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Psychological Elements of The Actors As an Intangible Factor in The Co-Creation Process

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ABSTRACT

The studies that investigate the intangible factors in the success of co-creation, including the psychological aspects of the engaged actors' individual psychology, have not been well addressed. The intangible components, particularly the psychological aspects, have gained little attention as many studies concentrate on tangible factors. The purpose of this study is to look into the psychological aspects of the actors as an intangible factor in the co-creation process between the Indonesian company PT X and the Indonesian Public Research Institute Y (PRI Y) through using Gerlink LIPI High Flow Nasal Cannula 01 (GLP HFNC 01) as a technological innovation. This study uses a case study strategy and qualitative method to obtain in-depth data and determine a more precise saturation point. The results show that personal proximity as a psychological aspect of interpersonal contact is the primary determinant of co-creation formation. Pleasant communication and personal engagement are crucial factors in establishing co-creation among industry, public R&D institutes, and consumers. The actors involved in the co-creation demonstrate that the individual's characters have a significant impact on fostering the co-creation process, such as open-mindedness, information-seeking, team leadership, interpersonal communication, and teamwork.

I. INTRODUCTION

Since late 2019, the pandemic has made it difficult for research institutions to remain active and work with several parties. The large number of medical devices required to treat COVID-19 patients inspired PRI Y and PT X to form a research collaboration. Kompas (2020) reported that since the beginning of 2020, researchers from PRI Y have collaborated with PT X and made a breakthrough in developing medical devices called High Flow Nasal Cannula 01 (HFNC 01) ventilators with High Flow Oxygen Therapy (HFOT) as breathing aids for COVID-19 patients without the need for invasive ventilators. In 2020, they sold 2,000 units, mostly to hospitals. This collaboration was successful in producing manufacturing goods and assisting the Indonesian government in managing COVID-19 patients during the pandemic. The phenomenon

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of successful collaboration in technological innovation product co-creation, such as HFNC products, can be analyzed to find its key success factors. For developing countries like Indonesia, increasing the focus on supporting technology adoption and imitation capabilities by linking industry and academia through collaboration is an important policy for escalating the National Innovation Capability (Cirera & Maloney, 2017). The Indonesian government continues to work and promote collaboration between industry and public research institutions (PRIs) or academia to meet specific market needs.

Co-creation is a collaborative activity in which academics/researchers, businesses, and customers work together to develop new product innovation (Ranga & Etzkowitz, 2013). In the interaction paradigm, co-creative of triple helix cooperation is essential (Etzkowitz, 1993; Leydesdorff, 1995) to foster a national innovation climate among universities/ R&D institutions, industry, government, and society as consumers (De Silva et al., 2020). The co-creation concept is a conduit for producing new ideas based on the industry's difficulties and needs. Science Industry Co-Creation (SIC) is a cooperative activity involving research, development, design, and marketing, while co-creation is a joint creation activity. Co-creation is also known as co-production or co-innovation, which is defined as sitting down and collaborating with others, and sharing assets and information to achieve shared objectives (Jeanine et al., 2020; Lazo-Porras et al., 2020).

Co-creation is a collaborative activity spanning many domains (Chesbrough et al., 2014) that aims to generate corporate and social value (De Silva & Wright, 2019). De Silva et al. (2020) introduced Science-Based Co-Creation (SBC) as a collaborative approach between actors from different organizations, namely universities, R&D, business, government, intermediary institutions, and the community, to contribute capital assets to generate added value in the business and social sectors. De Silva et al. (2020) stated that all cooperating actors share assets from their capital, such as knowledge, resources, networks, and cash, to complement and minimize their gaps to act on goals.

The important success component indicated by De Silva et al. (2020) for co-creation is the decision to engage in co-creation in the form of the roles of actors in facing obstacles, motivation, responding to problems and incentives needed or received. Inputs to co-creation by actors are tangible and intangible assets owned by individuals or institutions that are utilized to solve challenges and attain joint objectives. Managing co-creation focuses on applying complementary actors to create shared commercial and social value, as well as the scope of the intended business and social values, including innovation, reach, and superior product value. De Silva et al. (2020) and De Silva & Rossi (2018) stated that SBC is a collaboration that emphasizes the participation of the main actors, namely universities/R&D institutions/researchers and companies/industry, in joint creation from the beginning to the end of the production process for resulting innovation products to obtain business and social value (according to the purpose of working together).

