

Received November 9, 2018, accepted November 26, 2018, date of publication December 6, 2018,  
date of current version January 7, 2019.

Digital Object Identifier 10.1109/ACCESS.2018.2885375

# What Are the Indonesian Concerns About the Internet of Things (IoT)? Portraying the Profile of the Prospective Market

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This work was supported in part by the Ministry of Research, Technology, and Higher Education of Indonesia through the PTUPT 2018 Program, and in part by the United States Agency for International Development (USAID) through the Sustainable Higher Education Research Alliance (SHERA) Program for Universitas Indonesia's Scientific Modeling, Application, Research, and Training for City-centered Innovation and Technology (SMART CITY) Project, under Grant AID-497-A-1600004 and Grant IIE-00000078-UI-1.

**ABSTRACT** This paper aims to characterize the profile of the prospective IoT market in Indonesia. The primary data were collected in July 2018 through a comprehensive survey that sampled respondents representing the whole Indonesian population. The questionnaire was developed by extracting the 4 (four) main issues regarding which the potential users of the IoT technology may have concerns, i.e., willingness to use the IoT services, concerns related to rejection and worries about the IoT, the characteristics of the IoT hardware, and perceptions about the role of the IoT within the existing system. The results of the survey were analyzed to capture the profile of the prospective IoT market, and the strategic implications of the findings were considered. Several interesting results were found, ranging from answering the common question of what kinds of the IoT services are most anticipated to answering the delicate question of how the Indonesian people perceive the disruptive force that the IoT technology may exert. The contribution of this research is that it can be used as an initial guide or reference for regulators, the government and the IoT firms that will begin to deploy services in Indonesia.

**INDEX TERMS** IoT, Internet of Things, Indonesia, developing country, market, technology.

## I. INTRODUCTION

When a new technology is to be deployed in a country, actors in the national technological ecosystem must concern themselves not only with technical matters but also the non-technical aspects of the new situation. Every actor has specific concerns according to their institutional roles in the country. To ensure system harmonization, regulators and the government often relate the technical aspects of new technology to how it may align with the existing infrastructure the country already has. In addition, they may be mainly concerned with whether the new technology can support the country's program for improving the welfare of its people. On the other hand, national business actors will be concerned with whether the technology can earn them profits and improve the competitiveness of their companies. Finally, the people, as the main target for the adoption of the new technology, will be concerned with whether this new technology will be able

to fulfill their individual needs. Despite these differences, the common perception of the nontechnical aspects of new technology is that deployment should be successful and that the technology should be perfectly adopted by the market.

As one such new technology, the Internet of Things (IoT) has just begun to be deployed in many countries because of its rich advantages. This new technology promises a more efficient industrial operation system [1], [2] and an increased quality of life [3], [4] and is one of the main elements of smart homes [5] and other smart platforms [6]–[8]. On the other hand, IoT can also be considered as part of the stream of innovation in the fields of wireless and Internet technology. If IoT implementation is successful, it will open up opportunities for continuing technological development and other related innovations. Therefore, any country may see the importance of ensuring the success of IoT infrastructure deployment and the adoption of IoT services by the market.

However, new technologies can also fail in commercial deployment when the market profile is not properly characterized beforehand [9], [10], [11]. Such characterization requires answering several common questions, such as what types of services are mostly needed, what sorts of applications may be rejected, and what pricing scheme is ideal for the heterogeneous segmented market. For this reason, a market profile needs to be built based on comprehensive surveys of the people in the country.

The main objective of this paper is to characterize the profile of the prospective IoT market in Indonesia. Indonesia is the world's 4<sup>th</sup> largest market, with 262 million people. The population is spread over 13,000 islands, making the market very heterogeneous and segmented. The country has always been recognized as a leading adopter of technology; for instance, it has the 4<sup>th</sup> largest number of Facebook subscribers among all countries [12], [13] and has a significant number of active Twitter subscribers [14]. Some related works on technological implementation in Indonesia can be found in [15]–[18].

Business actors in Indonesia are considering the deployment of IoT services with a mass-market orientation, while the government is now eager to deploy IoT infrastructure to support the era of industry 4.0. [19]. In this study, we focus only on IoT retail customers by considering the total population of the whole country as the prospective market.

In this study, a comprehensive survey was conducted in July 2018, with 210 respondents from the 6 main islands, representing the whole Indonesian population at the 95% confidence level with a 7% margin of error. The questionnaire was developed by extracting the 4 (four) main issues regarding which the potential users of IoT technology may have concerns, i.e., willingness to use IoT services, concerns related to rejection and worries about IoT, the characteristics of IoT hardware, and perceptions about the role of IoT within the existing system. The results of the survey were analyzed to capture the profile of the prospective IoT market, and the strategic implications of the findings were considered.

The contribution of this research is that it can be used as an initial guide or reference for regulators, the government and IoT firms that will begin to deploy services in Indonesia. The players of wireless industry are already in the competitive market, so they have to work hard avoiding any business failure. It is expected that the results of this research can be further developed into a comprehensive strategy leading to the success of IoT service implementation.

The remainder of the paper consists of sections explaining the demographic profile and technological level of Indonesia (Section II), the methodology of this study (Section III), the findings and analysis (Section IV), and the conclusions (Section V).

