Indonesian Construction Sectors: An Analysis from the Economic Perspective

Ubaidillah Zuhdi
Faculty of Business Economics and Digital Technology
Universitas Nahdlatul Ulama Surabaya
Surabaya 60237, East Java, Indonesia
ubaidillah.zuhdi@unusa.ac.id

Mochamad Yunus and Yamato Tan
Faculty of Engineering
University of Pakuan
Bogor 16143, West Java, Indonesia
mochyunus@unpak.ac.id, yamato@unpak.ac.id

Rizqi Putri Nourma Budiarti and Hidayatul Khusnah
Faculty of Business Economics and Digital Technology
Universitas Nahdlatul Ulama Surabaya
Surabaya 60237, East Java, Indonesia
rizqi.putri.nb@unusa.ac.id, hidayatul.khusnah@unusa.ac.id

Abstract

The purpose of this study is to analyze the roles of construction sectors in the Indonesian national economy. This study uses Input-Output (IO) analysis as an analysis device. More specifically, this study employs the parts of IO analysis, namely simple output multiplier, simple household income multiplier, index of the power of dispersion, and index of the sensitivity of dispersion as analysis tools. The analysis period of this study is 1990-2005. In this study, the analyzed sectors are (1) construction on agriculture, (2) public work on road, bridge, and harbor, (3) construction and installation on electricity, gas, water supply, and communication, and (4) other construction. The results show that, by using both multipliers, the analyzed construction sectors did not include in the top five Indonesian industrial sectors from 1990 through 2005. By using both indices, the analyzed industries almost always occupied the quadrant IV on the period of analysis.

Keywords
Construction Sectors, National Economy, IO Analysis, Patterns.

1. Introduction
The industrial sectors have an important role in a national economy. They contribute not only on the micro aspect, but also on the macro aspect of a country. Their contribution can be seen both in developed and developing countries. One of the industries that worth to be discussed in this matter is the construction sector.

There are many previous studies discuss the contribution or role of the construction industry in the economy. For example, Bosch-Sijtsema and Gluch (2019) make an understanding of the agency and role of Building Information Modelling (BIM) players by applying the theoretical construct of institutional work. Zhang (2019) explores the text mining algorithms for the classification of automatic construction accident causes. Schönbeck et al. (2020) conduct the study to get two main things, namely (1) the information needed to control changes on the period of the healthcare construction projects, and (2) the available needed information in the current change management within the projects on the healthcare construction. Wernicke et al. (2021) construct a basis for measuring digital maturity of construction site operations.

Besides, Sezer and Bosch-Sijtsema (2020) investigate barriers and tensions between players within the service ecosystem of Construction and Demolition Waste (CDW) for the Swedish refurbishment projects. Sobieraj and

Metelski (2020) differentiate a number of factors that allow for a better understanding of investment process management in the industry of housing construction. Their study focuses on the case of Poland. Rondinel-Oviedo (2021) conducts the study which focuses on the status of the management of CDW in the Lima Metropolitan Area (LMA) for diagnosing the different phases in the management.

Based on the aforesaid previous studies, the study to analyze the economic aspect of the construction industry is still needed. This study is conducted to fulfill the gap. One of the tools in conducting the analysis is Input-Output (IO) analysis, the device in investigating the linkages of industrial sectors in one or more countries. The importance and originality of this study are that it explores the roles of the industry by applying several calculation methods from IO analysis which focusing on the national economy of Indonesia.

The purpose of this study is to analyze the roles of construction industries in the national economy of Indonesia. This study employs IO analysis as an analysis device. More specifically, this study uses the parts of IO analysis, namely simple output multiplier, simple household income multiplier, index of the power of dispersion, and index of the sensitivity of dispersion as analysis tools. The analysis period of this study is 1990-2005.

The rest of this paper is explained as follows. Section 2 shows the methodology of this study. Section 3 describes the results of calculations. Also, the discussions for the results can be viewed on this section. The next section, section 4, explains the conclusions of this study, and suggested further studies.

