

# Evaluation of Information System Implementation on Civil Registration Service at Surabaya, Indonesia (Case Study: Birth Certificate Service)

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## Abstract

Information systems and technology are expected to have a good impact on the civil registration service process including during the COVID-19 pandemic. DISPENDUKCAPIL Surabaya had transformed the civil registration service systems which are LAMPID system into KLAMPID, and KLAMPID COVID system later during the COVID-19 pandemic by implementing the information system. These transformations are proven in reducing the paper utilization and transportation activities which are expected to reduce the environmental impact that is generated by the civil registration service activities. However, those transformations are also proven to increase electricity consumption and internet use since there is information system equipment such as computers and databases equipment which are utilized. This study tries to evaluate the total environmental impact in each transformation by using the Life Cycle Assessment (LCA) approach. The environmental impact calculation results from SimaPro software for LAMPID, KLAMPID, KLAMPID COVID offline submission, and KLAMPID COVID online submission are 24.64 mPt, 41.95 mPt, 41.71 mPt, and 36.81 mPt respectively. This study indicates that the information system implementation was able to reduce the environmental impact from the paper utilization and transportation activities reduction, however, those reductions cannot cover the environmental impact that is generated from the information system equipment.

## Keywords

Information system, civil registration service, LCA, environmental impact

## 1. Introduction

The issue of information technology implementation and the role of information technology in civil registration service had been discussed since the late 20th century. In 1997, International Institute for Vital Registration and Statistic USA had been stated that information technology had a lot of functions in improving the civil registration process such as data entry, storage (databases), and retrieval. The information technology is also able to boost the sustainability performance of an organization in the aspects of economic, environment, and social. Additionally, the decreasing costs for the computerization equipment, including the software, made the implementation of IT feasible and affordable (Logrillo 1997).

Surabaya is one of the biggest cities in Indonesia, which has one of the best governments by having 59 national and four (4) international recognitions since 2017, including the UNESCO Learning City Award from UNESCO and Global Green City from Sustainable City and Human Settlements Award in 2017 (Pemerintah Kota Surabaya 2020). The government of Surabaya has a very big concern towards the governmental service including the performance of civil registration service that is executed by *Dinas Kependudukan dan Sipil Surabaya* which also known as DISPENDUKCAPIL Surabaya (CNN Indonesia, 2018). Forcing the DISPENDUKCAPIL Surabaya to improve their civil registration service activities including the implementation of an information system or information technology, resulting in a service system transformation from LAMPID (2014-2019) to KLAMPID (1 January 2020 – 22 March 2020) and KLAMPID COVID (22 March 2020) as the results of the pandemic.

The KLAMPID system was the effort of DISPENDUKCAPIL Surabaya in improving the civil registration service activities by implementing the information system and technology. The KLAMPID system was able to not only record any service submission but also record the time when a process was executed and finished allowing the DISPENDUKCAPIL staff to easily trace each submission. Furthermore, the computerization that was implemented in this system was able to substitute and reduce paper utilization and transportation activity. On the other hand, the KLAMPID COVID system was considered as the response of DISPENDUKCAPIL Surabaya toward the COVID-19 pandemic which obliges the health protocol towards all the civil registration activities. In KLAMPID COVID-19, the online submission platform was introduced to ease the civil registration service especially from the customer (allows the customer to submit the request from their home) while reducing the crowd in each service point at *Kelurahan* Offices where the conventional submission or offline activities occur. The online submission platform also offers a process that had a better environmental impact since the customers' transportation activities for the submission process are not necessary anymore.

By looking at that condition, the information system and technology gave a good impact on the civil registration service in Surabaya by giving a system that could reduce both paper utilizations and transportation activities. Furthermore, during the COVID-19 pandemic which made the demand for information technology implementation increases as IT is expected to be the solution for the health protocol obligation especially the social distancing to prevent the COVID-19 spread (Alam et al. 2020). Zeng et al. (2020) stated that one of the important aspects in IT implementation is environmental performance, and even the information system implementation for this case offered a reduction in paper utilization and transportation activities, DISPENDUKCAPIL Surabaya still invested in information system equipment which also results in an environmental impact such as from the electricity and the internet use. Therefore, this study tries to evaluate the implementation of information systems and technology at civil registration service executed by DISPENDUKCAPIL Surabaya from its environmental impact tradeoff between the paper and transportation reduction, and the investment of information system equipment. This study will focus on evaluating the birth certificate service process which has around 28000 submission from 1 January to 23 September 2020. This study aims to evaluate the information system implementation in civil registration service, which is the birth certificate establishment, executed by DISPENDUKCAPIL Surabaya, Indonesia from the perspective of environmental impact.

