

PAPER • OPEN ACCESS

How do the Indonesian ecologically conscious millennials value upcycled clothing?

To cite this article: C A Parung 2019 *IOP Conf. Ser.: Mater. Sci. Eng.* **703** 012031

View the [article online](#) for updates and enhancements.

How do the Indonesian ecologically conscious millennials value upcycled clothing?

C A Parung

Faculty of Creative Industry, University of Surabaya, Raya Kalirungkut, Surabaya, 60293, Indonesia

E-mail : christabelannora@staff.ubaya.ac.id

Abstract. Upcycling is a form of green action in the area of product management and it is a new emerging trend nowadays. According to the findings of previous researches, Ecologically Conscious Consumer (ECC) tends to purchase more sustainable products, including environmentally-friendly fashion products. However, though upcycled products are classed as environmentally-friendly products, there has not been any research yet confirming that ECC in developing country likes Indonesia value and has interest in purchasing it. The aim of this research is to identify green consumer behaviour in Indonesia towards upcycled clothing. An online survey was conducted through online questionnaires to find the relationship between green consumer in Indonesia and environmentally-friendly fashion, also how the ECC value upcycled clothing as a form of eco-friendly fashion. The research shows that Indonesian millennials are mostly environmentally conscious and adopt green buying behaviour. It was found that many of green consumers in Indonesia are unfamiliar with the word ‘upcycling’, but some of them have already purchased it as form of sustainable deeds. Mostly the participants valued upcycled products more than recycle products for the ideas and they are valued as work of art. Profound statistical analysis was used to get the result of this research.

Keywords: upcycle, green consumer, ecologically conscious, sustainable clothing

1. Introduction

Fashion is one of the biggest and most successful business and industries in the world. It is stated by JEC Democratic, Bureau of Labour that almost 1.8 million people work in fashion industry and there are more than 200,000 textile and fashion products manufacturers in the United States (US). This phenomenon does not only happen in US, but also in other countries which shows that fashion industries are making very impeccable growth. Despite its success, it is nothing new for fashion industry to be considered as one of the biggest contributors of this world’s pollution. The production process that turn raw materials into fashion products like garments, bags, shoes has negative impacts on environment, including water and air pollution, toxic chemicals and waste, etc. Kawamura stated that fast fashion as business model has made over-consumption among the consumers and leads to large numbers of waste [1]. This happens all around the world, including Indonesia which is ranked as top ten biggest textile producing countries in the world.



During the past decades, consumers' concern about environmental issues like excessive waste issue, global warming, water and air pollution have increased [2]. Consumers also started to show environmental awareness where they realize that their buying behaviour can directly affect environment. This type of consumers is called Ecologically Conscious Consumer or Ecologically Concerned Consumer (ECC), and it is defined as group of people who seek to buy / purchase products that does not have damaging impacts on the environment [3].

While fashion companies have to compete with each other in attracting consumers and make over consumption, consumers themselves have to 'make space' by throwing away or donating their clothes. This process is called post-purchase process in garment/clothing consumption which involves recycling, re-using, discarding and destroying clothing [4]. In this case, generally ECC tends to support recycling process more than destroying and discarding clothing since garments materials that are made from nylon and polyester is categorized as plastics contain toxic and non-biodegradable. Up-cycling is different from other forms of recycling because it is a conception of adding value to used products. Traditional recycling ways like down-cycle and recycle involve process like melting down and reconstructing process, and this process produces much CO₂ which is not that friendly for the environment. In the other hands, up-cycling is considered less harmful.

Upcycling is now a trend and it has gained attention and popularity among the green fashion consumers. Some news suggests that it is popular on online marketplaces as well [5]. Upcycling should be studied further to place fashion in a more sustainable and environmentally friendly condition. However, like new other grounds, not many people are aware of this trend. The purpose of this study is to gain insights about the green consumers' behaviour of upcycled products in Indonesia since buying behaviour of fashion ECC is often considered complicated and unpredictable [6].

