Role of green information system in developing corporate reputation and co-creation-innovation to attain sustainable performance

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Abstract. Service dominance was constructed by integrating co-creation and digital service innovation, also known as the ‘co-creation-innovation’ model. It was supported by the strength of existing firms, which is corporate reputation. The concept of co-creation-innovation itself is based on the theory of service dominant (S-D) logic. Past studies have focused on the critical elements of co-creation (CC) and digital service innovation (DSI), as well as corporate reputation (CR) in shaping a sustainable performance (SP). However, the study of co-creation-innovation and CR and its relationship to green environment has not been intensively explored. This study has aim to oversee the role of Green Information System (GIS; Green IS) in the development of corporate reputation and co-creation-innovation in order to attain sustainable performance. The study was conducted using a sample size of 195 respondents representing Indonesian telecommunication firms. Smart PLS was used as the statistical tool for analyses. Findings demonstrate that green IS directly and indirectly has a significant relationship on corporate reputation, CC and DSI. However, CR has a direct impact on CC but no direct impact on DSI. The limitations and implications of the current study and recommendations for future study is also discussed in this paper.

1. Introduction

Industry 4.0 brings about a new paradigm of digital transformation for firms, including the service innovation paradigm. The term of service innovation in the digital age also creates the need for expansion in the concept of service development, with the information technology system taking on a much important role [1]. Lusch and Nambisan (2015) suggests that the broader concept of is underlined by the service dominant (S-D) logic [2]. It includes: (1) the broadening concept of service shifting from the tangible-intangible category to becoming network-, information-, and experience-centric innovation, and (2) assess the impact of IT deployment to provide co-creation and deliver service innovation.

According to the S-D logic framework in digital service, the term of service, resources, exchange, and value is required to be conceptualized [3]. S-D logic uses the term of service to reflect the process to get benefits in relation to the operant such as knowledge competence. Therefore, the service is a denominator in exchange for process [4]. The term resource has also shifted from the good as an...
operand resource to the good imbedded with operant (knowledge and customer experience) [2]. Exchange and value have also shifted from the good, as operand exchange and source value also shifts into service as the beneficial application of operand resources are sometimes transmitted through as operand resources. The intangible resources then become an important factor in service innovation development, especially in conjunction with corporate reputation [5].

The second point is related to the role of IT in service innovation, with two roles acting as enablers (operand) and operant resources to creating value. In terms of service innovation, IT enables the establishment of a value network as well as sharing and integrating resources with knowledge. This results in fostering service innovations and collaboration with partners and co-partners [6]. As part of service innovation that the value relies on in exchanging services as operant, it means the firm could perform co-creation with the enablers of such services such as IT, where customers and partners have more of a value proposition [7].

In regards to the S-D logic, past studies on co-creation focuses more on co-creating value in developing customer experience [8–10], value creation development [11, 12], corporate social responsibility [13, 14], and digital platform development [15, 16]. However, have not focused enough on the use of alternative IT to ensure the development of corporate reputation. This is done by utilising eco-friendly technology that is more efficient and critical in the development process of service innovation [17]. As a result, the demand on green technology becomes more popular and will have a larger impact on the future sustainability of ecosystem of service innovation.

The development of corporate reputation, co-creation, and digital service innovation to attain a sustainable performance has been intensively explored in past studies. However, the study of corporate reputation, co-creation, and digital service innovation and the relationship with green Information system is still very limited. It’s correlation with Indonesia’s early stage of digital adoption has also not been explored extensively [18]. Therefore, the current study focuses on identifying the role of Green Information system (Green IS) in the development of corporate reputation and co-creation innovation in order to attain sustainable performance (SP) in the ICT Industry of Indonesia. The study also aims to investigate the digital transformation model based on the sustainability and service-dominant logic. The novelty of this study lies in identifying and testing the concurrent effects of studied variables in improving the understanding of sustainability transformation based on the SD-Logic concept in the Indonesian ICT industry.

2. Literature Review

The S-D Logic offers a wide range of social economic impact on service exchange, integration of resource, and co-creation of value [19]. The value concept involves not only economic and social values, but also the impacts on the ecosystem in conjunction with environmental factors as part of sustainability context [20]. A recent study shows the emergence of a new dominant logic to reflect the sustainability context, by developing multiple dominant logics [21]. The model is based on a two-side model, the top layer is service customer logics and the bottom layer consists of environment dominant logics.