## 2. Literature Review

### 2.1 Life Cycle Assessment

Life cycle assessment is a sustainable development tool that can be used to identify the environmental impact occurrence that is generated through the life cycle of a product or service (Graedel, 1998) LCA is a study that is often used to assess the environmental performance of a product or service from the material use, distribution stage, and the process (Wolfson et al. 2019) There is a framework that is used in an LCA study that consists of four stages (United Nations Environment Programme 2015)

1. Goal and Scope Definition which in this stage the goal and scope of how far the LCA study of a product/service life cycle will be implemented and to what peak are defined.
2. Life Cycle Inventory Analysis which in this stage the input-output, the activity or process flow are analyzed throughout the product/service life cycle.
3. Life Cycle Impact Assessment where the Life Cycle Inventory will be translated into the environmental impact.
4. Life Cycle Impact Interpretation where the discussion and conclusion about the LCA study is interpreted and explained.

## 3. Methods

### 3.1 Goal and Scope Definition

This study aims in evaluating the information system implementation in civil registration service executed by DISPENDUKCAPIL Surabaya, Indonesia. This study focuses on the birth certificate establishment which is one of the civil registration services that is affected by the implementation of the information system at DISPENDUKCAPIL Surabaya. This study compares the environmental impact that is generated by each stakeholder in each business transformation stage of LAMPID, KLAMPID, and KLAMPID COVID. This study measures the paper use, transportation, internet use, and electricity which are directly involved in the process of birth certificate establishment

process from the service submission by the customer until the finished certificate is claimed by the customer. The other office appliances such as air conditioner, water use, etc. are not included in the scope of this study. The data that is used in this study is the submission database from 1 January 2019 until 31 June 2020. Additionally, this study focuses on assessing the activities that is done by the customer (residents of Surabaya who request the service), *Kelurahan* Offices (the government office that has the role as the service point), couriers, and DISPENDUKCAPIL Surabaya.

### **3.2 Data Collection and Life Cycle Inventory Analysis**

This step involves the data collection process which then the collected data will be used in the identification of the Life Cycle Inventory of each activity in delivering the service of birth certificate establishment. The life cycle inventory will be distinguished based on each activity and stakeholder to give a better identification of the information system implementation impact on the activities and stakeholders (Martinez-Blanco et al. 2015). The life cycle inventory database that is used in this study is the Ecoinvent 3.5 database. The Ecoinvent 3.5 database is chosen as the inventory database for this study because this database uses the global scale condition (ecoinvent 2018).

### **3.3 Life Cycle Impact Assessment**

The identified life cycle inventory is translated into environmental impact in this step by using SimaPro 9.0 since this software is one of the major software that is widely used in LCA study (Heijungs 2020). SimaPro 9.0 software is used to calculate the environmental impact by using the ReCiPe 2016 as the assessment method. ReCiPe 2016 is one of the methods available in SimaPro 9.0 software which considers the global scale condition instead of a particular geographical location (Huijbregts et al. 2017). The environmental impact is also distinguished based on each activity and each stakeholder in this study so that the environmental impact change can be traced also in each business transformation (Martinez-Blanco et al. 2015).

### **3.4 Life Cycle Interpretation and Discussion**

In this step, the environmental impacts are analyzed to identify the change in each business transformation where the information system is implemented during KLAMPID and KLAMPID COVID transformation. The environmental impact generated by each stakeholder is analyzed and compared between the transformation stage. Then, the most affected activity and stakeholders are identified.

## **4. Data Collection and Life Cycle Inventory Analysis**

### **4.1 Data Collection Process**

There are several data that are collected in this study, which then those data are used to identify and analyze the Life Cycle Inventory (LCI) of the birth certificate establishment process at DISPENDUKCAPIL Surabaya. The data collection process is explained at Table 1.