2. Literature Review

2.1 *Upcycling as repurposing of clothing*

Products repurposing (such as clothing, tools, etc.) has undeniably gained much attention these days, especially in literatures about manufacturing and production [7]. This phenomenon happened as an impact of increased social responsibility [8]. Innovators have developed extraordinary ways to reuse and repurpose materials waste. However, even though the word 'upcycling' is still unfamiliar for some people, it is not a new phenomenon. It has been done by people in 1930s and 1940s when people preferred to reuse their old stuffs than buying new ones.

Upcycling is a form of repurposing product in which the product itself is broken down into separate materials – which is called 'down cycling', and using those separated materials, make a new product out of it. Both recycling and upcycling are popular in developing countries that do not have many resources. Upcycling is often thought as creative way to reuse products. The main thing that differentiate upcycling from recycling, is that upcycling was meant to 'upgrade' the used products – nicer, better quality, etc. Therefore, upcycling demonstrates more effective and beneficial way in reusing the broken-down materials. For example, upcycling gives the designers to use textile waste to create new fashion, re-invent the style and adjust it with the current style. Many studies have confirmed that many discarded garments still have good quality at the disposal time, and with upcycling, people can optimize products' use and reduce waste materials. Researchers also found that upcycling process allows the consumer / users have some kinds of 'attachment' to the products. This product attachment is an emotional experience that users feel when experiencing the products [9]. Upcycled products are combination of used products with different end uses which probably have many stories behind. For those reasons, upcycled garments are usually more expensive than usual recycled garments. Even though the upcycling market can worth more than a hundred million dollars worldwide, not many countries in Asia support this practice. Korean upcycling market cannot reach the numbers that upcycling markets reached worldwide. This supports in their research that stated that many Asians do not really like wearing second-hand clothes [10]. However, even though it has been stated that upcycling markets in Asia do not expand as big as ones worldwide, the demand for the products are increasing.

2.2 *Millennial ecologically conscious consumer (ECC)*

In recent years, almost every consumer started to purchase products that do not cause environmental problems. This happens because the environment nowadays is way more important than it was before to them. This type of consumer is called ecologically conscious consumer nowadays. Generally, Ecologically Conscious Consumers are aware of environmental problems that lead to eco-friendly lifestyle, such as green purchase, goods disposal, etc. ECC knows that by purchasing products that are not harmful for environment, they can contribute to ecological preservation. There are several studies investigating the variables influencing ecologically-conscious behaviour of consumers. Anderson and Cunningham characterized that green consumers are usually 40 years old and above – with high level of education and higher social status. On the contrary, some researchers do not find any significant relations between age, sex and ecologically conscious behaviour [11]. However, Lu, Bock, and Joseph expressed that consumers in general are not driven to stop using certain products only to boycott the environmentally harmful products [12]. They think that price, design, and qualities are also important factors for them in choosing products. Generation Y, often termed as Millennial Generation, is a recent population, comprised of people in the age of 18 – 34 years old. According to Vermillion and Pearl, this group tends to be environmentally conscious than other age group [13]. Moreover, the educated millennials also tend to worry more about their health and community. However, they also seem to care more about their social status, which indicates that their intentions buying environmentally-friendly product might not always because they really care about the environment.

RQ1 Are millennials consumers ecologically conscious?

RQ2 How does millennials consumers' environmentally conscious behaviour affect their buying behaviour?

RQ3 How do the millennial consumers accept and value recycled and upcycled clothing as a form of supporting environmentally-friendly product?

3. Method

Quantitative study was chosen as the methodology of this research and the author picked survey as the data collection method. Survey method was conducted to get substantive outcome and ease the spread of questionnaires to the participants. Non-probability sample consisting of undergraduate students in several universities in Indonesia was recruited for this study. Purposive sampling technique was chosen because the questionnaires are needed to be given to specific group of people having certain characteristics: millennials, well-educated, and ecologically-conscious.

Firstly, faculty members and staff from each university were briefed and given the online questionnaires via email. Next, they emailed the link to the students' representatives and those representatives explained to their friends about the purpose of the survey. Interested students were suggested to give feedbacks and answers of the questionnaires in two weeks. Although non-probability sampling (purposive sampling) was used, the students that participated in the study have many interests and characteristics. The questionnaire itself was divided into several sections based on the issues being identified. It consisted of several sections with Likert scales as measurement that indicates the participants answer from 'never' to 'strongly agree'. The first 5 questions determined the demographics of the participants. The next few questions were meant to gauge their behaviour towards the environment. Data was analysed statistically by measuring frequencies, descriptive, and also using chi - square tests that allow the author to get the profound statistical result.