2. Methodology

The methodology of this study is described as follows. The first step is to explain the data used. This study uses Indonesian IO tables for 1990, 1995, and 2005 as data. Initially, the tables consist of 161, 172, and 175 industrial sectors, respectively. After conducting the adjustment process, the tables have 159 industries. Those industries are described in Appendix. The second step is to show the Indonesian construction sectors used in this study. Table 1 shows those sectors.

The next step is to conduct the calculations by applying simple output multiplier, and simple household income multiplier. Miller and Blair (2009) describe the equations of both multipliers as follows:

$$m(o)_j = \sum_{i=1}^{n} l_{ij} \quad (1)$$

$$m(h)_j = \sum_{i=1}^{n} a_{n+1}\, l_{ij}. \quad (2)$$

The former model describes the simple output multiplier while the latter one explains the simple household income multiplier. More specifically, $m(o)_j$, $m(h)_j$, $a_{n+1,i}$, n, and l_{ij} are simple output multiplier for sector j, simple household income multiplier for sector j, the coefficients of labor-input, the number of analyzed sectors, and a sector-to-sector multipliers matrix, respectively.

Table 1. Indonesian Construction Sectors Used in This Study

Sector Number	Sector Name
133	Construction on agriculture
134	Public work on road, bridge and harbor
135	Construction and installation on electricity, gas, water supply and communication
136	Other construction

The fourth step is to conduct the calculations in order to analyze the characteristics of Indonesian industrial sectors on the analysis period, especially the Indonesian construction industries. The methods applied in the calculations are the (1) index of the power of dispersion, and (2) index of the sensitivity of dispersion. The former index is used to analyze the strength of one specific industry in influencing entire industries. A greater influence is aligned with the higher

index value. The detail of the index is explained by Ministry of Internal Affairs and Communications Japan (n.d.) as follows:

$$\text{Index of the power of dispersion by sector} = \frac{b_{*j}}{\bar{B}}. \quad (3)$$

The numerator is each sum of column in the table of inverse matrix coefficients while the denominator explains the mean value of the entire vertical sum in the table of inverse matrix coefficients. More specifically, the equations of numerator and denominator are explained as follows:

$$b_{*j} = \sum_i^n b_{ij} \quad (4)$$

$$\bar{B} = \frac{1}{n}\sum_j b_{*j} = \frac{1}{n}\sum_i \sum_j b_{ij}. \quad (5)$$

Further, b_{ij} and n are the value of Leontief inverse from sector i to sector j, and total number of analyzed industries, respectively. The latter index is utilized to analyze the sensitivity of the specific industry to the external influences. A greater sensitivity is aligned with the greater index value. More specifically, one particular industrial sector is called more sensitive to the influences from the external aspects if it has a higher index value. The detail of the index is described by Ministry of Internal Affairs and Communications Japan (n.d.) as follows:

$$\text{Index of the sensitivity of dispersion by sector} = \frac{b_{i*}}{\bar{B}}. \quad (6)$$

In this index, the numerator is each sum of row in the table of inverse matrix coefficients while the denominator describes the mean value of the entire horizontal sum in the table of inverse matrix coefficients. Further, the equations of the numerator and denominator of the index are explained as follows:

$$b_{i*} = \sum_j^n b_{ij} \quad (7)$$

$$\bar{B} = \frac{1}{n}\sum_i b_{i*} = \frac{1}{n}\sum_i \sum_j b_{ij}. \quad (8)$$

In order to get a compatibility sense with the previous index, equation (7) is slightly changed from the original source. More specifically, the part describes the total number of discussed industrial sectors, n, is added into the equation. As with the previous explanation, b_{ij} is the Leontief inverse value from sector i to sector j. Conclusions of the study, and suggested further researches are explained on the last step.

