Moderating effects of green IS on the relationship between organizational agility, customer experience and digital service innovation to achieve sustainable performance

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Abstract. This study focuses on the empirical analysis to assess the role of digitalization through Green Information System (GIS) on the relationship between organizational agility (OA), customer experience (CX), and digital service innovation (DSI) to achieve sustainable performance (SP) in the Indonesian Information Communication and Technology (ICT) industry. The authors seek to examine the technological impact as part of digital transformation antecedents of CX and OA in developing DSI. The study also aims to investigate the digital transformation model to attain a more sustainable ICT performance in Indonesia. The novelty of this study lies in the identifying and testing the concurrent effects of studied variables in improving the understanding of DSI and SP as part of the Indonesian ICT digital transformation model. The study used a sample of 195 Indonesia ICT firms. The finding from PLS-SEM reveals that GIS has a significant moderating role in accelerating the development of DSI on the relationship with CX and OA, while SP is positively and significantly influenced by CS, OA and DSI. The implication and the proposed of digital transformation model for Indonesian ICT firms is also discussed in this paper.

1. Introduction
Industry 4.0 enables service providers to adopt various business models, especially in-service innovations to capture the opportunities to disrupt among the existing business and services. The convergence of information communication and technology (ICT) provides modern services, offering enablers for the industry to gain benefit in terms of efficiency, effectiveness, and a wide range of innovation. Therefore, the ICT industry plays a strategic role in the nation’s economic growth [1]. Service innovation is defined as a service delivery based on the evolving customer behaviour and market trends to build the cognition, emotions, and experience of customers. The most noteworthy societal service innovations are also known to be involved in increasing the sustainable value and performance [2]. While ICT has become more connected through digital platforms, there are also various driving factors in the development of service innovation. Numerous studies have also covered the topic of customer experience [3-5]. While most studies focus on the impact of technological advancements are also more focused on customer and service, it has also pushed for the effectivity of the organization and leverage it to become more agile [6, 7].

The key success factor in developing service innovation is to deliver efficiency and effectiveness and to mitigate the adverse risks as a result of technologies. One of which is its impact on the...
The notion of going green is adopted Green Information System (GIS) to ensure environmental sustainability through by utilize technology in a more efficient and eco-friendly way [8]. Past studies have shown that the more advanced adoption of GIS has a positive correlation with customer satisfaction [9], hence increasing the demand for green technology which influences the sustainability in the future.

Past studies have also explored intensively on the development of service innovation to attain sustainability performance, however this has not been done on the relationship between service innovation and GIS, as well as its correlation with the early stage of digital adoption in industries like Indonesia [10]. Therefore, the current study focuses to empirically identify the relationship between digitalization through GIS, organizational agility, and customer experience in the development of digital service innovation in order to attain sustainable performance in the Indonesian ICT industry. The study also aims to investigate the digital transformation model to attain a sustainable performance of the Indonesian ICT. The novelty of this study lies in identifying and testing the concurrent effects of the studied variables in improving the understanding of digital service innovations and sustainable performance as part of the Indonesian ICT digital transformation model.

2. Literature Review

The study on sustainable performance have been increasingly examined, with focus on the critical antecedents of customer experience in digital service innovation world [2-4, 11-14]. In this regard, the role of customer experience becomes critical to drive the change of the organisation and to achieve sustainable performance. Hence, the relationship between customer experience and digital service innovation in a framework of digital transformation should bring a positive influence on performance [13].

The framework of literature review in developing digital service innovation in this current study was developed based on the gap between barrier and opportunity as seen in Figure 1 below.

**Figure 1. Opportunity and Barrier Model Framework**

The model was driven from the benefit of the GIS to bring the advantage in capturing opportunities and to provide effectiveness and efficiency in developing gap of internal capabilities [8]. GIS also efficiency and effectiveness in order to provide better customer experience and organisational agility.
Past studies have also covered the antecedent of sustainability. One of antecedent is CX that could transform customers into organizational advocates that underlies the potential to benefit the firm’s competitiveness and long-term performance by utilising the marketing mix method [15]. In addition, besides customer experience, the concept of organization agility and environmental service environment such as GIS is continuously linked to the attained sustainable performance [16].

The antecedent of customer experience was derived from a customer journey that consists of the activities from customer relation, product and service brand, personalization and engagement with customer after sales [17, 18]. Customer experience involves the behaviour, cognition, and emotions of customers [12, 19-21]. Testing the empirical significance of customer experience through ICT technology, it has found that the use of Information Technology could alter the customer experience [22]. Customer experience is a long-term process, when customers have a better experience, the positive results would affect the company in the long run and result in a more sustainable performance.

Organisational agility can improve customer experience in order for it to adapt to customer needs and changes. Agility can be taken in so many different ways, generally related to the speed of adaptation and move quickly to align with the changing of environment. With an environment that is more dynamic and uncertain, the antecedent of organisational agility also comes in a variety, however it is mostly discussed in relation to the leadership in decision making, culture, and system which also includes technology and organization [23, 24]. This reflects a new paradigm from routines to more dynamic activities. New paradigms include a new mindset in decision making to new forms of integrated relationships among all activities as well as new measures for performance assessment.