4. Discussion

The author received a total of 107 responses from graduated and non-graduated millennials, 54.2% of which were female and the rest (45.8 %) were male respondents. 88.8% had already graduated or were still studying in college and 11.2% did not go to college/ did not graduate. Most of these participants are from art and design background which are about 43% followed by social which are 31.8%, STEM (Science, Technology, Engineering and Mathematics) which are 16.8%, and the rest are health and others. More importantly, 63.6 % of these participants are not familiar with the word 'upcycling'. One important and fundamental factor analysis was done on the questions measuring their environmental consciousness. Overall, this first analysis sought to distinguish millennials'

behaviour towards environment. Ahn and Park (1998) stated that to be considered as ecologically conscious consumers, they need to have eco-friendly lifestyle and have green purchase behaviour. These 4 items questioned stated that mostly these participants can be considered as ECC. Regarding to the first research question, it seemed that age, sex, and major background do not influence their environmental consciousness. Overall, all millennials are likely to be environmentally aware and conscious. Table 4.1. shows the percentage of Likert Scale answers towards the environmental related items.

Table 4.1. Principal component regarding to environment.

No	Items	Agree	Neutral	Disagree
1	I always look for rubbish bin when I am about to throw away rubbish	95.3	4.7	0
2	I always check the label of product to find out whether it's environmentally friendly	37.4	42.1	20.6
3	I am aware that garment industry has bad impact on environment	74.8	19.6	5.6
4	It is important for me to buy environmentally-friendly product	63.6	27.1	9.3

The following analysis sought to identify consumers' environmentally conscious behaviour and its effect on their buying behaviour. To answer this, crosstab analysis was done on the environmental concern segment and their 'green' fashion consumption. Chi-square test was done to see whether the independent variables were "fit". Green Fashion Consumption here was marked by green waste disposal habits, like clothes donation, and also green purchase like buying second-hand clothing, and fixing broken clothes. Those who tend to be environmentally conscious much likely to adopt green fashion consumption. There were several items regarding to these two segments, however there were three variables that crossed with asymp. Sig value ≤ 0.05 . Table 4.2 indicates both dependent and independent variables which has valid correlations, and this answered the research question number two, the environmentally conscious millennials tend to have a green buying behaviour. There is a positive relationship between those two variables.

Table 4.2. Cross tabulation of Environmental Consciousness and Green Fashion Consumption Components

No	(Environmental Consciousness)	(Green Fashion Consumption)	As
1	I always look for rubbish bin when I am about to throw away rubbish	I always feel good donating my old clothes	.033
2	I always check the label of product to find out whether it's environmentally friendly	I love to buy second-hand clothing	.050
3	It is important for me to buy environmentally-friendly product	I tend to modify and fix my broken clothes than buy a new one	.004

Research question number 3 was the main question in this research. Frequency analysis was done using SPSS and overall, millennials tend to agree to swap clothes and buy second-hand clothes which indicate that they mainly have green purchase behaviour. However, the numbers are not significantly different for 'swap clothes' variables, the author had a chance to gain further information and this was because of pride. They do not mind swapping clothes with strangers, or even buying them, it is just their self-image they are worried about. Table 4.3 shows the frequency percentage of millennials recycled and upcycled clothing buying behaviour.