3. Results and Analysis

Tables 2, 3, and 4 show the top five Indonesian industrial sectors observed from the value of simple output multiplier in 1990, 1995, and 2005, respectively. Miller & Blair (2009) explain that an output multiplier for sector j is the total value of production in all industrial sectors of the economy that is needed in order to fulfill a currency's worth of final demand for the output of sector j. They also describe that, for the simple output multiplier, the total value of production is coming from the model of households exogenous.

Analyzed construction sectors do not include in the tables. By using this result, one can argue that the sectors did not generate the attractive impact to the economy of Indonesia on the analysis period through an additional final demand. Another interesting point from the multiplier is the sectors 66, 111, and 112 can be seen in tables. Those sectors are made up textile goods except wearing apparel, prime movers engine, and machinery and apparatus, respectively. This fact describes the consistency of the sectors in attracting the Indonesian economy from 1990 through 2005. Machinery and apparatus sector occupies the first rank in table 4 which the value is 3.004. This value indicates that in order to satisfy a rupiah's worth of final demand for the sector's output in 2005, all Indonesian industries needed to produce the products which the total value was Rp 3.004.

Table 2. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Output Multiplier, 1990
(Source: Zuhdi (2014) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Output Multiplier
1	97	Plastic products	2.973
2	112	Machinery and apparatus	2.943
3	66	Made up textile goods except wearing apparel	2.779
4	68	Wearing apparel	2.692
5	111	Prime movers engine	2.685

Table 3. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Output Multiplier, 1995
(Source: Zuhdi (2014) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Output Multiplier
1	124	Aircraft and its repair	2.792
2	112	Machinery and apparatus	2.777
3	66	Made up textile goods except wearing apparel	2.737
4	68	Wearing apparel	2.685
5	111	Prime movers engine	2.623

Table 4. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Output Multiplier, 2005
(Source: Zuhdi (2014) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Output Multiplier
1	112	Machinery and apparatus	3.004
2	124	Aircraft and its repair	2.992
3	111	Prime movers engine	2.809
4	127	Musicals instruments	2.608
5	66	Made up textile goods except wearing apparel	2.595

Figure 1 shows the simple output multiplier values of analyzed industries on the period of analysis. Based on the figure, one can say that the analyzed industries have same pattern, namely value decreasing could be seen from 1990 through 1995 while the opposite phenomenon was happened between 1995 and 2005. This fact might be influenced by the financial crisis that hit Indonesia in 1997-1998.