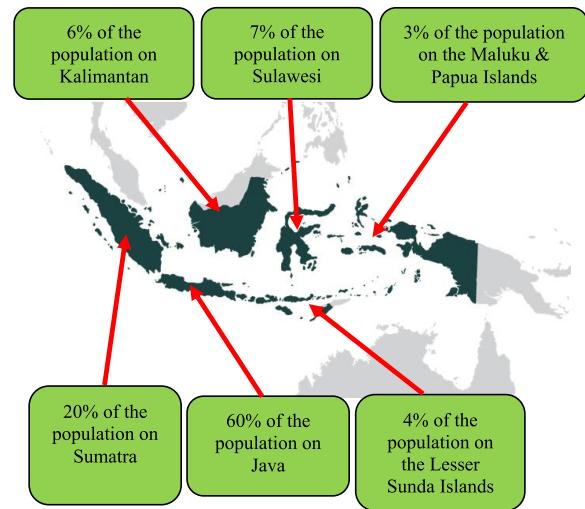
## II. THE COUNTRY OF INDONESIA

### A. DEMOGRAPHIC PROFILE

Indonesia is the country with the 4<sup>th</sup> largest population in the world, with approximately 262 million people. The annual

population growth is approximately 1.49%, and the median age is 28 years old [20]. The GDP value in 2017 was 1,015,539 million USD, and the GDP per capita was 3,876 USD [21]. In 2016, Indonesia's GDP was the 8<sup>th</sup> largest in the world [21], and it is predicted to have the 5<sup>th</sup> most economic potential in the world in 2030 and the 4<sup>th</sup> most in 2050 [22]. This strong economic potential is mainly contributed by the predominance of people in the population who are near the age of peak productivity.

As the largest archipelago in the world, Indonesia has 13,000 populated islands. The population is spread over 6 main island regions, as visualized in Fig. 1, of which the two most populated islands are Java (60% of the population) and Sumatra (20% of the population).



**FIGURE 1.** The demography of the Indonesian population in the 6 main island regions.

The number of Indonesian people who have received a higher-level education is considered at the medium level, and 572 universities are recognized in the global university ranking system [23]. Indonesia's economy relies on the agricultural and trading sectors, with approximately 60% of the population being farmers. The data show that in 2015, approximately 54% of the population lived in cities, while 67% will live in cities by 2050 [20]. This trend may indicate a move towards increased industrialization. The inflation rate is 3.18% (July 2018), and the Gini ratio is approximately 0.389 (March 2018).

Unfortunately, Indonesia can be categorized merely as a technology-adopting country because very few technological products are produced by the domestic market. The market value of telecommunication products was 4,836 million USD in 2016, 95% of which were imported [24].

### B. TECHNOLOGICAL REGIME

Indonesia has had a post and telecommunications network since 1856, when the first electric telegraph was established during the Dutch colonial era. In 1976, Indonesia launched the Palapa A1 satellite, making Indonesia the third country in

the world (after the USA and Canada) to operate a national satellite network [25]. However, despite this long history of telecommunications network deployment, the number of fixed-phone subscribers is only 15 million. In contrast, the number of mobile phone subscribers is approximately 254 million. This large number of mobile subscriptions can be attributed to a common behavior of Indonesians, many of whom have more than one cellular subscription. The number of Internet users is 143 million [26], and 70% of them prefer to access the Internet from a handheld mobile device [27].

The development of cellular technology began in the 1990s with the 2G-GSM standard, while the 3G era, based on WCDMA, began in 2006. In 2015, 6 operators in Indonesia officially deployed 4G-LTE networks. Most of the Indonesian cellular market is shared by three leading operators: Telkomsel, XL Axiata, and Indosat Ooredoo.

Mobile service has successfully penetrated 97% of the populated areas of Indonesia. This figure shows that cellular operators in Indonesia are committed to targeting all levels of the Indonesian market. Nonetheless, there has been a decline in EBITDA (earnings before interest, tax, depreciation and amortization) for major operators in Indonesia. This shows a serious business concern related to operation in the saturated national market. Consequently, the exploitation of IoT as a new technology is absolutely necessary for existing operators to ensure their business sustainability and open up new potential revenue streams.

### C. CONCERNING IoT

The Indonesian governmental agency in charge of regulating telecommunications is the Ministry of Communications and Information Technology (MCIT). In accordance with the country's vision for realizing an information-based society, the MCIT is currently actively developing various regulations to support the presence of new technologies, including IoT technology. The government has committed to moving forward with the deployment of an industrialization framework consistent with the era of industry 4.0 [19], and the Internet of Things is the main technological platform that shall facilitate it.

For Indonesians, IoT is a highly anticipated technological platform. However, up to now, operators, industry leaders and the MCIT have not shown any special preference for which IoT platform will be the focus of development; several LoRa trials are being conducted, as well as SigFox and NB-IoT. Because development is currently still in the initial phase, some Indonesian IoT actors have joined an IoT forum and are actively giving input to the MCIT as regulations are being developed. Compared to the large market potential, the number of local industrial firms dealing in IoT manufacturing in Indonesia is still very low. Moreover, prospective operators who are expected to deploy IoT networks and services have still not explicitly stated their development plans.

## III. RESEARCH METHODS AND IMPLEMENTATION

### A. METHODS

The main objective of this study is to **characterize the profile of the prospective IoT market in Indonesia**. When deployed in a country that is very broad and heterogeneous, IoT technology cannot satisfy all levels of society. However, if the goal is mass-market adoption, then the technology must have general characteristics that are desired by the people in the country.

We utilize the concept of second generation of Innovation Model, also known as the market-pull theory. Under this theory, technological innovations are assumed to arise as the results of customer needs [28]. The message from the prospective market is captured, and subsequently transformed into relevant service. Hence, in order to capture such a message, we conducted comprehensive survey based on a questionnaire related to 4 market profile categories broken out into 7 questions, the details of which are listed in Table 1.

**TABLE 1.** The 4 categories broken out into 7 questions.

PROFILE CATEGORY	Specific questions
<u>Category #1</u> Willingness to use	What types of IoT services are most wanted by individuals?
	What IoT service areas are perceived to offer the most benefit to society and the country?
<u>Category #2 Rejection and worry</u>	What factors make the market reluctant or likely to refuse to use IoT technology?
	What factors lead to worry about IoT?
<u>Category #3 Hardware characteristics</u>	What kinds of hardware characteristics of IoT devices are desired by potential users ?
<u>Category #4</u> Interaction with the existing technological system	Will IoT replace or merely support the current system?
	What constraints and problems are perceived regarding the current mobile cellular system?