Table 4.3. Millennials Recycled and Upcycled Buying Behaviour

Items	Agree	Neutral	Disagree
1 I like to swap clothes with my close friends and families	43.9%	25.2%	30.8%
2 I like buying secondhand clothes	61.7%	16.8%	21.5%
3 I buy secondhand clothes because it is cheap	50.5%	23.4%	26.2%
4 I buy secondhand clothes because it has unique style	55.1%	22.4%	22.4%
5 I prefer modified clothing than the unmodified ones	16.8%	43.9%	39.3%
6 I like buying upcycled clothing	55.1%	33.6%	11.2%

From the table above, it can be informed that millennials indeed love buying recycled and upcycled products. However, it is hard to know the buying intentions, whether it is as an act of environmental consciousness or they were only appreciating a work of ‘art’. This might support Lu, Bock, and Joseph (2013) who indicates that even the most environmentally-conscious consumer do not always buy product over ‘environmental concern’. The author took further analysis in the 21.5% who disagree in buying secondhand clothes. With the asymp. Sig of .000, it is confirmed that they dislike buying them over cleanliness reason.

Unlike the previous segments, here demographics play a consequential part. The cross-tab analysis between two variables (Sex and Modified-Unmodified Clothes), also Major background and Upcycled Clothes were undertaken which lead to an interesting result. Male participants tend to like unmodified ones (recycled clothes), while female participants have bigger number in ‘Agree’ and ‘Neutral’ than male.

Table 4.4. Sex and Modified Clothes Variable Counts

		Modified over the unmodified ones			Total	
		D	N	A		
Sex	Male	Count	23	23	3	49
		Expected Count	19.2	21.5	8.2	49.0
	Female	Count	19	24	15	58
		Expected Count	22.8	25.5	9.8	58.0
		Count				

Interesting results also came in the case study of ‘Tesco bag’. On the questionnaires, the author gave an example of upcycled clothing that was made of an old shopping bag from a certain supermarket in England. Crosstab analysis was undertaken between major and their interest in certain upcycled products variables, and with the asymp.sig .002, the people who are interested the most in the upcycled products were from Art and Design background. In contrary, the people who are likely to disagree were from STEM background.

Table 4.5. Major and Upcycled Products Cross Tab

		Case 01 Tesco Bag Upcycled			Total	
		D	N	A		
Major	Art and Design	Count	6	8	32	46
		Expected Count	11.6	10.7	23.6	46.0
	STEM	Count	11	4	3	18
		Expected Count	4.5	4.2	9.3	18.0
	Social	Count	7	11	16	34
		Expected Count	8.6	7.9	17.5	34.0

Health	Count	1	0	0	1
	Expected Count	.3	.2	.5	1.0
Others	Count	2	2	4	8
	Expected Count	2.0	1.9	4.1	8.0

5. Conclusions

In general, Indonesian millennials are considered to be ecologically conscious, and there are no correlations between gender, age and their behaviour. This behaviour is the one that leads to their green buying behaviour, which has been proven, is very much related. However, during their purchasing time, it is not clear yet whether the intention of their purchase is underpinned by their environmental consciousness. In some ways, millennials also take design, price, and style into consideration. Subsequently, their green behaviour also leads to their acceptance and how they value recycled and upcycled products. Even though they are not familiar with the word 'upcycling', unconsciously Indonesia millennials have taken part in such area. Though both male and female participants fully agreed that upcycled products has to be more expensive than regular products because of the 'sense of art', not everyone choose to buy it more than the recycled ones. Female participants can accept upcycled products more than the male ones, but this does not mean that male participants reject it. From the questionnaires, the author can conclude that male participants prefer recycled ones because they do not want too many modifications (style-related). This study also proved that participants from art and design background tend to have more interest in upcycled clothing with its 'uncommon and peculiar style' than others from other background.

This research will be able to help brands and retails to target the environmentally-conscious fashion consumer and develop their awareness in green fashion consumption. Also, for educators and students, the findings of this research can be used for further observations in upcycling area.