Table 1. Data collection process

No.	Inventory Data	Description and Assumption
1.	Paper utilization	There is a standard operating procedure (SOP) that is implemented by DISPENDUKCAPIL Surabaya in executing the civil registration process. This SOP becomes the main source in the identification of the paper utilization for the LCI of this study. Then, the inventory data for the paper utilization is derived from Ecoinvent 3.5 database.
2.	Transportation by customer	For the manual submission, customer needs to visit the <i>Kelurahan</i> office for the submission process. To calculate the transportation distance for each customer, the author utilizes the Google Maps features, which the average distance from each <i>Kelurahan</i> is used.
3.	Transportation by courier	The couriers have the responsibility to ship the requirements from <i>Kelurahan</i> Office to DISPENDUKCAPIL Office and the finished documents from DISPENDUKCAPIL Office to <i>Kelurahan</i> Office. The transportation distance is calculated from the average distance (from Google Maps) between each <i>Kelurahan</i> Office to DISPENDUKCAPIL Office divided by average daily submission, assuming that the couriers travel once a day each for the requirements shipping and finished document shipping.
4.	Processing time	The processing time refers to the average time of each submission is submitted until its finished. For the KLAMPID and KLAMPID COVID, the processing time data is derived from the submission data from 1 January 2020 until 31 June 2020 by calculating the average time from submission until the process is finished (legalized birth certificate printing). Unfortunately, for the LAMPID, the average processing time cannot be derived since there was no database for that record the submission and the finish date. The processing time data is important for the LCI identification of KLAMPID and KLAMPID COVID system since, in this transformation stage, the processing time is highly related to the inventory that is generated by the database facility.
5.	Electricity and Internet use	Electricity and internet use are related to the process that requires a computer and/or database equipment. Other than the databases, the inventory for electricity and internet use is based on the processing time in each activity (i.e., submission recording, and request processing). The time for each activity is based on the interview with the staff that is responsible for each activity. On the other hand, the database inventory is based on the total processing time that is calculated from point 4 in this table.

#### 4.2 Business Process Evolution

From 2014 until June 2020, DISPENDUKCAPIL Surabaya has implemented some service systems that are expected to improve the performance of the civil registration service. During 2014-2019, DISPENDUKCAPIL Surabaya implemented a system, called LAMPID, in executing the civil registration service activity in which the involvement of the information system was still limited. In 2020, DISPENDUKCAPIL Surabaya introduces the KLAMPID system as the transformation of LAMPID where most of its activity required and involved the information system. Compared to LAMPID, the paper use and transportation were reduced during the KLAMPID system, since the paper used as the required requirements was substituted by the scanning process and the transportation activity was substituted by the integrated system between the DISPENDUKCAPIL Surabaya office and each *Kelurahan* offices as the government agencies that had the role of civil registration service point which allowed *Kelurahan* office directly sent the scanned requirement to DISPENDUKCAPIL office without the help of couriers. March 2020, the COVID-19 pandemic stroked Indonesia, forcing all activities including the civil registration service to oblige with the health protocol. Then on March 23rd, 2020, KLAMPID COVID system was introduced as the response to the pandemic condition. KLAMPID COVID system allowed the customer to perform online submission without the need of coming to the service point. However, the customer still could submit through the offline method by directly came to the service point. Figure 1. is the depiction of the system transformation that occurs during 2014-June 2020.