The study of the use of technology the ICT industry has two main advantages. First is in relation to customers exploring opportunities and second is the suppliers providing operational excellence and efficiency [25, 26]. Other than that, Studies on the information technology role shows the relationship between the acceptance of information technology and organisational agility to achieve sustainable performance [27] and support the development of digital service innovation.

Digital service innovation was adopted for ICT firms to prevent the disruption of businesses by start-ups and new entries that bring new business models. The design in the development of digital service innovation was taken from the start-up culture, with more flexibility, innovation, and risk taking. It is also combined with incumbent firms’ strong customer base and capital [28, 29]. Tate et al. (2018) define digital service innovation as a sprint process to select service innovation challenges by implementing hybrid of design-led innovations and scrum software development, as shown in Figure 2.

![Figure 2. Digital Service Innovation Development](image-url)
The digital service is design-driven, with a customer centric approach on innovation. It starts from the incubation process as part of research and development to deliver proof-of-concept (POC), digital artefacts, and validation before a commercial launch. Virtual teams are appointed to deliver the POC and artefacts while the holistic team validate and integrate it all to be ready for the commercial launch. The use of Information system technology is important to speed up collaboration to ensure all the process of governance is delivered in a timely manner.

Considering the importance of Information system technologies, green information systems are taking critical parts to ensure that digitation and eco-driven technologies are not only improving environmental quality but also has impact in accelerating the development of organizational agility [30] and customer experience capabilities [9]. Moreover, organizational agility also has a significant impact on the development of digital service innovation [3, 7, 11], which is closely related to sustainable performance [31, 32].

Therefore, based on the above literature, it is hypothesised that:

1. Hypothesis-1: OA has a significant impact on DIS.
2. Hypothesis-2: OA has a significant impact on SP.
3. Hypothesis-3: CX has a significant impact on DIS.
4. Hypothesis-4: CX has a significant impact on SP.
5. Hypothesis-5: DIS has a significant impact on SP.

Green information system has a significant influence as a moderator on the relationship between organisational agility and digital service innovation as well as the relationship between customer experience and sustainable performance.

The following Figure 3 demonstrates the conceptual model of the current study.

![Figure 3. Conceptual Model](image-url)

### 3. Methodology

#### 3.1 Research design:
The current study investigates the influence of the moderating role of green information system on relationship between organisational agility, customer experience, and digital service innovation to drive sustainable performance in the Indonesian ICT sector.

#### 3.2 Population and sample:
Out of 542 ICT firms that are currently operating in Indonesia, which consists of network providers and Internet service providers, an appropriate sample size is needed for this population in order to generalise the findings of the study. The appropriate sample size is 195 firms that were taken for
empirical analysis, as the minimum rule of thumb for sample selection is 35 [33]. Predictors and variables of the study and 5% level of significance of the sample size was obtained out of the 195 firms. Smart PLS was used to analyse and process the collected data.

3.3 Sampling technique:
Simple random sampling was used to allow respondents to have equal chances to be selected for data collection [34], with the firms as the units of analyses and senior leaders of at least general manager level as respondents. A seven-point Likert scale ranging from 1 (‘Not at all satisfied’) to 7 (very satisfied’) was used to examine the response for each construct of the study.

4. Result
Measurements of the model are done to ensure that the latent variables and dimensions has consistency, reliability, and validity. Indicators and dimensions generally have Cronbach’s Alpha (CA) and composite reliability (CR) loadings of above 0.7. The average variance extracted (AVE) is used to evaluate convergent validity exceeds 0.5. Results are shown in Table 1.

Table 1. Construct Reliability and Validity

|                      | Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) |
|----------------------|------------------|-------|------------------------|----------------------------------|
| Customer Experience  | 0.751            | 0.748 | 0.841                  | 0.571                            |
| Green IS             | 0.716            | 0.719 | 0.841                  | 0.638                            |
| Organizational Agility | 0.857          | 0.858 | 0.913                  | 0.778                            |
| Service Innovation   | 0.752            | 0.758 | 0.841                  | 0.570                            |
| Sustainable Performance | 0.886          | 0.892 | 0.917                  | 0.689                            |

Discriminant validity is demonstrated in Table 2 below, in which according to Hair et al. [34], the values should be higher than 0.6.

Table 2. Discriminant test result

|          | 1     | 2     | 3     | 4     |
|----------|-------|-------|-------|-------|
| 1 Organizational Agility | 0.882 |       |       |       |
| 2 Customer Experience | 0.683 | 0.755 |       |       |
| 3 Service Innovation   | 0.682 | 0.746 | 0.808 |       |
| 4 Sustainable Performance | 0.461 | 0.727 | 0.755 | 0.830 |

Direct testing of hypotheses are used to assess the direct significant relations between the two latent variables.