The first category considers aspects of the market profile related to consumers' "willingness to use IoT services", decomposed into 2 questions. This category covers which specific IoT services are preferred by individuals and which are preferable for the country.

The second category considers aspects of the market profile related to the possibility of market rejection and market

worry regarding the use of IoT services. It is decomposed into 2 questions, i.e., one question to determine the reasons why the market may be reluctant to adopt or may be likely to reject IoT services and one question to determine the issues that make consumers worried about using IoT technology.

The third category concerns the IoT hardware characteristics that the market expects. We asked the respondents to define their preferred hardware characteristics, such as color, shape and weight.

The fourth category concerns the interactions of IoT technology with the existing system. It consists of two questions. The first asks how the market perceives IoT and its relationship with the existing non-IoT system. The second question asks about obstacles that most users perceive regarding current mobile phone applications. This question is relevant because it can be assumed that constraints felt today may be analogous to possible problems that must be anticipated by the developers of upcoming IoT services.

## B. PREPARATION AND IMPLEMENTATION

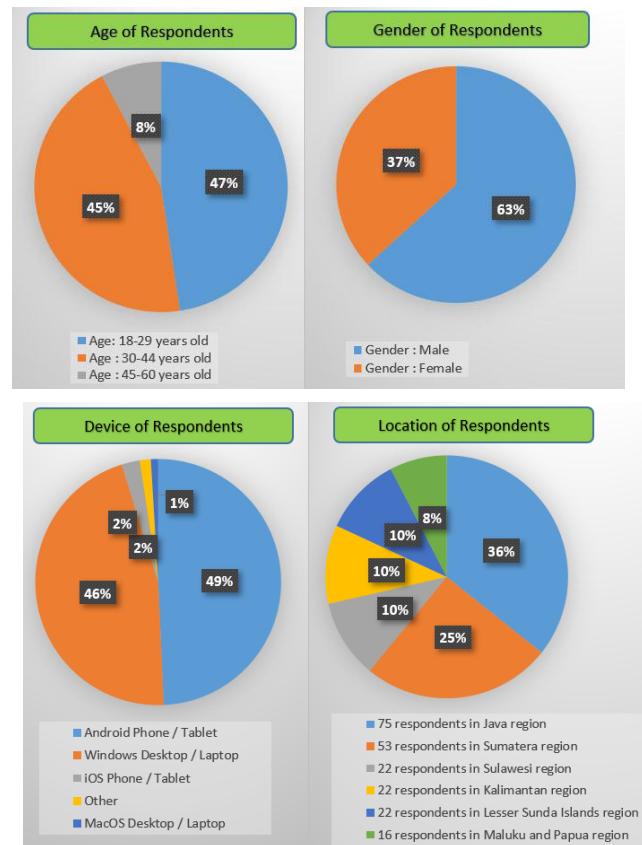
To obtain our primary data, we conducted a survey of the Indonesian potential IoT market of 262 million people. On preparing the survey, we set number of respondents to be 210 for achieving a margin of error of 7% at a confidence level of 95%. The primary data is collected through random sampling, where the numbers of samples were proportional to the population percentages in the corresponding island regions. The formulation of questionnaire is designed by targeting respondents who are the active users of wireless technology device, while the respondents' age is between 18 and 60 years old. That is because we assume such groups of people are the most prospective IoT users which already have initial understanding of the technology.

The survey implementation was conducted in the first and second weeks of July 2018. The electronic questionnaire was sent to 210 random respondents, and all is returned completely. The complete profile of respondents is shown in Fig.2, including the age, gender, used device and the location of respondents.

Fig. 2 shows that the number of respondents is relatively proportional with Indonesian populations spread over the 6 largest island regions (as seen in Fig. 1). The respondents are mostly male (63%), while the age's structure is comparable between the group of 18-29 years old (47%) and 30-44 years old (45%). Concerning respondents' device, 49% of respondents has completed the questionnaire by using Android-based phone/tablet, while 46% of respondents are using Windows-based PC/Laptop. Such a number has also indicated the current technological regime in Indonesia, showing the domination of Android and Windows over the other platforms.

## IV. RESULTS AND DISCUSSION

Technology acceptance is closely related to human psychological behaviors. In general, acceptance of a technology can be measured based on factors that develop dynamically with



**FIGURE 2. The profile of respondents: Age, Gender, Device and Location.**

the user's situation [29]–[33]. Thus, to create an ideal technological ecosystem, any actors in the system must be able to translate hidden messages from the market representing the attitudes of potential customers. The results below reflect such messages from the potential IoT market in Indonesia.

