Collaborative of ICT Research in Indonesia

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Abstract. Information technology has an impact on the emergence of various studies in the world. The effect of research occurs in fields of study such as education, economics, social, and technology. This study shows the results of studies related to Information and Communication Technology research conducted in collaboration with various parties in Indonesia in the last five years, from 2015 to 2019. The study was conducted by studying multiple articles published and indexed on the Garuda portal, as a gateway for researchers in Indonesia.

1. Introduction
Penetration of Indonesian internet users, reaching 171 million people out of a total population of 264 million [1], Indonesia has the highest number of internet users in the world [2]. In terms of research in Indonesia, the Ministry of Research, Technology and Higher Education of the Republic of Indonesia manages two research publication portals. First, the portal Science and Technology (Sinta), this portal indexes research in Indonesia. Moreover, the second is the Garuda portal that is obtained as a gateway to search for various Indonesian research articles [3]–[5].
In Indonesia, at least 176,506 researchers verified by the Sinta portal from 2,697 journals, and 26, 174 books. The number of documented journal articles was 73,752 articles, 48,390 conference papers, and 46.12 book chapters. Besides that, there were also 2,028,528 documents in Google Scholar [4].

On the Garuda portal, there were at least 888085 articles, 1310 publishers, 8199 journals, grouped in 40 subjects [3]. In 2018, Indonesia succeeded in achieving the highest number of studies in ASEAN, with 33722 articles in scientific publications. The next position is Malaysia, with 33138 articles and 22639 articles from Singapore [4]. This success is undoubtedly inseparable from the various programs launched by the government in supporting education, as expressed by President Joko Widodo in his state address [6]. Moreover, the implementation of various strategies realized by the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia [7].

Collaboration is not only in the academic world but also in the industry [8]. The academic and industrial collaboration will create synergies and opportunities in producing more creative and innovative knowledge [9], and provide intellectual and economic benefits [10]. Collaborative articles between academics and industry have an impact on the growth of the scientific communication climate and the development of science and technology. There is technology transfer from the industry for research and development for academics.

In the impact factor and citation, international articles written in collaboration are more credible than articles written by an individual because they contain high up-to-date updates and widely quoted by authors from various countries. International collaboration tends to produce more new research and can capture the broader scientific community [11]. Besides that, articles written together international tend to be quoted higher than national co-writing or the only written work [12], [13].

Related research in the field of information and communication technology (ICT), the productivity of the publication of articles in this field is not much of a concern. Also, this seen from various existing studies [14]. Therefore, through this research, we examine how research productivity is related to information and communication technology (ICT) in Indonesia, especially in collaborative research.

Our research-based on collecting data sources in the form of a collection of articles that come from searches on the Garuda portal. So, the resulting research phenomenon is related to ICTs in Indonesia. The results of this study include the number of research developments per year, and the results of comparative studies of the number of articles produced each year, individually or collaboratively. The output of this research also provides the number of collaborations between the authors, moreover, the number of items related to the grouping of research in four areas of study in general.

2. Material

2.1. Collaboration Research

The development of technology opens the horizon of information for many parties [15], [16]; this is undoubtedly an opportunity and challenge for humans, including researchers. Various forms of research have grown from time to time, with multiple innovations. So that numerous types of research have been produced by researchers, likewise, for higher education circles [17]. In addition to teaching, research is at the heart of the university. So that research was carried out both individually and collaboratively. International collaborative research develops with a pattern that is faster than exponential [18]. Besides, papers with single writers also go down from year to year [19]. Research collaboration between institutions is the most popular form of collaboration [19]. The development of collaboration also occurs between disciplines, both in the past, present, and future [20].

The diversity that collaborates in research has a strong and positive correlation to the production of scientific innovations. The struggle from individuals to collaboration provides benefits for knowledge, so it is more towards research that has a tremendous impact. From previous studies, approval of publication was higher in research conducted in collaboration with various institutions. Smaller, and diverse teams from multiple institutions that produce highly innovative work compared to groups in one institution [21].
Scientific research from various universities has significantly contributed to economic growth and social change in society [22]. Research collaboration can be carried out through collaborative research within and between universities, including with the industrial or international world [23]. International collaborations have a positive correlation with research performance [24]. High-impact studies have shown that dependence on performance in teamwork [25].

Changes in the research climate shift dramatically into the form of collaborative research through large networks, such as involving interdisciplinary disciplines that reach between countries and continents [26]. This change is a challenge for researchers, in addition to expertise, problems also occur in changing the outlook for supporters and bearing funds towards research [25].