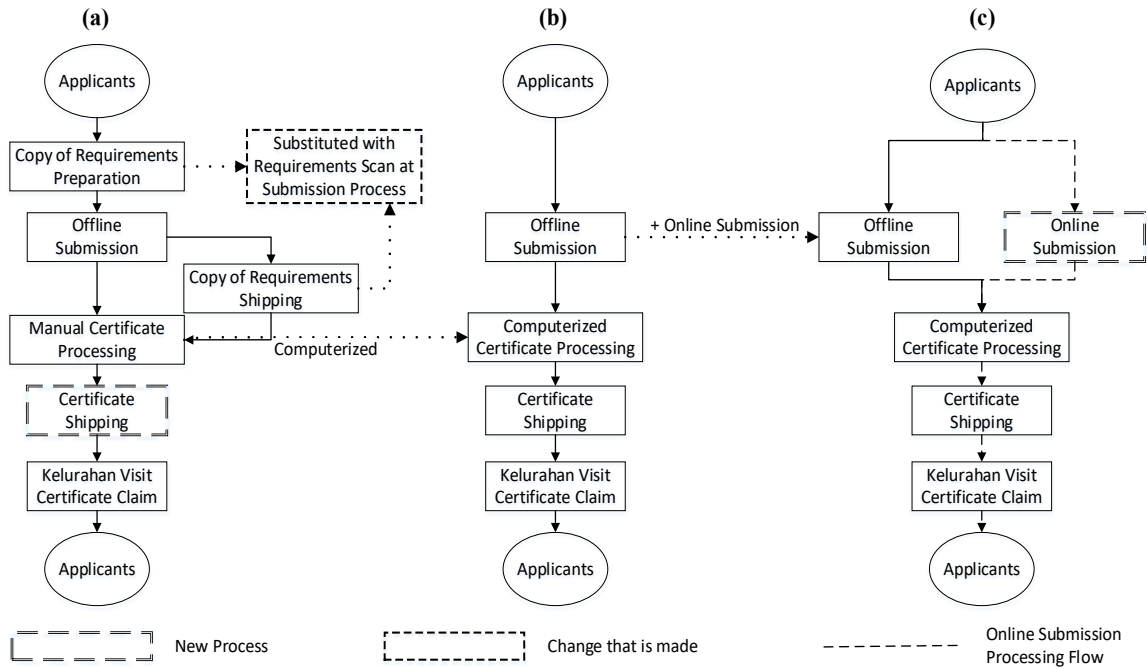


Figure 1. System transformation (a) LAMPID, (b) KLAMPID, (c) KLAMPID COVID

### 4.3 Life Cycle Inventory Analysis

After the life cycle inventory is identified, then the identified inventory in Table 2 – 5 are translated into the environmental impact by using SimaPro Software.

Table 2. Customer life cycle inventory

CUSTOMER							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Units
					Offline	Online	
Submission	Requirements Prep	Printed Paper	26.20	-	-	-	Gr
	Kelurahan Visit	Transportation	0.91	0.91	0.91	-	Km
	Online	Electricity + Internet use	-	-	-	15.00	Minutes
	Kelurahan Visit	Transportation	0.91	0.91	0.91	0.91	Km

Table 3. Kelurahan office life cycle inventory

KELURAHAN							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Unit
					Offline	Online	
Submission Recording	Form Kelurahan	Printed Paper	4.23	-	-	-	gr
	Request Recording	Computer + Internet Use	5.00	5.00	5.00	-	minutes
	Invoice Printing	Printed Paper	4.37	4.37	4.99	-	gr

Table 4. Courier life cycle inventory

COURIER							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Unit
					Offline	Online	
Requirements shipping	<i>Kelurahan</i> to DISPENDUKCAPIL	Transportation	0.71	-	-	-	km
Finished document shipping	DISPENDUKCAPIL <i>Kelurahan</i>	Transportation	0.71	0.71	0.71	0.71	km

Table 5. DISPENDUKCAPIL office life cycle inventory

DISPENDUKCAPIL							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Unit
					Offline	Online	
Request Processing	Verification	Computer + Internet Use	-	3.00	3.00	3.00	minutes
	SIAK Recording	Computer + Internet Use	10.00	10.00	10.00	10.00	minutes
	Manual Certificate Legalization	Printed Paper	4.99	-	-	-	gr
	TTE Signing	Computer + Internet Use	-	15.00	15.00	15.00	minutes
	Legalization	Computer + Internet Use	-	10.00	10.00	10.00	minutes
	Certificate Printing	Printed Paper	-	4.99	4.99	4.99	gr
Submission Database	Database facility	Electricity + Internet Use	-	252.26	41.71	41.71	hours

## 5. Results and Discussion

### 5.1 Environmental Impact Assessment Results Discussion

The environmental impact values are analyzed based on each activity and stakeholder, which are then summed up based on each system transformation. The result for the environmental impact assessment uses the mill points (mPt) of environmental impact and is explained in Table 6. through Table 9. for the stakeholders of the customer, *Kelurahan*, courier, and DISPENDUKCAPIL respectively. Then in Table 10. the environmental comparison between stakeholders is explained

Table 6. Environmental impact generated by customer

Customer							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Units
					Offline	Online	
Submission	Requirements Prep	Printed Paper	4.23	-	-	-	mPt
	<i>Kelurahan</i> Visit	Transportation	3.68	3.68	3.68	-	mPt
	Online	Electricity + Internet use	-	-	-	0.46	mPt
	<i>Kelurahan</i> Visit	Transportation	3.68	3.68	3.68	3.68	mPt
<b>Total</b>			<b>11.60</b>	<b>7.36</b>	<b>7.36</b>	<b>4.14</b>	<b>mPt</b>

Table 7. Environmental impact generated by *Kelurahan* office

<i>Kelurahan</i>							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Units
					Offline	Online	
Submission Recording	Form <i>Kelurahan</i>	Printed Paper	4.23	-	-	-	mPt
	Request Recording	Computer + Internet Use	0.46	0.46	0.46	-	mPt
	Invoice Printing	Printed Paper	1.11	1.20	1.20	-	mPt
<b>Total</b>			<b>5.80</b>	<b>1.66</b>	<b>1.66</b>	<b>0.00</b>	<b>mPt</b>