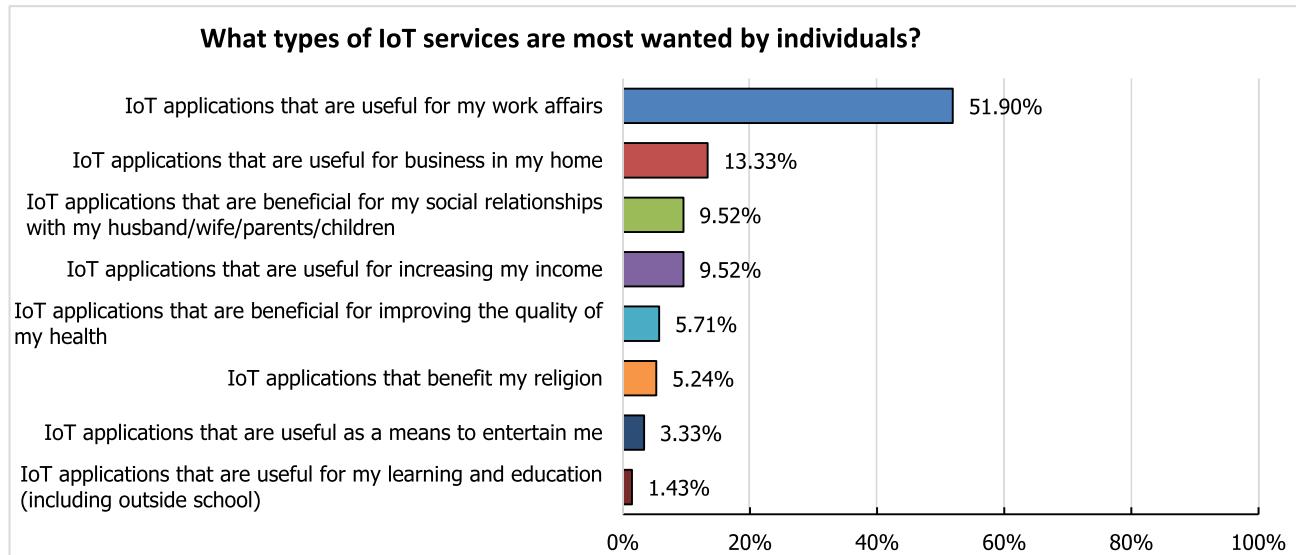
### A. PROFILE CATEGORY #1: WILLINGNESS TO USE

The purpose of this category is to capture “the Indonesian market’s willingness to use IoT services for their specific needs”. This profile category is composed of 2 questions.

#### 1) WHAT KINDS OF IoT SERVICES ARE MOST WANTED BY INDIVIDUALS?

The purpose of this question is to determine what types of IoT services are most wanted by individuals. This is related to the direct benefits that will be felt by prospective customers when they implement IoT. We presented 8 service categories and asked the respondents to choose the one that they considered the most important. Fig. 3 shows the results of the survey.

The findings show that more than 50% of the Indonesian market desire IoT applications that will provide benefits regarding their work affairs. Furthermore, approximately 13% of respondents want IoT applications that will provide benefits for domestic work. These two findings are not surprising because in general, IoT technology is indeed designed to assist in daily work and in the realization of



**FIGURE 3.** Results on Profile Category #1 Question #1.

the “smart home” concept. From the individual perspective, the smart home is the most familiar example of the type of completely automated system that IoT technology may create.

An interesting finding is that approximately 9.52% of respondents want IoT applications that will be beneficial in improving the quality of their family relationships with their parents, children, and husband or wife. In addition, it turns out that Indonesian people are truly religious, with 5.24% feeling that IoT technology can ideally be directed toward benefiting religious life. This may be an interesting prospect if IoT developers can identify what type of application can best fulfill this function. It is interesting to note that the market’s desire for such IoT functions is only slightly different from the desire for IoT applications that can improve the quality of health (5.71%) and even higher than the desire for IoT applications that are useful for entertainment (3.33%) or education (1.43%).

The strategic implications of these findings concern niche markets, for which prospective IoT organizers must truly pay attention to the types of applications desired by the market. Sometimes, the desired applications are not mainstream but rather are focused on specific demands. For example, as the most populous Muslim country in the world, Indonesia may be a suitable market for IoT applications related to religious life, such as an automated call to prayer at the mosque.

We pay attention to the contradictory findings as the results show that IoT applications for entertainment and education are in the bottom two. At first glance it appears that this phenomenon is contrary to the potential trend that Indonesian users will potentially adopt any mobile-based applications, including Virtual Reality games and service applications that help learning in school. We argue that the survey results do

not show that people will reject entertainment applications, but when it is compared to other six IoT service categories, they shall put it on the second-lowest priority for adoption. It also means that the respondents consider that entertainment-related service have been able to be obtained through any ordinary smartphones-based applications.

Related to the lower respondents’ preference for IoT applications for learning and education, such a fact must be taken seriously by Indonesian policy makers (government). This phenomenon illustrates how the Indonesian sense a need for new technologies that can improve the educational infrastructure system. Such a low sense becomes unattractive, whereas a quality education system is one of the important pillars in improving the nation’s competitiveness [34]. In this case, government should keep promoting the significant role of technology in improving education, so that both government and people both feel the need for it.

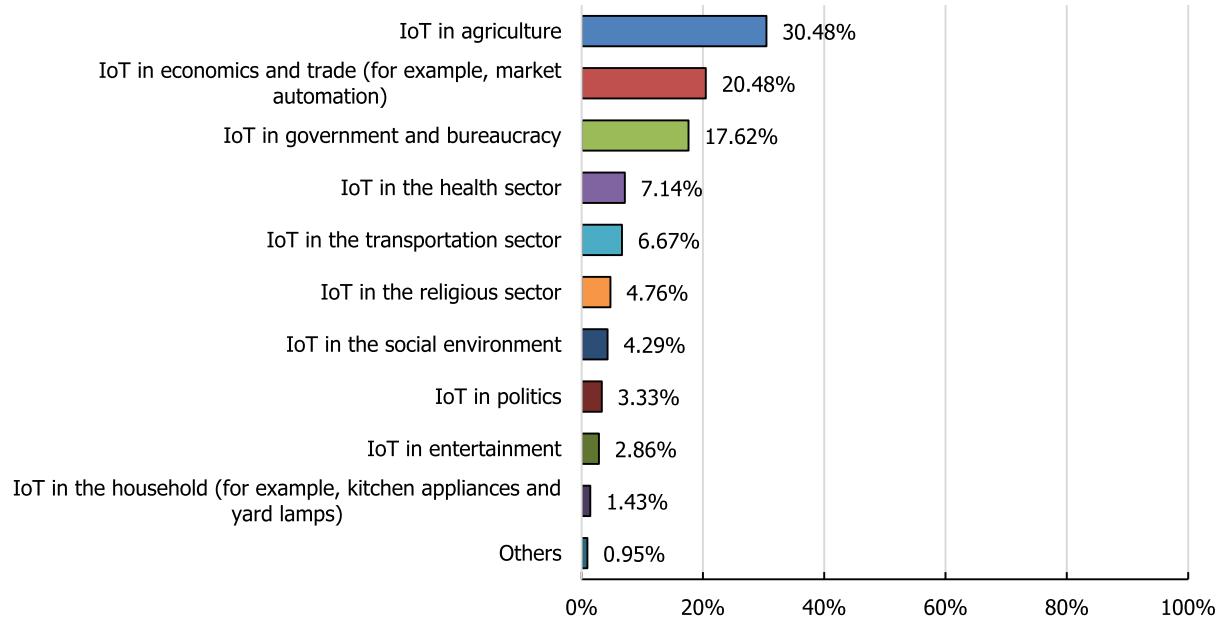
## 2) WHAT IOT SERVICE AREAS ARE PERCEIVED TO OFFER THE MOST BENEFIT TO SOCIETY AND THE COUNTRY?