The emergence model has three major elements of sustainability: economics, society, and the environment to support co-creation-innovation and achieve sustainable performance as shown in Figure 1. In other words, when all elements are connected in the digital world, a firm’s responsibility does not only cover the economic business in making profit. It is also responsible in society and to optimize the use of technology to maintain and renew the natural environment. The development of ecosystem in society requires intangible values in a relationship with corporate reputation as part of the strength of established companies [22]. Meanwhile, the use of green IS in the environmental sector in response of the environmental risk and efficient technology is required, not only for the benefit of corporate reputation [17], but also in developing service innovation [23, 24].
Green information systems (GIS) is an initiative to address environmental sustainability in organizations [25]. The main focus of GIS is either to maintain energy saving Information System equipment or using IS in society to reduce the environmental impacts by digitising and going paperless. Previous studies show that the use of GIS has a significant impact on corporate reputation [17]. And green IS has positive relationship in developing innovation including service innovation [26] and supporting collaboration to have co-creation with co-creators or customers [27].

On a social point of view, the role of corporate reputation is taking critical part on co-creation-innovation. The company reputation is defined as the perception of set of economic and non-economic identities according to the past action and to be considered as a social policy of the company [28]. Corporate reputation also influences the development of co-creation [29]. In a previous study, it was found that corporate reputation support in developing innovation in firms include service innovation [30].

Co-creation consists of a customer journey including activity of co-design, co-production, co-promotion, co-price, co-distribution and co-brand [12]. Co-creation is defined as collaboration or joint activities with co-creators to create value. Co-creation also has a significant impact on service innovation [9, 31, [32].

Digital service innovation was adopted from start-ups and new entries that are strong in flexibility, innovation, and risk-taking. The concept is then combined with the strength of incumbent firms, which are mainly on customer base and capital [22]. The definition of the digital service innovation is a process to select the service innovation challenge by implementing a hybrid of design-led innovation using software. Digital service innovation activities involve the activity on incubation business, research, and development as well as the validation and integration process on the existing products and processes [33]. It starts from the incubation process as part of research and development to deliver proof-of-concept (POC), digital artefacts, and validate before the commercial launch. The virtual team has appointed to deliver the POC and artefacts and the holistic team are going to validate and integrate to be ready in commercial. The use of Information System technology is important to speed up and collaborate to ensure the all governance process timely deliver, digital service innovation has significant relation on sustainable performance [34, 35].

![Sustainability Literature Framework](image-url)
Therefore, based on the above literature review, it is hypothesized that;
1. Hypothesis-1: GIS has a significant impact on DIS.
2. Hypothesis-2: GIS has a significant impact on CC.
3. Hypothesis-3: GIS has a significant impact on CR.
4. Hypothesis-4: CR has a significant impact on DIS.
5. Hypothesis-5: CR has a significant impact on CC.
6. Hypothesis-6: CC has a significant impact on DIS
7. Hypothesis-7: CC has a significant impact on SP
8. Hypothesis-8: DIS has a significant impact on SP
The following Figure 2 demonstrates the conceptual model of the current study.

3. Methodology

3.1. Population and sample:
The population consists of 542 ICT firms that are currently operating in Indonesia, made up of network and Internet service providers. An appropriate sample size is needed for this population in order to generalise the findings of the study, with a minimum rule of thumb of 35 [36]. However, the sample used for this study was 195 firms, which fulfils the minimum requirement and should be able to represent the population. Predictors and variables of the study and 5% level of significance in the sample size was obtained out of the 195 firms. Smart PLS was used to analyse and process the collected data.

3.2. Sampling technique:
Simple random sampling was used to allow respondents to have equal chances to be selected for data collection [37], with the firms as the units of analyses and senior leaders with a minimum of general manager level 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
Two measurement tests were taken, the first is done to test the consistency, reliability, and validity of latent variables, and the second test to assess the hypothesis and model. The model tests include reliability and validity tests to asses’ indicators and dimensions through finding the loadings of Cronbach’s Alpha (CA) and composite reliability (CR), which should be above 0.7. The average variance extracted (AVE) to evaluate convergent validity should also exceed 0.5. Discriminant validity tests were also conducted to ensure the construct dimensions and indicators are completely separated from each other. Results of reliability and validity tests are shown in Table 1.
Table 1. Construct Reliability and Validity

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|--------------------------------------------|
| Cronbach's Alpha | rho_A | Composite Reliability | Average Variance Extracted (AVE) | Remarks |
| Digital Service Innovation | 0.831 | 0.832 | 0.887 | 0.663 | Valid |
| Co-creation | 0.955 | 0.956 | 0.964 | 0.817 | Valid |
| Corporate Reputation | 0.848 | 0.907 | 0.904 | 0.758 | Valid |
| Green IS | 0.716 | 0.721 | 0.840 | 0.637 | Valid |
| Sustainable Performance | 0.886 | 0.902 | 0.916 | 0.687 | Valid |

Discriminant validity is demonstrated in Table 2 below, in which according to Hair et al (2014); the values should be higher than 0.6.

