HTMT criterion.

In conclusion, the measurement model provided strong evidence of convergent validity, reliability, and discriminant validity, confirming its overall robustness for further analysis.

Table 5. Discriminant Validity: HTMT

	Business Model Innovation	Business Performance	Collaboration	Perceived Regulation Readiness
Business Model Innovation	-			
Business Performance	0.567	-		
Collaboration	0.804	0.465	-	
Perceived Regulation Readiness	0.444	0.263	0.449	-

With the measurement model validated as parsimonious, the structural model was evaluated using the Bootstrapping technique. Effect sizes were determined based on Cohen's (1988) guidelines, where 0.01, 0.20, 0.50, and 0.80 indicate very small, small, medium, and large effects, respectively. The results, summarized in Table 6, are as follows:

- Perceived Regulatory Readiness significantly influences Collaboration ($t = 2.750$, $p < 0.05$, $f^2 = 0.132$), supporting H1.
- Collaboration positively and significantly impacts Business Model Innovation ($t = 10.656$, $p < 0.05$, $f^2 = 0.779$), supporting H2.
- Perceived Regulatory Readiness has a positive and significant effect on Business Model Innovation ($t = 2.008$, $p < 0.05$, $f^2 = 0.039$), supporting H3.
- Business Model Innovation significantly affects Business Performance ($t = 3.455$, $p < 0.05$, $f^2 = 0.134$), supporting H4.

However, the moderating role of Collaboration in the relationship between Business Model Innovation and Business Performance is not significant ($t = 0.386$, $p > 0.05$, $f^2 = 0.003$), meaning H5 is not supported. Similarly, Perceived Regulatory

Readiness as a moderator does not significantly influence this relationship (t = 1.369, p > 0.05, f^2 = 0.039), resulting in H6 not being supported.

These findings underscore the direct positive effects of regulatory readiness and collaboration on business model innovation and performance, while the moderating effects remain insignificant.

Table 6. Hypotheses Testing

	t-value	p-value	Decision	f^2	Effect size
Perceived Regulation Readiness → Collaboration	2.750	0.006	Support	0.132	Very small
Collaboration → Business Model Innovation	10.656	0.000	Support	0.779	Medium
Perceived Regulation Readiness → Business Model Innovation	2.008	0.045	Support	0.039	Very small
Business Model Innovation → Business Performance	3.574	0.000	Support	0.168	Very small
Collaboration → Business Model Innovation towards Business Performance	0.386	0.700	Not Support	0.003	Very small
Perceived Regulation Readiness → Business Model Innovation towards Business Performance	1.369	0.172	Not Support	0.039	Very small

The first hypothesis (H1, supported, t-value = 2.750) confirms a positive relationship between perceived regulatory readiness and collaboration. In the IoT industry, stronger legal certainty is crucial for fostering collaboration among companies within the ecosystem. The second hypothesis (H2, supported, t-value = 10.656) establishes a significant link between collaboration and business model innovation. Enhancing collaboration enables companies to boost their competitiveness and drive innovation in business models (Eppler & Hoffmann, 2012).

The findings indicate that greater collaboration increases the likelihood of innovative business model development. The third hypothesis (H3, supported, t-value = 2.008) investigates the relationship between perceived regulatory readiness and business model innovation. In a dynamic regulatory landscape, businesses must design flexible models that adapt to evolving regulations. Aligning business models with regulatory changes enhances performance by ensuring compliance and agility in response to these shifts. The fourth hypothesis (H4, supported, t-value = 3.574) validates the positive relationship between business model innovation and business performance.

Consistent with earlier research, the study highlights business model innovation as a critical driver of performance, particularly in emerging sectors like

IoT (Futterer et al., 2017). This finding aligns with literature emphasizing that business model innovation plays a vital role in improving organizational performance (Zott et al., 2011) and supports prior research linking innovation to firm success (Bowen et al., 2010; Rosenbusch et al., 2011). The fifth hypothesis (H5, not supported, t-value = 0.386) explores the moderating role of collaboration in the relationship between business model innovation and business performance. This hypothesis assumed that collaboration is pivotal for accessing external resources, especially for smaller or newer firms focused on specialized technologies or core competencies (Hui, 2014). However, previous studies have noted that collaboration does not always influence the link between innovation and performance (Tuominen & Anttila, 2006).

Similar findings in the digital market industry indicate that collaboration may not directly impact business performance (Power et al., 2010). The sixth hypothesis (H6, not supported, t-value = 1.369) examines the moderating effect of perceived regulatory readiness on the relationship between business model innovation and business performance. The hypothesis was based on the idea that dynamic regulatory environments could present opportunities for businesses (Schneider & Spieth, 2013). While earlier research suggests that regulatory changes can shape the outcomes of business model innovation (Bohnsack et al., 2014; De Reuver et al., 2009; Zott & Amit, 2007), this study finds that regulatory readiness does not significantly strengthen the relationship between business model innovation and performance in the IoT sector. This suggests that although regulatory changes influence the industry, they do not necessarily enhance this specific connection.

CONCLUSION

Business model innovation is a vital component of a company's strategic approach. According to contingency theory, there is no one-size-fits-all strategy, as many contextual variables influence strategic fit (Donaldson, 1996). Companies must continuously refresh their business models to meet evolving customer demands. Sustainable business performance is driven by ongoing innovation in business models (Sousa-Zomer & Miguel, 2018).

This study underscores the necessity of continuous business model innovation, especially in the IoT sector. New regulations or collaborative opportunities often prompt IoT companies to revisit and adjust their business models. Adapting the business model to keep pace with a dynamic environment is essential for achieving long-term success.

IoT security standards present several challenges, particularly regarding both technical and non-technical aspects of security, such as data privacy. From a technical standpoint, companies must address security at the device level and during end-to-end data transmission. Regulatory frameworks for the application layer remain complex due to their broad scope. Non-technical aspects, including the protection of consumer personal data and data access management, also require attention. Beyond technical policies, regulatory measures must also address these non-technical concerns to ensure comprehensive security standards in IoT.

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