Whereas the previous question addressed the perceived benefits of IoT for individuals, the purpose of this question is to probe public opinion about which IoT applications are felt to be most beneficial to the country and the general public.

We presented 11 choices of IoT service areas, and the respondents were asked to choose the one that they considered to provide the greatest benefit to the community and the country. Fig. 4 shows the results of the survey.

The findings show no absolute dominance in any one service area, but the respondents consider IoT applications for agriculture (30.48%), economics and trade (20.48%) and government (17.62%) applications to provide the greatest benefits for society and the country. This is in accordance

### What IoT service areas are perceived to offer the most benefit to society and the country?



**FIGURE 4.** Results on Profile Category #1 Question #2.

with the status of Indonesian as a largely agrarian country, which the community also recognizes. It is interesting to note that the public also wants the government sector to implement IoT, under the assumption that this technology will facilitate administrative and bureaucratic affairs.

Furthermore, the respondents additionally consider the implementation of IoT in the health sector (7.14%) and transportation (6.67%) to be important. The interesting thing is that although personally, respondents are interested in IoT applications that are beneficial for their home affairs (the second most preferred option in Fig. 3), they consider this IoT area to be the least important from the perspective of society as a whole (Fig. 4). This indicates that the public considers smart homes to be unimportant for collective implementation in Indonesian society. However, the benefits of such technology are felt to be important to individuals.

The last finding seems not aligned with the global technological trend which is actually heading towards smart home deployment. Our analysis led to the point that the aggregate benefits of smart home has not been understood properly by the society. This fact reflects that the current perception is just about the automation of home devices, whereas what is more important is the ultimate goal of smart home, namely the energy efficiency within the house and the increased quality of life for home owners. Subsequently, the collection of individual efficiency and individual quality of life will form an aggregate advantages within the community, society and the country.

### B. PROFILE CATEGORY #2: REJECTION AND WORRY

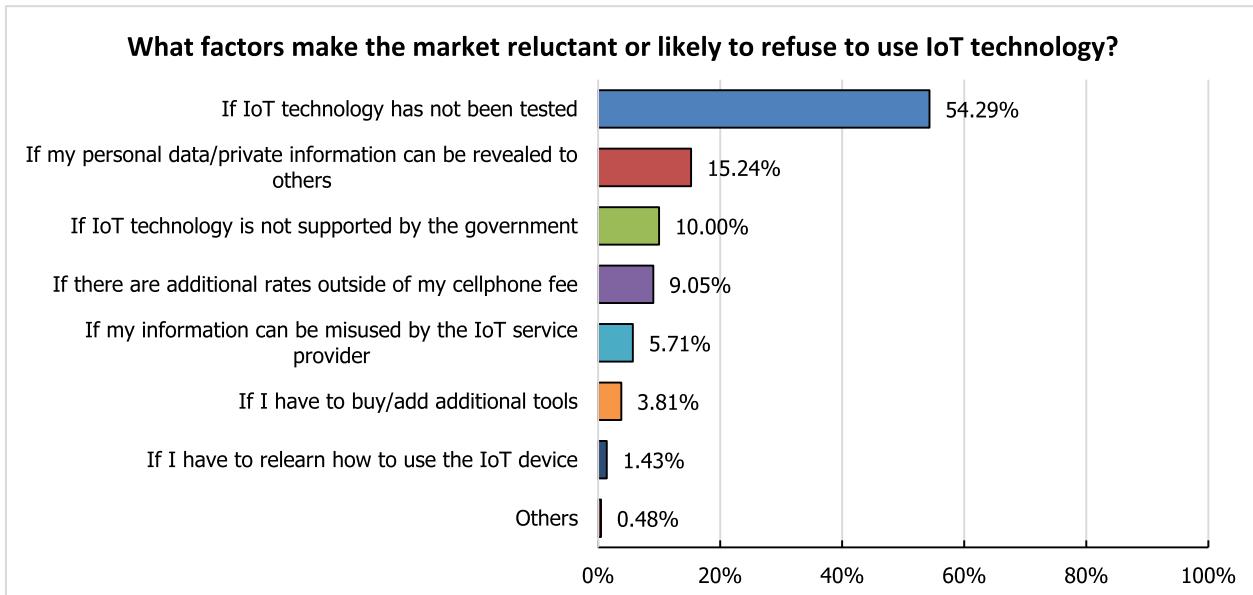
With this category, we try to capture the factors that may be a barrier to IoT implementation, including the fears of potential IoT users. Our survey asked 2 questions.

#### 1) WHAT FACTORS MAKE THE MARKET RELUCTANT OR LIKELY TO REFUSE TO USE IOT TECHNOLOGY?

We presented 8 choices of preformulated reasons that potential users may not want to use IoT technology. By considering the proportions with which these reasons were selected by the respondents, IoT service developers can anticipate strategies related to the factors that are likely to make users reluctant or even refuse to use IoT technology. Fig. 5 shows the results of the survey.

The findings in Fig. 5 show that Indonesian consumers tends to be reluctant or may refuse to use IoT technology that has not been tested (54.29%). Reluctance is also caused by a concern that private customer information and personal data may be revealed to others (15.24%). Another significant finding is that some portion (10%) of the respondents would reject a service that it is not supported by the government.