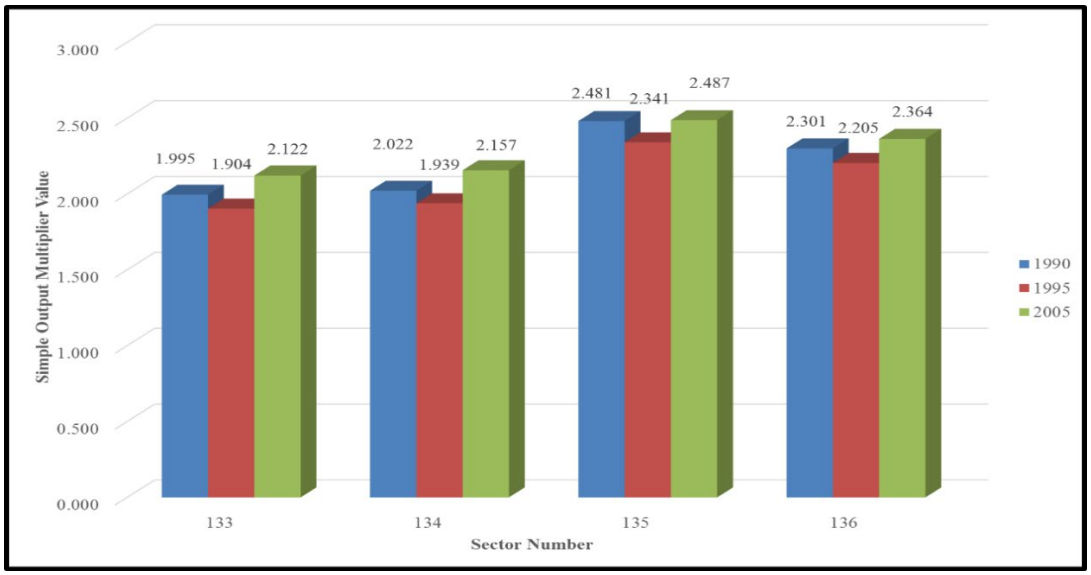

Figure 1. The Simple Output Multiplier Values of Analyzed Industries, 1990-2005

Tables 5, 6, and 7 explain the top five Indonesian industrial sectors viewed from the value of simple household income multiplier in 1990, 1995, and 2005, respectively. Miller & Blair (2009) describe that the multiplier is applied to explain the economic impacts of new final demand as measured by new households income by using the model of households exogenous. Based on the information in the tables, one can say that only one sector that appears in both multipliers, namely musical instruments, the sector number 127.

Table 5. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Household Income Multiplier, 1990 (Source: Zuhdi (2015) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Household Income Multiplier
1	151	General government	0.952
2	154	Other community services	0.629
3	152	Education services	0.579
4	11	Rubber	0.523
5	140	Railway transport	0.519

Table 6. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Household Income Multiplier, 1995 (Source: Zuhdi (2015) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Household Income Multiplier
1	151	General government	0.758
2	152	Education services	0.666
3	154	Other community services	0.659
4	11	Rubber	0.523
5	127	Musicals instruments	0.508

Table 7. Top Five Indonesian Industrial Sectors Viewed from the Value of Simple Household Income Multiplier, 2005 (Source: Zuhdi (2015) with Slight Modifications)

No.	Sector Number	Sector Name	Simple Household Income Multiplier
1	151	General government	0.643
2	154	Other community services	0.602
3	152	Education services	0.598
4	11	Rubber	0.477
5	155	Private motion picture and its distribution	0.454

As with the previous multiplier, the analyzed industries do not include in simple household income multiplier tables too. One of the interesting points from this multiplier is the compositions of the related tables are similar. More specifically, there are four industries that appear in each table that related to the multiplier, namely (1) general government, (2) other community services, (3) education services, and (4) rubber. In 2005, the values of those sectors were 0.643, 0.602, 0.598, and 0.477, respectively. These values indicate that, in 2005, an additional rupiah of final demand for the sectors would generate Rp 0.643, Rp 0.602, Rp 0.598, and Rp 0.477 of new household incomes, respectively, when all direct and indirect impacts were changed into rupiah estimates of incomes. Another interesting point is the first position of the tables is owned by the sector number 151, general government.

Figure 2 explains the simple household income multiplier values of analyzed industrial sectors on the analysis period. Based on the figure, one can argue that the analyzed industries have same pattern, namely value increasing appeared from 1990 through 1995 while the opposite phenomenon could be seen between 1995 and 2005. This pattern is different with the one owned by the previous multiplier.