Table 8. Environmental impact generated by courier

Courier							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Units
					Offline	Online	
Requirements shipping	<i>Kelurahan</i> to DISPENDUKCAPIL	Transportation	2.87	-	-	-	mPt
Finished document shipping	DISPENDUKCAPIL <i>Kelurahan</i>	Transportation	2.87	2.87	2.87	2.87	mPt
<b>Total</b>			<b>5.74</b>	<b>2.87</b>	<b>2.87</b>	<b>2.87</b>	<b>mPt</b>

Table 9. Environmental impact generated by DISPENDUKCAPIL office

DISPENDUKCAPIL							
Process	Activities	Inventory	LAMPID	KLAMPID	KLAMPID COVID		Units
					Offline	Online	
Request Processing	Verification	Computer + Internet Use	-	0.09	0.09	0.09	mPt
	SIAK Recording	Computer + Internet Use	0.30	0.30	0.30	0.30	mPt
	Manual Certificate Legalization	Printed Paper	1.20	-	-	-	mPt
	TTE Signing	Computer + Internet Use	-	1.22	1.22	1.22	mPt
	Legalization	Computer + Internet Use	-	0.30	0.30	0.30	mPt
	Certificate Printing	Printed Paper	-	1.20	1.20	1.20	mPt
Submission Database	Database facility	Electricity + Internet Use	-	26.95	26.71	26.71	mPt
<b>Total</b>			<b>1.50</b>	<b>30.06</b>	<b>29.83</b>	<b>29.83</b>	<b>mPt</b>

Table 10. Environmental impact comparison

ENVIRONMENTAL IMPACT COMPARISON					
Stakeholder	LAMPID	KLAMPID	KLAMPID ONLINE		Units
			Offline	Online	
Customer	11.60	7.36	7.36	4.14	mPt
<i>Kelurahan</i>	5.80	1.66	1.66	0.00	mPt
Courier	5.74	2.87	2.87	2.87	mPt
DISPENDUKCAPIL	1.50	30.06	29.84	29.80	mPt
<b>Total</b>	<b>24.64</b>	<b>41.95</b>	<b>41.71</b>	<b>36.81</b>	<b>mPt</b>

The value from Table 10. is depicted in the Figure 2. In this graph the environmental impact changes from each stakeholder through each system transformation are shown.