The dominance of potential users who responded with concerns regarding testing shows that the majority of prospective users in Indonesia already have an awareness of device quality. This is because the Indonesian market has already reached a mature stage in the era of mobile technology. The market is already familiar with a series of Internet platforms, and consumers are getting smarter. The implication of our findings is that any device offered on the market should have passed



**FIGURE 5.** Results on Profile Category #2 Question #1.

appropriate quality assurance tests for a massive number of subscribers. This poses a challenge for Indonesian regulators and the government to ensure proper quality assurance for any IoT device.

Fig. 5 also shows that 9.5% of respondents would be reluctant to adopt IoT technology if there were additional fees beyond the cost of a cellphone and that 3.81% of respondents would be reluctant to buy additional equipment. Such a minor percentage also means a good sign for the business since the majority of prospective users are not considering price as a main burden to adopt the IoT technology. The implications of these last two factors are related to the concept of pricing scheme. Although IoT and cellular platforms are two different things, the implementation of IoT must follow a strategy that makes it appear as if these two technologies are part of a single, seamless platform.

In response to such an implication, we created 2 additional questions related with IoT pricing scheme. We asked all respondents about what pricing scheme are preferred, and how much subscription price would be spent monthly. The results are shown in Fig. 6. The finding has indicated that majority of prospective users in Indonesia (67%) prefer to bundle IoT service with mobile service subscriptions. For the mobile network operators, the finding implies a strategic consequence that IoT service can be offered to their 4G subscribers by treating IoT service as the additional paid-service of existing mobile technology.

Fig. 6 shows that the majority of respondents (38%) has shown a preference to spend a monthly subscription price in the range of IDR 50,000 (USD 3.3) - IDR 100,000 (USD 6.6). Interestingly, there are 10 % of respondents showing a willingness to spend any price as long as the IoT service is giving a clear benefit to them. They are the prospective market

who care more about service quality and service experience, rather than care about the service price.

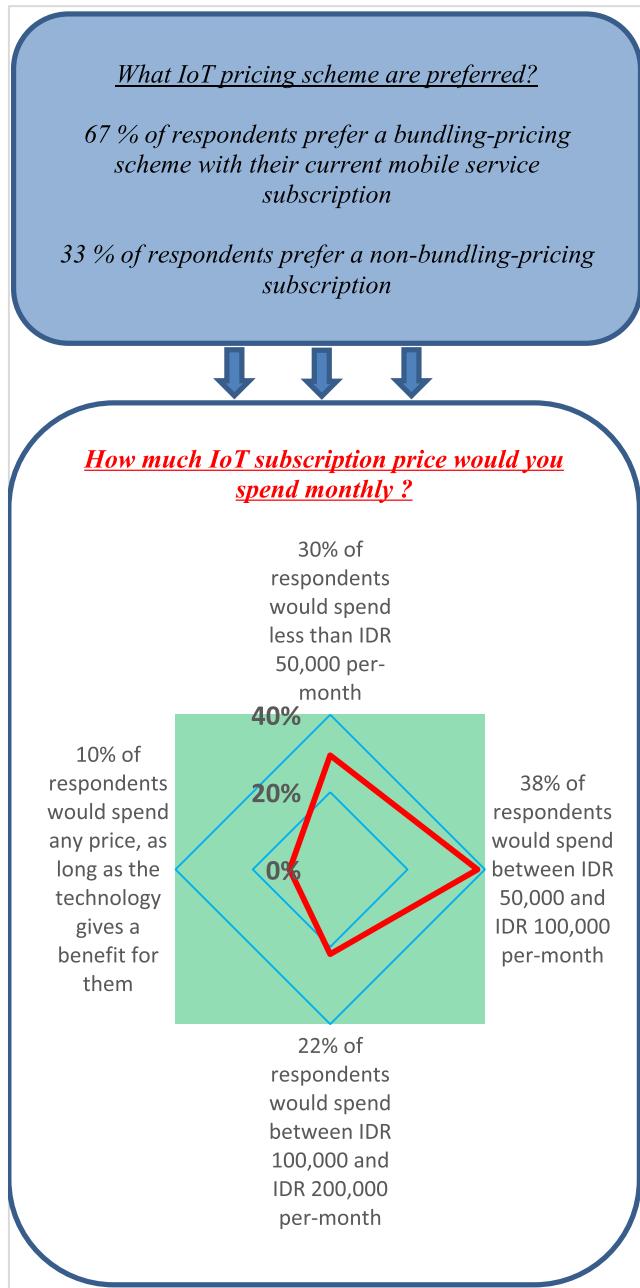
## 2) WHAT FACTORS LEAD TO WORRY ABOUT IoT?

Whereas with the previous question, we identified factors leading to the possibility of rejection or reluctance to adopt, the purpose of this question is to identify things that users would be worried about when using IoT applications. The respondents were asked to choose the one factor they feared the most, and the results are shown in Fig. 7.

Fig. 7 shows that the majority of respondents (46.19%) are concerned that the devices they would use would be easily damaged and unreliable. This finding is again related to the quality of the product. It is consistent with the main finding in Fig. 7 that consumers are reluctant to use a product that has not yet been tested.

Furthermore, 19.05% of the respondents are concerned about data security, and 10.95% worry about the potential of IoT devices to disrupt family relationships. At first glance, the worry about family relationships appears inconsistent with the perceived benefits of IoT devices. However, these findings are interesting because they indicate that Indonesian consumers consider that any technology must respect traditional values and family values. This finding is consistent with the fact that 10% of the respondents are worried that IoT technology may have negative consequences such as encouraging the consumption of pornography and amoral behavior. By contrast, only approximately 2.89% of the respondents worry about losing control of intelligent IoT devices (e.g., the potential that robots may become dangerous).

Without mentioning any real examples of IoT devices, the questionnaire nevertheless deliberately asked about the benefits of IoT applications related to religious aspects.