Table 2. Cross Loading test result

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|-----------------------------------|
| Digital Service Innovation | Co-creation | Corporate Reputation | Green IS | Sustainable Performance |
| DSI1 | 0.869 | 0.503 | 0.357 | 0.746 | 0.465 |
| DSI2 | 0.818 | 0.517 | 0.370 | 0.709 | 0.416 |
| DSI3 | 0.831 | 0.532 | 0.228 | 0.660 | 0.357 |
| DSI4 | 0.816 | 0.743 | 0.506 | 0.535 | 0.734 |
| CC1 | 0.701 | 0.938 | 0.444 | 0.597 | 0.623 |
| CC2 | 0.711 | 0.918 | 0.473 | 0.659 | 0.659 |
| CC3 | 0.656 | 0.930 | 0.452 | 0.572 | 0.662 |
| CC4 | 0.642 | 0.923 | 0.472 | 0.548 | 0.756 |
| CC5 | 0.613 | 0.868 | 0.608 | 0.689 | 0.645 |
| CC6 | 0.583 | 0.841 | 0.429 | 0.482 | 0.638 |
| CR1 | 0.424 | 0.601 | 0.895 | 0.586 | 0.664 |
| CR2 | 0.467 | 0.442 | 0.881 | 0.512 | 0.745 |
| CR3 | 0.261 | 0.228 | 0.835 | 0.331 | 0.600 |
| GIS1 | 0.530 | 0.692 | 0.603 | 0.764 | 0.577 |
| GIS2 | 0.763 | 0.510 | 0.364 | 0.832 | 0.411 |
| GIS3 | 0.639 | 0.343 | 0.418 | 0.796 | 0.410 |
| SP1 | 0.519 | 0.593 | 0.584 | 0.828 | 0.833 |
| SP2 | 0.397 | 0.415 | 0.767 | 0.449 | 0.723 |
| SP3 | 0.625 | 0.679 | 0.587 | 0.561 | 0.897 |
| SP4 | 0.497 | 0.617 | 0.617 | 0.457 | 0.858 |
| SP5 | 0.645 | 0.685 | 0.510 | 0.391 | 0.824 |

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

H1: The first hypothesis examines the relationship between GIS and DSI. Tests show that t-value was observed as 14.029 and p<0.05, indicating that H1 is accepted.

H2: to investigate the relationship between ‘GIS and CC’, with results demonstrating the t-values and p-values as 10.597 and p<0.005, 2; therefore, H2 is accepted.

H3: H3 investigates the relationship between “GIS and CR” with results indicating the t-value as 15.723 and p<0.005; therefore, H3 is accepted.
**H4:** H4 investigates the relationship between ‘CR and DSI’, with results indicating the t-value as 1.810 and p<0.005; therefore, H4 is rejected.

**H5:** H5 investigates the relationship between ‘CR and CC’, with results indicating the t-value as 2.998 and p<0.005; therefore, H5 is accepted.

**H6:** H6 investigates the relationship between ‘CC and DSI’, with results indicating the t-value as 7.438 and p<0.005; therefore, H6 is accepted.

**H7:** H7 investigates the relationship between ‘CC and SP’, with results indicating the t-value as 9.164 and p<0.005; therefore, H7 is accepted.

**H8:** H8 investigates the relationship between ‘DSI and SP’, with results indicating the t-value as 4.814 and p<0.005; therefore, H8 is accepted.