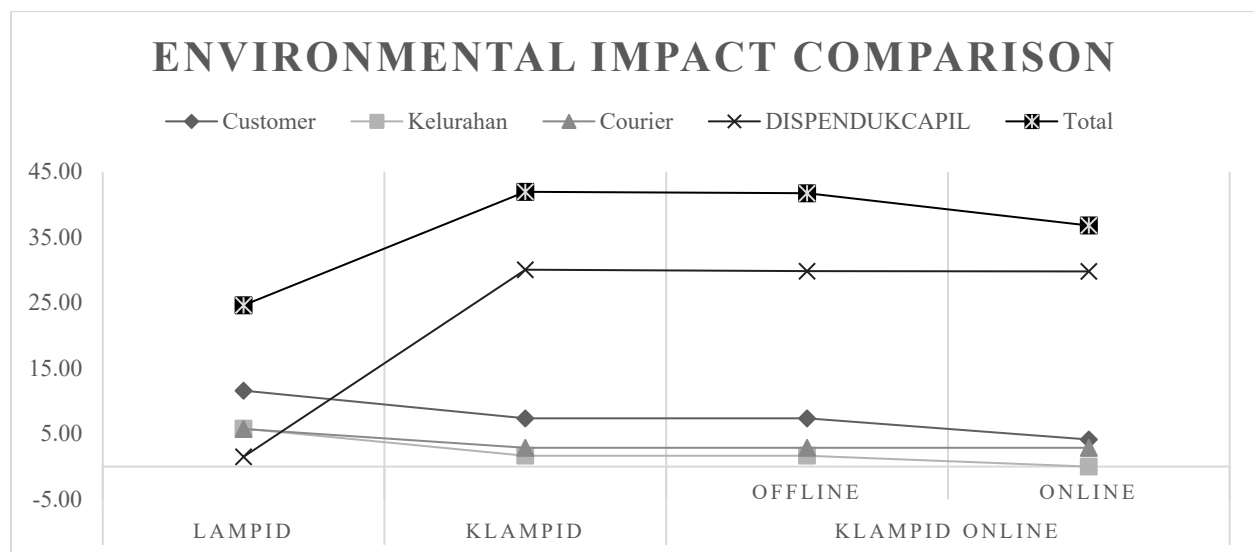


Figure 2. Environmental impact comparison

This study results, shown in Figure 2., show that the system transformation that implements the information system has a higher environmental impact compared to the previous system which is LAMPID. Compared to LAMPID which has 24.64 mPt of environmental impact for each birth certificate establishment, the KLAMPID and KLAMPID COVID (for both the online and offline submission) have 41.95 mPt, 41.71 mPt, and 36.81 mPt of environmental impact, respectively. However, it is shown that most of the environmental impact increase is contributed by the DISPENDUKCAPIL Surabaya and from Table 9., mostly it is caused by the Database Facility. While, on the other hand, the environmental impact that is generated by other stakeholders tends to have a lower environmental impact however the reduction cannot cover the environmental impact increase caused by the Database Facility.

The database facility has an environmental impact contribution of 26.95 mPt (89.65% of the total environmental impact generated by DISPENDUKCAPIL) during the KLAMPID System and 26.71 mPt (89.55% of the total environmental impact generated by DISPENDUKCAPIL) during KLAMPID COVID. So that, during KLAMPID System and KLAMPID COVID the total environmental impact increases by 26.95 mPt and 26.71 mPt respectively. On the other hand, the environmental impact reduction from paper use is 4.23 mPt for the customer, 4.23 mPt for *Kelurahan*, and 1.2 mPt for DISPENDUKCAPIL. The environmental impact reduction from the transportation is 2.87 mPt for the couriers and 3.68 mPt for the customer.



## 6. Conclusion

The Life Cycle Assessment result of the birth certificate service system transformation indicates that the implementation of the information system reduces the environmental impact generated by the customer, *Kelurahan* Office, and couriers. The information system substitutes the utilization of paper and transportation into electricity utilization that results in lower environmental impacts. However, to implement the information system, DISPENDUKCAPIL Surabaya requires database facilities to store and proceed with every incoming service submission. Furthermore, the database facilities generate more prominent environmental impacts compared to the reduction from the paper and transportation reduction. These results show that it is important to consider a wider perspective of the observed system instead of focusing on a certain process or stakeholder in an LCA study. Manzardo et al. (2020) stated that by considering a wider perspective the result of the LCA study will be more effective compared to only focus on a certain process or stakeholder. If this study only focusses on one stakeholders' perspective, the result will show a different conclusion and information about the birth certificate service system transformation.

One of the service system transformations, KLAMPID COVID System, was implemented in response to the COVID-19 pandemic. Some studies stated that the COVID-19 pandemic somehow brings a positive impact on environmental change globally (Saadat et al. 2020 and Somani et al. 2020). That statement is based on which during the pandemic most of the activities must be done by "work from home" which will reduce the emission from the transportation even it requires the use of an information system to cope with. In this study, the result shows that the online submission has a better environmental impact compared with the offline submission during the KLAMPID COVID system. This study result is aligned with the study from Saadat et al. (2020) and Somani et-al. (2020) since the system that is applied during the COVID-19 pandemic, which is the KLAMPID COVID system, not only accommodate the health protocol but also reduce the paper utilization and transportation activities by substituting it with the online submission platform.

DISPENDUKCAPIL Surabaya implements the Information System (IS) to improve the performance of its service system. Additionally, the information system plays an important role in improving the sustainability of firms in the areas of economy, environment, and society (Zeng et al. 2020). The system transformation from LAMPID to KLAMPID and KLAMPID COVID-19 was expected not only to improve the service system but also the sustainability aspect such as the environmental performance by reducing the paper utilization and transportation activities. However, this study results show that the opposite which the transformation that implements the IS generates higher environmental impact compared with the previous system which is LAMPID. The IS, actually, successfully reduces the paper utilization and the transportation activities from the customer and the couriers, however, the IS requires a facility that generates higher environmental impact compared with the environmental reduction that is expected before. The success of IS implementation in reducing the environmental impact from the paper use and the transportation activities also can be seen from the comparison between the online and offline submission, however, even the online submission which reduces the transportation activities from both the customer and the courier, the environmental impact reduction is still smaller compared to the environmental impact that is generated by the database facility.

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