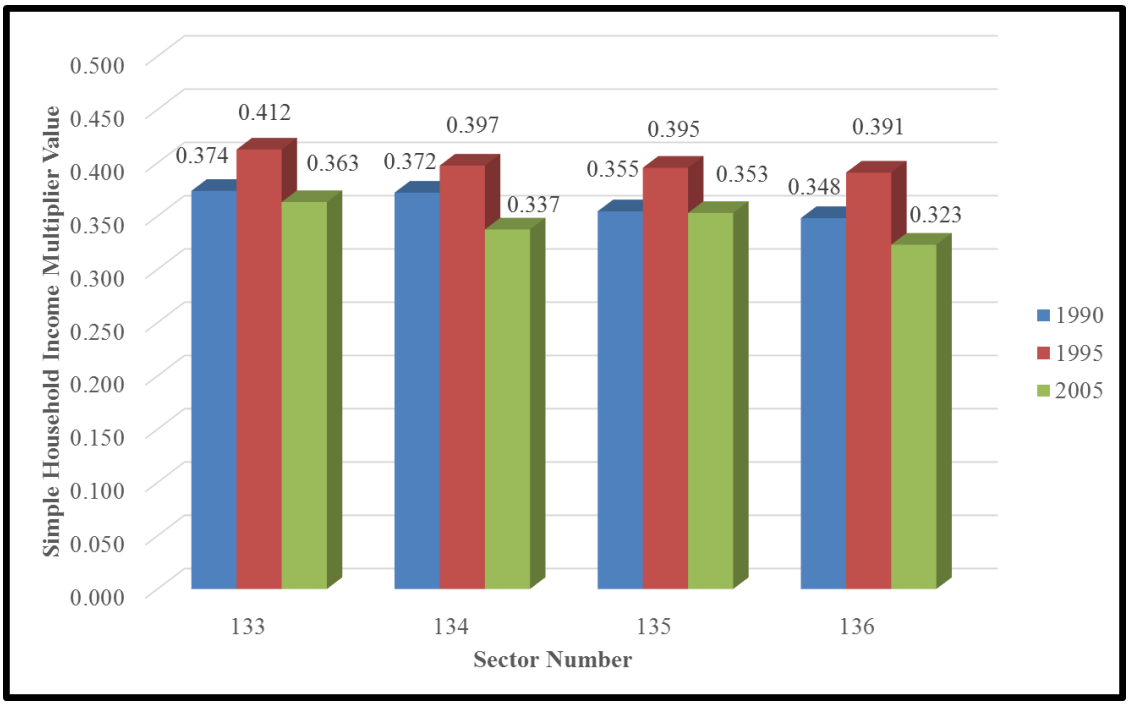

Figure 2. The Simple Household Income Multiplier Values of Analyzed Industries, 1990-2005

Table 8 summarizes the quadrants of analyzed industries on the analysis period. The quadrants come from the combination of both indices used in this study, namely the index of the power of dispersion, and the index of the sensitivity of dispersion. The combination itself generates four quadrants.

Each quadrant has characteristics. More specifically, the quadrant I is a location where the values of both indices are more than one. In other words, the industries include on this quadrant are those most affected by the external aspects as well as have strong influences on the entire industries. The opposite phenomena can be viewed on the sectors which include on the quadrant III. On the other hand, quadrant II is a place where the value of the index of the power of dispersion is less than one while the value of another index is more than one. One can say that the industries include on this quadrant are those which have weak impacts on the entire industries, but they get high influences from the changes of external aspects. The opposite characteristics are owned by the industries which include on the quadrant IV.

Table 8. The Quadrants of Indonesian Construction Sectors, 1990-2005

Sector Number	Sector Name	Quadrant		
		1990	1995	2005
133	Construction on agriculture	IV	III	IV
134	Public work on road, bridge and harbor	IV	IV	IV
135	Construction and installation on electricity, gas, water supply and communication	IV	IV	IV
136	Other construction	IV	IV	IV

Based on the information in the table, on the analysis period, one can say that the analyzed sectors almost always occupied the quadrant IV. An exception could be seen on the construction on agriculture sector in 1995. These facts

explain that the majority of analyzed industries had strong impacts on the entire industries, but they got low influences from the changes of external aspects on the period of analysis.

4. Conclusions and Further Researches

This study analyzes the roles of Indonesian construction industries in the Indonesian national economy by using IO analysis. More specifically, this study uses simple output multiplier, simple household income multiplier, index of the power of dispersion, and index of the sensitivity of dispersion as analysis tools. The analysis period of this study is 1990-2005. The analyzed Indonesian construction sectors in this study are (1) construction on agriculture, (2) public work on road, bridge and harbor, (3) construction and installation on electricity, gas, water supply and communication, and (4) other construction.

The results show that, by using both multipliers, the analyzed construction industries did not include in the top five Indonesian industrial sectors from 1990 through 2005. By using both indices, the analyzed sectors almost always occupied the quadrant IV on the period of analysis. An exception could be observed on the sector number 133, construction on agriculture, in 1995. These facts show that the majority of analyzed industries had strong effects on the entire industrial sectors, but they got low impacts from the changes of external aspects on the analysis period.