Table 3 below demonstrates the direct relationships between variables.

| Hypothesis | Standard Deviation | t statistics | p-values | Remarks |
|------------|--------------------|--------------|----------|---------|
| H1 Green IS -> Digital Service Innovation | 0.045 | 14.029 | 0.000 | Significant |
| H2 Green IS -> Co-creation | 0.049 | 10.597 | 0.000 | Significant |
| H3 Green IS -> Corporate Reputation | 0.037 | 15.723 | 0.000 | Significant |
| H4 Corporate Reputation -> Digital Service Innovation | 0.049 | 1.810 | 0.070 | No Significant |
| H5 Corporate Reputation -> Co-creation | 0.072 | 2.998 | 0.003 | Significant |
| H6 Co-creation -> Digital Service Innovation | 0.048 | 7.438 | 0.000 | Significant |
| H7 Co-creation -> Sustainable Performance | 0.059 | 9.164 | 0.000 | Significant |
| H8 Digital Service Innovation -> Sustainable Performance | 0.056 | 4.814 | 0.000 | Significant |

Tests to assess the mediating relationship between variables were also conducted to investigate the indirect effects, shown in Table 4.

| Indirect Hypothesis | Standard Deviation | t statistics | p-values | Remarks |
|---------------------|--------------------|--------------|----------|---------|
| Green IS -> Digital Service Innovation -> Sustainable Performance | 0.033 | 5.060 | 0.000 | Significant |
| Green IS -> Co-creation -> Sustainable Performance | 0.032 | 9.094 | 0.000 | Significant |
| Green IS -> Co-creation -> Digital Service Innovation -> Sustainable Performance | 0.016 | 3.191 | 0.001 | Significant |
| Green IS -> Corporate Reputation -> Digital Service Innovation -> Sustainable Performance | 0.008 | 1.854 | 0.064 | No Significant |
| Green IS -> Corporate Reputation -> Co-creation -> Sustainable Performance | 0.025 | 2.657 | 0.008 | Significant |
| Green IS -> Corporate Reputation -> Co-creation -> Digital Service Innovation -> Sustainable Performance | 0.004 | 3.442 | 0.001 | Significant |

The overall research model based on SEM-PLS is shown in Figure 3.
5. Discussion
Findings of the current study have implications on the model of digital transformation. Green IS definitely playing a significant role in shaping corporate reputation, co-creation, and digital service innovation to achieve sustainable performance, especially in the Indonesian market. Results of the current study have implication on the model on the digital transformation of Indonesia’s ICT Industry, as shown in Figure 4.

According to the S-D framework, the environment has an influence on the service dominant logic. Hence, findings of the current study reveal the model of two dominant logic in sustainability frameworks.

Corporate reputation has a significant effect on the development of co-creation, as it is a part of maintaining the social sustainability of an established firm. This finding is aligned with the value of corporate reputation in co-creation [29]. For that reason, major companies such as Facebook, Google, and Apple constantly maintain their corporate reputation to attract potential co-creators [38]. However, corporate reputation itself does not have a direct, significant effect in the development of digital service innovation. This finding supports the phenomenon of disruption of innovations in which many incumbent firms fail to maintain their competitive advantage despite their positive reputation.

Co-creation is important in digital world, as it is strongly related to digital service innovation and supports sustainable performance. The current study has found that co-design activities have the most significant impact on sustainable performance compared to the five other co-creation activities. This indicates that design is important for customers and to ensure a successful implementation of co-creation of products and services.
Digital service innovation enables firms to have a culture that is more similar to start-up companies, especially in offering digital services. However, in order to rise in digital services, an incubation process is required. This means innovations in the business model design is required. Changes towards creating digital service innovations would also involve partners, customers, suppliers, third parties, technology and regulations. However, it would result in a number of outputs, including experience, leveraging of services, redesigning, restructuring, and a new way of diversification of digital services.

Lastly, sustainable performance can be achieved if results of the current performance is strong enough. With proven results, the digital ecosystem and content innovation can be explored even further by utilizing new technologies such as blockchain, artificial intelligent, robotic automation, augmented reality, and quantum computing.

6. Conclusions
The SD logic provides the framework in delivering the co-creation innovation model in a digital transformation based on a sustainability approach. The study has found that Green IS significantly influences the development of corporate reputation, co-creation, and digital service innovation which are required elements in building a sustainable performance. Corporate reputation itself as a direct, significant effect on co-creation, however does not have any effect on digital service innovation.

The study would help the Indonesian ICT sector to focus on the use of Green IS in a digitization process to have a more effective and efficient way of using natural resources while transforming
towards digital service innovations. However, the study has its limitations in terms of its model, sampling, and period of study. Future studies are recommended to explore a more complex model and use a more advanced statistical tool for analyses. A longitudinal study design is also recommended to assess the long-term progress and effects of the digital transformational model.

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