H1: The first hypothesis examines the relationship between OA and DSI. Tests show that the t-value was observed to be2.523 and p<0.05, indicating that H1 is accepted.
H2: To investigate the relationship between OA and SP, with t-values and p-values of4.424 and p<0.005, respectively. Therefore, H2 is accepted.
H3: H3 investigates the relationship between CX and DSI, with t-value of7.311 and p>0.005. Therefore, H3 is accepted.
H4: H4 investigates the relationship between CX and SP, with t-value of6.036 and p>0.005. Therefore, H4 is accepted.
H5: H5 investigates the relationship between DSI and SP, with t-value of14.754 and p>0.005; therefore, H5 is accepted.
Tests conducted on the relationship between the moderating role of green information system and OA and DSI, as well as CX and SP results in t-values of 2.349 and 2.866 respectively, and p-values of 0.004 and 0.019 respectively. This shows that GIS has a significant influence in accelerating the development of DSI, both for organizational agility and customer experience.

Table 3 demonstrates the direct relationships within the study.

| Hypothesis | Standard Deviation | T Statistics | P Values | Remarks |
|------------|--------------------|--------------|----------|---------|
| H1 Organizational Agility $\rightarrow$ Digital Service Innovation | 0.059 | 2.523 | 0.012 | Valid |
| H2 Organizational Agility $\rightarrow$ Sustainable Performance | 0.057 | 4.424 | 0.000 | Valid |
| H3 Customer Experience $\rightarrow$ Digital Service Innovation | 0.061 | 7.311 | 0.000 | Valid |
| H4 Customer Experience $\rightarrow$ Sustainable Performance | 0.054 | 6.036 | 0.000 | Valid |
| H5 Service Innovation $\rightarrow$ Sustainable Performance | 0.049 | 14.754 | 0.000 | Valid |

Tests were also conducted to assess the indirect effects, with results that are listed in Table 4. The overall research model based on SEM-PLS is shown in Figure 4.

| Organizational Agility $\rightarrow$ Service Innovation $\rightarrow$ Sustainable Performance | 0.045 | 2.389 | 0.017 | Significant |
| Customer Experience $\rightarrow$ Service Innovation $\rightarrow$ Sustainable Performance | 0.050 | 6.363 | 0.000 | Significant |

Figure 4. Research Results
5. Discussion

Findings of the current study have implications on the model of digital transformation towards digital service companies as part of the sustainable business development as shown in Figure 5. The model is like a spiral, consisting of five circles of activities in each process.

The first circle is based on the finding on the significant influence of green information system to accelerate the development of organizational agility and customer experience capabilities. It includes the development of the information system in the front and back office, communication portals, and email. The first circle ensures the development of a paperless information system.

The second circle is related to organizational agility, in which the digitalization process improves the agility of organizations. The current study defines the organization agility, consisting of people, cultural, and systematic perspectives especially in collaboration and processes as well as people’s mindset to support the development of sustainability policy. Digitisation takes part in bringing agility online and in shaping a virtual organization.

Customer experience takes part in the third circle. Technological platforms are utilised to enable firms to expand in size and scale to offer the maximum amount of products and services. This is done through customer relations, product pricing, personalisation, and branding supported by big data, online, and digital channels to engage with customers.

The current study found that trust is critical in the digital world, hence the governance of customer relation processes and brand performance as part of intangible services take an important role in sustainability. One of the critical parts of sustainability development is creating a digital ecosystem through digital social communities. Digital social communities have a significant influence in promoting criticising the delivery of products and services.

![Digital service transformation model](image-url)

**Figure 5.** Digital service transformation model
When organization agility and customer experience is supported by green information systems, the development of a digital service ecosystem takes on a critical part in the transformation model. Digital service innovation enables firms to have a culture similar to start-up companies in creating digital services to excel in performance, with support from operational efficiency that is enabled by green information system and based on customer experience. Digital service innovation also provides an innovative platform of digital services for the firms to bring in new developments, diversifications, and transformations from one digital business model to another. This is supported by organisational agility in order to be aligned with customer needs.

The last circle is sustainable performance by supporting digital ecosystem readiness. Digital contents, structure, and governance of innovations have enabled new technologies such as blockchain, artificial intelligence, automation robotic, augmented reality, and quantum computing to be developed by firms with more prudent digital service innovation platforms that are supported by organisational agility and customer experience orientation.

6. Conclusions
The study has found that green information system has a significant influence in accelerating the development of digital service innovation. Digital service innovation can be positively developed by organizational agility and customer experience. Whereas, the combination of organisational agility, customer experience, and digital system innovations moderated by green innovation system supports the achievement of a sustainable performance. The study would help the Indonesian ICT sector to focus on using green information system in the digitisation process to provide effective resource allocations, innovate, and transform towards digital service innovation. The study contributes towards the sustainability transformation framework that enables the use of green information system, organization agility, and customer experience orientation in the development of digital service innovation.

Limitations of this study include the research model, sampling, and time horizon of study. Future studies should consider adopting a more sophisticated model with more advanced statistical methods. A longitudinal study design is also recommended to ensure that the digital transformation is consistently implemented.

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