**FIGURE 6.** Results on IoT Pricing Scheme.

The results shown in Fig. 3 and Fig. 4 are consistent, indicating that a portion of the respondents consider such applications to be important. These findings are also correlated with the finding in Fig. 7 that consumers have specific concerns that IoT technology may facilitate the spread of pornography.

This finding presents no contradiction with the findings in Fig. 3, which show that 50% of the respondents want IoT devices that will help with their work; indeed, the findings support each other. This finding is again related to the finding in Fig. 3 that respondents are also interested in devices that will foster closer family relationships. In short, the new IoT services introduced on the Indonesian market should facilitate

users' jobs but should not exert effects in opposition to the traditional family values and religious convictions of Indonesian people.

### C. PROFILE CATEGORY #3: HARDWARE CHARACTERISTICS

This category is aimed at determining the physical characteristics of IoT devices desired by potential users. Apart from the benefits of IoT applications, we asked the respondents to choose one (out of four) characteristics that they would most prefer in their IoT hardware. Fig. 8 shows the results of the survey.

Fig. 8 shows that 52% of the respondents want the physical device characteristics to be clearly advantageous for performance and user experience, that is, IoT devices should be compact, lightweight and small. Moreover, 38% of the respondents are most concerned with utilization costs, i.e., electricity usage. This is an interesting finding related to Indonesia's electricity tariff, which tends to be perceived as expensive. Only 6% of respondents are concerned with whether IoT devices should be local products (manufactured in Indonesia), and only 3% of the respondents prioritize the appearance of the device, such as shape and color.

### D. PROFILE CATEGORY #4: INTERACTION WITH THE EXISTING SYSTEM

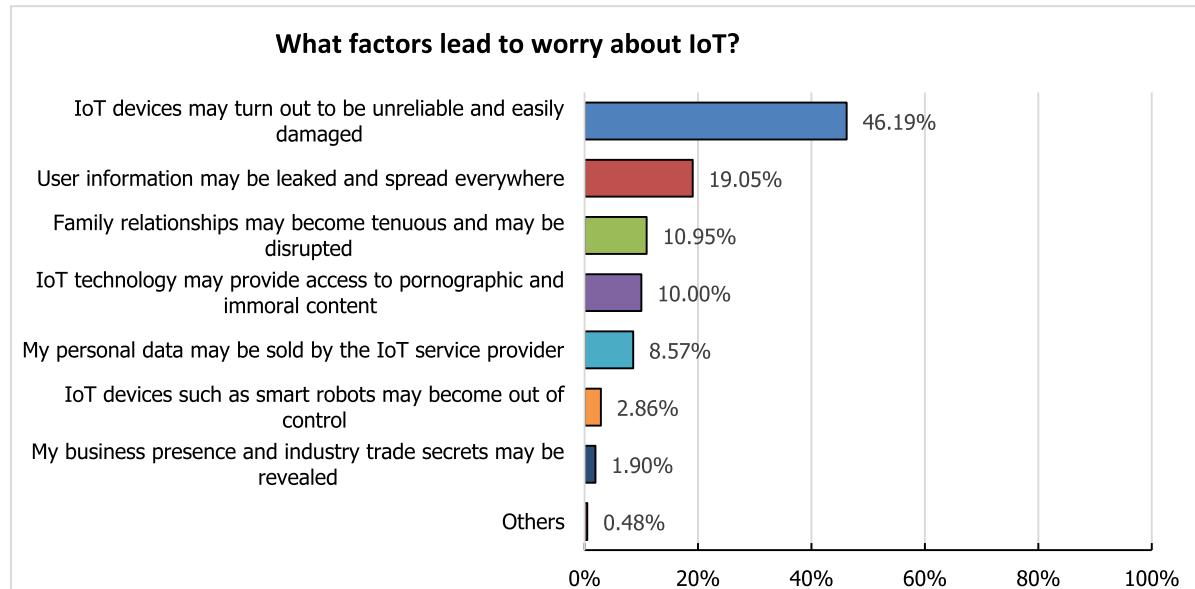
This category is aimed at identifying the responses of prospective users when viewing IoT in relation to existing technology, including the cellular technology platform. Our respondents are Indonesians who have access to the Internet and are mobile cellular subscribers. We decompose this category into 2 questions.

#### 1) WILL IOT REPLACE OR MERELY SUPPORT THE CURRENT SYSTEM?

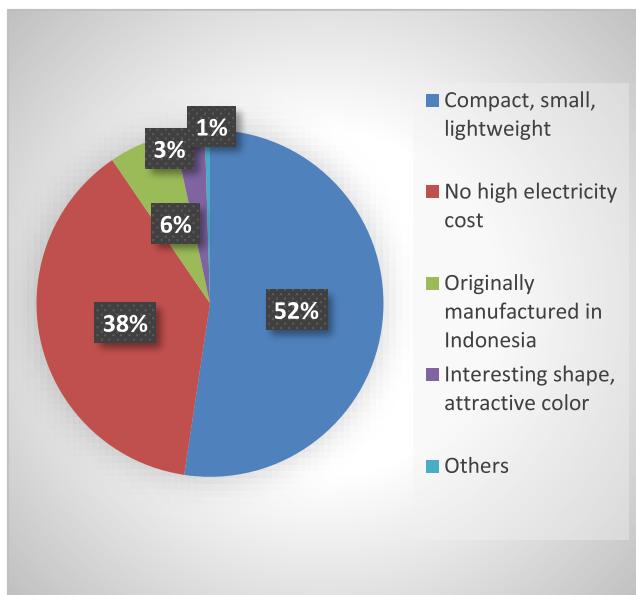
We asked about the perception of potential users regarding whether IoT technology will "replace the old (current) system" or "support the old system". It was found that 71.43% of the respondents consider that the role of IoT is merely to facilitate the existing technology system they already have. The implication is that IoT service implementers must consider that the majority of Indonesians still have a "psychological dependency" on the old system.