Referring to Law No. 11 of 2019 concerning the National Innovation System of Science and Technology (Sisnas Iptek), which focuses on the interaction or connectedness of R&D institutions as producers of knowledge and technology with other parties, the industry as a user is not optimally managed and must be improved. Cirera and Maloney (2017) asserted that the failure of developing countries to implement a national innovation system is due to the inadequacy of capacity development escalation that focuses on infrastructure and human resource development rather than developing and fostering simple collaborative projects aimed at innovation.

Researchers such as De Silva et al. (2020) discovered this issue and claimed that many developed countries are using co-creation models between R&D institutions, companies/industry, and consumers to reduce the them and produce market-acceptable innovative goods. However, Triyono et al. (2019) stated that the relationship between R&D institutions and industry has not yet been created effectively due to inconsistencies in actor views.

Furthermore, several r of studies on co-creation that have not explored many psychological

aspects yet, including those conducted by Mendez-Aparicio et al. (2020), discovered that customer involvement in co-creation is due to the experience and satisfaction that creates shared value due to user expectations that are relevant to the offered product. Chen et al. (2019) found that the co-creation of well-being is dynamic because of a transformative process whereby a focal actor's subjective well-being is the outcome of balancing challenges and resources to achieve equilibrium (state). this depends on the focal actor's and other engaged actors' psychological ownership over the focal actor's well-being and subsequent resource integration. Hair et al. (2016) stated that psychological ownership arises from the customers' involvment in the product development process. It is positive feedback for companies to pay more attention to inputs and the integration of value creation from co-creation activities.

Based on Liu et al. (2020), the type of co-creation collaboration is transactional as a psychological contract and offers knowledge to the community or co-creation team. Previous research on the significance of investigating psychological factors in co-creation cooperation, such as that by Al-Kumaim et al. (2020), examined the role of maintaining continuous involvement of online platforms in creating shared value among individuals at universities and demonstrated that personal factors and perceived benefits were the initial motivational factors in establishing cooperation, whereas the continuation of further cooperation depends on the individual characteristics. Carranza et al. (2020) investigated the adoption of e-banking as a shared value creation potential in co-creation, and the findings indicated that when e-banking customers have a positive attitude regarding the usage of e-banking, they also have a larger intention to be creative and contribute. Moreover, Garro-Abarca et al. (2020) discovered that the communication process is crucial for working in virtual teams, and that trust management is crucial for leadership, empowerment, and cohesiveness in co-creation cooperation. Nájera-Sánchez et al. (2020) mapped eleven thematic groups of technology co-creation and discovered that co-creation collaboration requires an open and consumer-centered flow of innovation research, service ecosystems, and service innovation. They also identified two new trends, namely servitization and sharing of economic phenomena.

This research in psychology aims to compile several contributions to conceptual and psychological drivers of shared value creation in organizations and individuals. In a nutshell, the value of co-creation refers to the value created and experienced through collaboration among multiple stakeholders (Martínez-Cañas et al., 2021; Prahalad & Ramaswamy, 2000; Saarijärvi et al., 2013). This paradigm shift concept emphasizes the shared outcomes of service organization interactions with stakeholders (Grönroos, 2017). Moreover, value co-creation is a company model technique that establishes distinctive strategic alliances (De Oliveira & Cortimiglia, 2017). Moreover, it might be the primary emphasis of firms seeking to build higher shared value (Merz et al., 2018). However, results are influenced by various internal and external factors, including individual/group/organizational qualities, expectations, involvement level, and surroundings (Martínez-Cañas, 2021; Jaakkola et al., 2015; Hsieh & Chang, 2016). Companies can strategically improve their connections with important stakeholders by understanding the impact of these elements and the contingency.

Based on previous research findings, it is explained that the psychological aspect is an important factor that can influence the start, process, and sustainability of the activity of product co-creation from industrial research. The psychological aspect is an intangible aspect that is not considered by management and policies to grow and create a cultural climate that supports cooperation in co-creation between R&D and industry and consumers in creating technologically innovative products.