References

- [1] Kawamura Y 2005 *Fashionology: An introduction to fashion studies* (Oxford: Berg)
- [2] Van Dam Y and Apeldoorn P 1996 Sustainable Marketing *J. Macromarketing* **16** pp 45-56
- [3] Roberts J A 1996 Green Consumers in the 1990s: Profile and Implications for Advertising. *J. Bus. Res.* **36** pp 217-31
- [4] Ha-Brookshire J and Hodges N 2008 Socially Responsible Consumer Behavior? *Clothing Text Res J.* **27** pp 179-96
- [5] Goldsmith B 2009 Trash or treasure? Upcycling becomes growing green trend. Retrieved 9
- [6] Nordås H 2004 *The Global Textile and Clothing Industry post the Agreement on Textiles and Clothing* (Geneva : WTO Publications)
- [7] Zink T, Maker F, Geyer R, Amirtharajah R and Akella V 2014 Comparative Liife Cycle Assessment of Smartphone Reuse: Repurposing vs Refurbishment *Int. J. Life Cycle Assess.* **19** pp 1099-109
- [8] Lee, Young & Halter, Holly & K P Johnson, Kim & Ju, and Haewon 2012 Investigating Fashion Disposition with Young Consumers. *Young Consumers.* **14** pp 67-78
- [9] Schifferstein & P H and Zwartkruis-Pelgrim E P H 2008 Consumer-Product Attachment: Measurement and Design Implications. *Int. J. Des.* **2**
- [10] Xu Y, Chen Y, Burman, Ritika, Zhao and Hongshan 2014 Second-hand Clothing Consumption: A Cross-Cultural Comparison between American and Chinese Young Consumers *Int. J. Consum. Stud.* **38** Preprint 10.1111/ijcs.12139
- [11] McEvoy J 1972 The American concern with the Environment : Social Behavior *Nat. Resour. Environ.* pp 214-36
- [12] Leslie Lu, Dora Bock, Mathew Joseph 2013 Green marketing: what the Millennials buy *J. Bus. Strategy* **34** pp 3-10 Preprint 10.1108/JBS-05-2013-0036
- [13] Vermillin L and Pearl J 2010 Green marketing: making sense of the situation. *Proc. Acad. Marketing Stud.* **15** pp 68-72

10th Conference Series

Advanced Materials and Engineering

10th International Conference
on Advanced Materials and Engineering

517

10th International Conference
on Advanced Materials and Engineering

10th International Conference on Advanced Materials and Engineering

10th International Conference on Advanced Materials and Engineering

10th International Conference on Advanced Materials and Engineering

IOP Conference Series: Materials Science and Engineering



With the ability to publish proceedings from events of any size, *IOP Conference Series: Materials Science and Engineering* provides a comprehensive solution for materials science and engineering conferences



RSS



Sign up for new issue notifications

Table of contents

Volume 703

2019

[◀ Previous issue](#) [Next issue ▶](#)

International Conference on Informatics, Technology and Engineering 22–23 August 2019, Bali, Indonesia

Accepted papers received: 06 November 2019

Published online: 05 December 2019

[Open all abstracts](#)

Preface

OPEN ACCESS 011001

Preface

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 011002

Peer review statement

[+ Open abstract](#) [View article](#) [PDF](#)

Papers

Green Manufacturing and Green Processes

OPEN ACCESS 012001

The use of blockchain to support sustainable supply chain strategy

J Parung

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012002

Green chemical engineering: challenges in chemical industrial processes for a better life

L Riadi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012003

Xylanase production from combined *Reutealis trisperma* with potato dextrose broth by *Tricoderma reesei*: the effect of pretreatment

Y E Agustin, L Riadi and T P Utami

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012004

Regulatory performance of two different tuning methods for milk cooling control system

R Agustriyanto

[+ Open abstract](#) [View article](#) [PDF](#)