The understanding regarding the roles of Indonesian construction sectors in impacting the Indonesian national economy on the period of analysis is obtained from the current study. However, the study would gain a broader insight about the roles if the study could use the longer analysis period. Therefore, as a further research, the study proposes the same analysis by utilizing the longer period of analysis, such as from 1990 through 2015. One of the important points in conducting this further research is the prices and industrial sectors used on the analyzed IO tables should be same.

The other suggested further research from the study is to do an international comparison using the same methods. The comparison can be conducted among developed as well as developed-developing nations. The comparison might explore the roles of the construction sectors of compared countries so the similarities and differences among those regarding the industries can be analyzed. One of the examples of this further research is the comparison between Indonesia and Japan.

Acknowledgements

The authors would like to thank Universitas Nahdlatul Ulama Surabaya for providing the research funding.

Appendix

The Indonesian Industries (Source: Zuhdi et al. (2014) with Slight Modifications)

Sector Number	Sector Name
1	Paddy
2	Maize
3	Cassava
4	Other root crops include sweet potatoes
5	Groundnut
6	Soybeans
7	Other beans
8	Vegetables
9	Fruits
10	Cereals and other food crops
11	Rubber
12	Sugarcane
13	Coconut

14	Oil palm
15	Fibre crops
16	Tobacco
17	Coffee
18	Tea
19	Clove
20	Other estate crops
21	Other agriculture
22	Livestock and livestock product except fresh milk
23	Fresh milk
24	Poultry and its product
25	Other livestock raising
26	Wood
27	Other forest product
28	Sea fish and other sea products
29	Inland water fish and its product
30	Coal
31	Crude oil
32	Natural gas and geothermal
33	Tin ore
34	Nickel ore
35	Bauxite ore
36	Copper ore
37	Gold and silver ore
38	Other mining
39	Crude salt
40	Quarrying, all kinds
41	Meat and entrails of slaughtered animal
42	Processed and preserved meat
43	Dairy products
44	Canning and preserving of fruits and vegetables
45	Drying and salting of fish
46	Processed and preserved fish
47	Copra, animal oil and vegetables oil
48	Rice
49	Wheat flour
50	Other flour
51	Bakery product and the like
52	Noodle, macaroni and the like
53	Sugar
54	Peeled grain, chocolate and sugar confectionery
55	Milled and peeled coffee
56	Processed tea

57	Soya bean products
58	Other foods
59	Animal feeds
60	Alcoholic beverages
61	Non-alcoholic beverages
62	Tobacco products
63	Cigarettes
64	Yarn and cleaning kapok
65	Textile
66	Made up textile goods except wearing apparel
67	Knitting mills
68	Wearing apparel
69	Manufacture of carpet, rope, twine and other textile
70	Leather tanneries and leather finishing
71	Manufacture of footwear and leather products
72	Sawmill and preserved wood
73	Manufacture of plywood and the like
74	Wooden building components
75	Manufacture of furniture and fixtures mainly made of wood, bamboo and rattan
76	Manufacture of other products mainly made of wood, bamboo, rattan and cork
77	Manufacture of non-plastic plait
78	Pulp
79	Paper and cardboard
80	Paper and cardboard products
81	Printing and publishing
82	Basic chemical except fertilizer
83	Fertilizer
84	Pesticides
85	Synthetic resins, plastic and fibre
86	Paints, varnishes and lacquers
87	Drugs and medicine
88	Native medicine
89	Soap and cleaning preparation
90	Cosmetics
91	Other chemical products
92	Petroleum refineries products
93	Liquefied of natural gas
94	Smoked and crumb rubber
95	Tire
96	Other rubber products
97	Plastic products