How can this dependency be accommodated, even though it is clear that new technological innovations may have the potential to be a creative disruptive force [35], [36]? For example, changing the manual payment system on the toll road by using e-money chips could lead to strong backlash when several hundred employees had to be laid off because their jobs were replaced by machines.

The strategic implications are that any new technology should not abruptly change the dependency on the existing technology. There should be a smooth transition and shifting process with a gradual migration. When a new technology is introduced, it must be tied to previous innovations. One should avoid the perception that the new

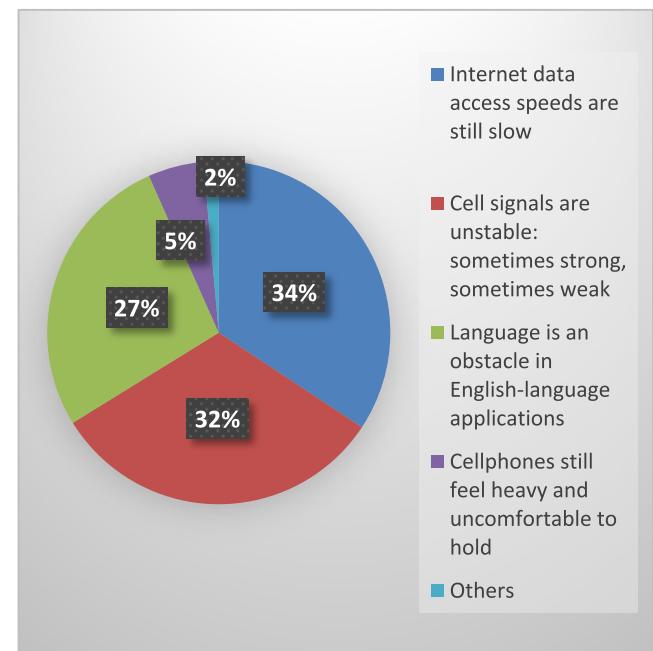


**FIGURE 7.** Results on Profile Category #2 Question #2.



**FIGURE 8.** Profile Category #3: IoT hardware characteristics.

technology will eliminate the old. The disruptive force of IoT should be disguised to prevent psychological conflict in potential users. Especially in the case of the modernization of the industrial manufacturing sector, the consequences will definitely include a reduction in the number of human laborers. However, this must be accomplished by means of an effective transition strategy, emphasizing that the new technology is not intended to replace but rather to assist in their work. The relevant theory has been discussed in [37], which delves deeply into the relationships among industrial psychology, engineering and the relevant human factors.



**FIGURE 9.** Results on Profile Category #4 Question #2: The constraints felt by mobile phone users today.

## 2) WHAT CONSTRAINTS AND PROBLEMS ARE PERCEIVED REGARDING THE CURRENT MOBILE CELLULAR SYSTEM?

We asked about the constraints most users feel with regard to current mobile phone applications. This question is relevant because all respondents are cellular mobile users, so it can be assumed that prospective IoT users are also current cellular mobile users. The constraints they feel today can be assumed to be analogous to possible problems that must be anticipated by the developers of upcoming IoT services. Fig. 9 shows the results of the survey.

The findings in Fig. 9 show that 34% of respondents feel that the speed of Internet access is slow and that 32% consider their cellular signals to be unstable. The access speed issue is related to Quality of Service (QoS), while the signal stability is related to Quality of Experience (QoE). Both of these concerns are related to the network infrastructure, so the implication is that IoT providers must maintain good QoE and QoS performance.

Interestingly, 27% of the respondents consider that the use of English on the device is an obstacle. This finding reaffirms the typical characteristics of the Indonesian market as a developing country with a low level of foreign language literacy. Meanwhile, only 5% of the respondents feel constrained by the physical characteristics of their cellphones, considering them heavy and uncomfortable to hold. The low percentage associated with this response indicates that the general physical characteristics of the mobile phones currently in circulation are not a significant obstacle. This is consistent with the finding in Fig. 8 that 52% of respondents want IoT devices that are compact and lightweight. Their desire is quite reasonable because the market has not yet received IoT devices, so they can imagine their preferences freely.

## V. CONCLUSIONS

This research has characterized the profile of the prospective Indonesian IoT market. The profile characterization was derived from responses to a questionnaire addressing 4 main issues regarding which the potential users of IoT technology may have concerns, i.e., the willingness to use IoT services, concerns related to rejection and worries about IoT, the characteristics of IoT hardware, and perceptions about the role of IoT within the existing system.

The results highlight the following distinctive characteristics of the market profile:

1. Considering personal preference, the majority of the Indonesian market (51.90%) is interested in IoT applications that will provide benefits in terms of their work affairs.
2. Although there is no absolute dominance in one service area, Indonesians consider that IoT technology for agriculture (30.48%) will provide the most benefit to the country.
3. The majority of the Indonesian market (54.29%) will tend to be reluctant or refuse to use IoT technology that has not been tested. This is consistent with the finding that most Indonesians (46.19%) worry that new products may be easily damaged or broken. Overall, these findings imply a general market concern about product quality.
4. Indonesian consumers are concerned that any new service should not act in opposition to the traditional values and religious convictions of Indonesian people.
5. The majority of the market (53%) wants IoT devices to be physically compact, lightweight and small.
6. The majority of the Indonesian market still has a “psychological dependency” on the old system.

Although new technology may serve as a disruptive force, causing inevitable changes to the old system, society still values a new technology that merely supports the existing system instead of replacing it.

7. Current market concerns are related to the mobile network infrastructure, suggesting that IoT providers must maintain good QoE and QoS performance in their IoT services.

These results raise important points that should be translated by IoT system developers into a real product that is well aligned with the Indonesian market profile. Whatever the form of the real product, it must be able to satisfy the demand of the Indonesian market as captured by the market profile constructed in this research.

The overall findings become an initial guide or reference for regulators, the government and IoT firms, which can be further elaborated by other relevant parties. To conclude, it acts as the foundation of more comprehensive strategies in the near future.

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