-
- OPEN ACCESS** 012005
The solubility correlation of azobenzene derivatives in supercritical carbon dioxide: a short review
R S Alwi and A S Iryani
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012006
Container storage tariff policy analysis using combining game theory and system dynamics approach
A G Budianto and B Wirjodirdjo
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012007
Effect of NR-g-cellulose coupling agent into NR-cellulose composite dispersibility and its physical properties
H Handayani, A Cifriadi, A S Handayani, M Chalid, S Savetlana and M Christwardana
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012008
Formulation and characterization of chitosan-alginate freeze dried matrices loaded with oleoresin extract of red ginger
E A Krisanti, A Safiya and K Mulia
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012009
The effects of electroculture on shoot proliferation of garlic (*Allium sativum L.*)
Von Louie R Manguiam, Ashley Marie N. Margate, Rose Danielle G Hilahan, Harold Gian L Lucin, Kristopher Ray S Pamintuan and Adonis P Adornado
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012010
Preparation and characterization of polyvinyl alcohol-chitosan-tripolyphosphate hydrogel for extended release of anti-tuberculosis drugs
K Mulia, S A Chadarwati, A J Rahyussalim and E A Krisanti
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012011
The surface roughness analysis using sound signal in turning of mild steel
Anayet U Patwari, A A Zamee, M H Bhuiyan and S M Sakib
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012012
A review of a machine design of chocolate extrusion based co-rotating twin screw extruder
P Pitayachaval and P Watcharamaisakul
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012013
Tofu wastewater treatment through a combined process of coagulation-flocculation and ultrafiltration
P Prawati, A Oktariany, S S Putri, I Aditya and S Kartohardjono
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012014
Carbon emission modelling in container terminal operations planning using a system dynamics approach
D N Prayogo
[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012015
Effects of initial concentration, adsorbent mass, pH and temperature to personal care products waste removal with activated carbon as adsorbent

H R Priyantini, L Riadi, C Effendi, F Effendi and A Mitayani

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012016
The integration of social responsibility into business operation: case study of Indonesian manufacturing industry

E D Rinawiyanti, C Huang and S As-Saber

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012017
A kinetic study of oil-in-water emulsion formation stabilized by rice husk ash and lecithin

L Sapei, S W Kurniawan and A P Siantoro

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012018
A systematic literature review for developing sustainability assessment tool: formulating the state of the art and future direction

Y Sari, A Hidayatno, A Suzianti and M Hartono

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012019
Controlled release fertilizer based on starch chitosan encapsulation

E Savitri, E Purwanto, A N Kodrat and E Yonathan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012020
Price and inventory policy strategy model in a price sensitive dual channel supply chain structure considering product substitution

R Y H Silitonga and N Christina

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012021
Assessing materials from hoarded mobile phones: hidden e-waste subject for reverse logistics

R Siringo, H Herdiyansyah, R D Kusumastuti and A E Lucianto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012022
Optimisation of subtractive rapid prototyping process parameters using response surface methodology

T J Suteja and M A Hadiyat

[+ Open abstract](#) [View article](#) [PDF](#)

Green Design and Innovation

OPEN ACCESS 012023
Green dynamic capability for enhancing green innovations performance in a manufacturing company: a conceptual framework

R Amaranti, R Govindaraju and D Irianto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS 012024
Combined structural equation modelling – artificial neural networks model for predicting customer loyalty

M A Hadiyat

[+ Open abstract](#) [View article](#) [PDF](#)

-
- OPEN ACCESS** 012025
The use of consumer behavior to identify the flow mapping of waste cooking oil: A finding from Semarang, Indonesia
S Hartini, D P Sari and A A Utami
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012026
Perceived kansei and performance-based usability impact on satisfaction for web-based applications
M Hartono
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012027
Measurement of student satisfaction and loyalty using service quality model for higher education (HedQual) at industrial engineering department University of Pelita Harapan
N Hartono, Laurence and B F Tjahjadh
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012028
Expertise-based decision makers' importance weights for solving group decision making problems under fuzzy preference relations
E Herowati
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012029
Organic-inorganic nanocomposite membranes for molecular separation and bioapplications
J Hou, P D Sutrisna, L Li and V Chen
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012030
Tensile Properties of Kenaf Fiber by Alkalinization Treatment: Effect of different concentration
Ismojo, K A Zahidah, E Yuanita, E Kustiyah and M Chalid
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012031
How do the Indonesian ecologically conscious millennials value upcycled clothing?
C A Parung
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012032
Passive design implementation as sustainable development approach on vertical housing case study: Sentra Timur Residence
T Riotama and H Herdiansyah
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012033
Development and usability evaluation of virtual guide using augmented reality for Candi Gunung Gangsir in East Java
I M Ronyastra, I Hapsari and F P Pani
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012034
The Role of Ergonomics in Supporting Supply Chain Performance in Manufacturing Companies: a Literature review
N Sampouw and M Hartono
[+ Open abstract](#) [View article](#) [PDF](#)