98	Ceramic and earthenware
99	Glass products
100	Clay and ceramic structural products
101	Cement
102	Other non-ferrous products
103	Basic iron and steel
104	Basic iron and steel products
105	Non-ferrous basic metal
106	Non-ferrous basic metal products
107	Kitchen wares, hand tools and agricultural tools
108	Furniture and fixed primarily made of metal
109	Structural metal products
110	Other metal products
111	Prime movers engine
112	Machinery and apparatus
113	Electric generator and electrical motor
114	Electrical machinery and apparatus
115	Communication, electronical equipment and apparatus
116	Household electronics appliances
117	Other electrical appliances
118	Battery and storage battery
119	Ship and its repair
120	Train and its repair
121	Motor vehicle except motorcycle
122	Motorcycle
123	Other transport equipment
124	Aircraft and its repair
125	Measuring, photographic and optical equipment
126	Jewelry
127	Musicals instruments
128	Sporting and athletics goods
129	Other manufacturing industries
130	Electricity and gas
131	Water supply
132	Residential and non-residential buildings
133	Construction on agriculture
134	Public work on road, bridge and harbor
135	Construction and installation on electricity, gas, water supply and communication
136	Other construction
137	Trade
138	Restaurant
139	Hotel

140	Railway transport
141	Road transport
142	Sea transport
143	River and lake transport
144	Air transport
145	Services allied to transport
146	Communication services
147	Banking and other financial intermediaries
148	Insurance and pension fund
149	Building and land rent
150	Business services
151	General government
152	Education services
153	Health services
154	Other community services
155	Private motion picture and its distribution
156	Amusement, recreational and cultural services (private)
157	Repair shop n.e.c
158	Personal and household services
159	Other goods and services n.e.c

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Biographies

Ubaidillah Zuhdi is an Assistant Professor at the Faculty of Business Economics and Digital Technology, Universitas Nahdlatul Ulama Surabaya. Currently, he is a dean of the faculty. He earned his doctorate degree from the Department of Industrial Administration, Tokyo University of Science. Previously, he was an Assistant Professor at the Faculty of Management and Economics, Gdansk University of Technology. He has published many journal papers. His research interests include (1) the economic analyses of the sectors of Information and Communication Technology (ICT), creative industry, livestock, agriculture, energy, and fishery, (2) applied economics, (3) policy analysis, (4) IO analysis, and (5) mathematical modeling.

Mochamad Yunus is a Lecturer at the Electrical Engineering Department, Faculty of Engineering, University of Pakuan, Bogor, West Java, Indonesia. He is a Research Engineer in the Microwave, Antenna and Propagation. Since January 2001, he is an Associate Professor at the University of Pakuan, Bogor, West Java, Indonesia. He received the Doctoral Degree in Electrical Engineering from the Universitas Indonesia, Indonesia, in 2016.

Yamato Tan is a Lecturer at the Electrical Engineering Department, Faculty of Engineering, University of Pakuan, Bogor, West Java, Indonesia. Currently, he is a Head of the Electrical Engineering Department. He has published journals in the fields of Renewable Energy and Information & Communication Technology (ICT). He is also as a Practitioner/Consultant, Trainer and Implementor for Projects in the fields of Renewable Energy (Solar Power Plant) and Information & Communication Technology.

Rizqi Putri Nourma Budiarti is a Lecturer in the Department of Information Systems, Faculty of Business Economics and Digital Technology, Universitas Nahdlatul Ulama Surabaya. She currently serves as a Head of Research and Innovation Unit at the Directorate of Research and Community Service at the university. In addition, she serves as the Chief Editor of the Applied Technology and Computing Science Journal. She holds a master's degree in engineering from the multimedia intelligent network department, Institut Teknologi Sepuluh Nopember. Her research interests include (1) machine learning, (2) data mining, (3) virtual reality, (4) networking, and (5) Big Data.

Hidayatul Khusnah is a lecturer at the Faculty of Business Economics and Digital Technology, Universitas Nahdlatul Ulama Surabaya. She has published many research articles. Her research interests include (1) management accounting, (2) behavioral accounting, (3) financial accounting, and (4) business management.