This phenomenon of collaboration between researchers requires a variety of policies to support the quality and quantity of collaborative research [27]. Financial support was also thoughtfully prepared by various countries, in addition to being related to principles in managing scientific teams, organizations, and societies [20], [21]. For example, in early 2019, the United Kingdom announced the allocation of funds for research in facing global challenges with a value of 262 million USD [25]. Research on collaborative research has been carried out in various countries, including in Italy [24]. In Brazil also research related to collaboration between higher education, industry, and government in Brazil [28].

Other research related to the international investigation is carried out by various studies. For example, the effect of gender on the results of publications using a model of geographical organization, institutional prestige, and collaboration patterns [29], [30]. In addition, research related to the application of the mentor model in study [31], credit scores and the benefits of publications regarding collaborative research [32], application of technology [33]–[35], a key factor related to the success of the published collaboration [28], [30], which influences the results of questionable research [19]. Besides introducing essential things that should be a concern for researchers, such as technology, human resources, the results of knowledge, cultural effects, services for third parties, the real value of the invention itself, and and patterns of technology use for humans [36], [37].

2.2. Indonesia
In developing various strategies in Indonesia prioritized development through collaboration and technological support in multiple fields, including government support in the field of education, such as improving the results of research [6]. Collaborative initiatives are the central part developed by the government, primarily to deal with the dynamics of an ever-flaring global economy [6], [30].

The research potential generated and penetration of internet users in Indonesia, access for researchers is also very supportive of research in Indonesia. In addition to the high number of academics, the use of access to the global world is also very high utilized by highly educated people [1], [4].

In Indonesia this collaboration research has been carried out including collaboration between disciplines [38], cultural influences in conjunction [39], and the main areas of concern from the results of research collaboration namely education, management, technology and social [14], the use of various tools, including collaboration related to changes in the environment [40], as well as research conducted by teachers [41]. In Indonesia, several programs and assistance for researchers have been carried out by the government to improve the results of scientific collaborations. Government assistance channeled through, among others, community service programs, and collaborative research between universities [7].

3. Methodology
The method used in this research is the study of literature. Literature collected from the Garuda portal based on published article data from 2015 to August 2019. Article material as the primary source selected through articles on research collaboration related to information and communication technology. Article selection is carried out with a combination of the following searches:

\[ H = K_A \ OR K_B \]

H: results of the articles collected
K_A: All articles created using the keyword "teknolegi informasi kocomunikasi"
Kb: All articles created using the keyword "information communication technology"

4. Finding and Discussion

4.1. Number of Articles

Based on the search results on the Garuda portal, for articles published since 2015 with the keyword "teknologi informasi komunikasi" found 270 items found, and for the search key articles "information technology communication" were 94 articles.

In the article selection phase, articles chosen as the material for this research. Some items not included as research material. This exception is caused by duplication, in addition to being caused by articles that appear are introductions from journals.

So finally, the total articles used as research material is 347 articles. The number of items is a benchmark for the results of Indonesian research related to the writing of information and communication technology titles.

4.2. Growth of Articles, Individual Research, and Collaboration

The development of article growth to increase from 2015 to 2018. While in 2019 the event has not yet been seen, because of this research conducted in August 2019.

In terms of comparisons between studies conducted individually, it appears that the number has decreased compared to the research conducted in collaboration, as shown in Figure 1.

![Article and Collaboration Growth](image)

**Figure 1: The development of research articles (left), Number of collaborations in the research (right)**

4.3. Number of collaborations in research

The highest number of writers collaborating is seen in 2018, reaching eight authors. Different from other years, there were four writers in 2016 and 2017.

![Research Field Developments](image)

**Figure 2: Research developments based on the field of study**
While in 2015 and 2019 (until August 2019), the maximum number of writers each amounted to three authors, as shown in Figure 1.

4.4. Field of Study from Research Collaboration
The main research fields in this study divided into the fields of education, economics, social, and technology. Based on these four primary areas of study, shown that ICT research on education is the most widely studied field. This position always occurs at most from year to year, especially from August 2015 to August 2019. After that, more research is developing in the field of management. Furthermore, the social and technological fields. The management sector has increased since 2017 (Figure 2).

5. Conclusion
Collaborative research through the keyword ICT in the title has increased, especially since 2017. The number of collaboration authors also varied, which generally consisted of three researchers. The highest record ever occurred in 2018, research conducted by as many as seven researchers in one article. The main fields of study tend to be in the areas of education and management, then technology and social.

Research results can be used by various parties, especially in developing strategies for writing scientific papers from research results. In the future, multiple forms of research are still needed, both from other fields or in the same area. Specially to study various other aspects, such as what motivates research, or obstacles that are often found by researchers.

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