The formulation of the problem in psychology-related research can practically provide an overview and support deeper knowledge about individual characters in co-creation activities. The questions in this study are: What are the characteristics of individuals who can build and carry out successful and sustainable Science Industry co-Creation (SIC)

activities? How does the psychological aspect play an important role in creating a successful collaboration of the GLP HFNC-01 product? This study aims to explore the SIC (PT X & PRI Y) from a psychological perspective based on the individual characteristics of co-creation actors. The study's findings aim to gain a better understanding of the psychological aspects that can support the research climate through research collaboration and co-creation activities between researchers and industry, as well as consumers. The findings are expected to have theoretical implications for the individual characteristics that influence the success and sustainability of co-creation activities.

II. METHODOLOGY AND RESEARCH FRAMEWORK

To investigate and understand the significance that individuals or groups ascribe to a social or human situation, this study adopted a qualitative analysis method (Creswell, 2014; Simon, 2009; Swaborn, 2010). Stake (1994) and Yin (2014) collect evidence using a naturalistic methodology (a real-life context). Robson's (1993) case study is a research technique that entails an empirical investigation of a specific contemporary event in its real-world environment using numerous sources of information. The objective of the case study method is to investigate the psychological qualities of the co-creation actors. This psychological approach investigates in further depth the nature and personality of each individual actor in the co-creation process. This study was conducted throughout 2021, with data gathering occurring over the course of five months, from June to October 2021. Each interview was mostly online, a maximum of 2 hours long, and conducted more than once for each expert.

The interviews were transcribed to complete the required supporting data using document data (photographs, presentation documents, and supporting articles) provided by key informants. Since this research was conducted during the COVID-19 pandemic, the data gathering was limited to in-depth online interviews because face-to-face interviews were not possible during the period.

This research framework was adapted from De Silva et al. (2020) by focusing on the intangible asset aspect as a determining factor for the success of co-creation (Figure 1). The framework was developed to explore the psychological aspects of co-creation actors as intangible assets by using the case of a successful research collaboration between PT X and PRI Y in the co-creation of HFNC product

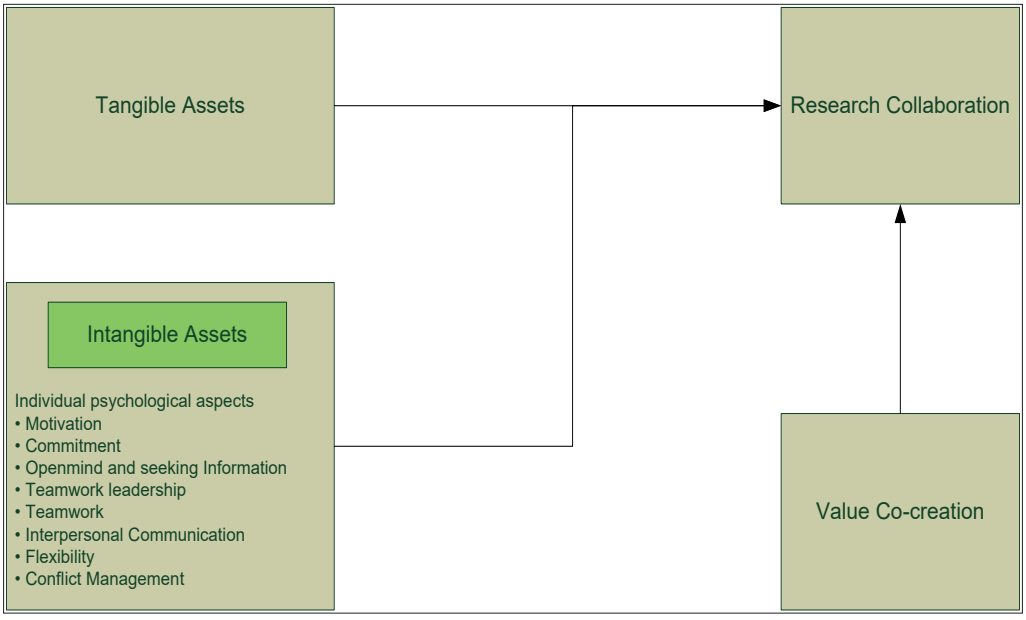

Figure 1. Research Framework

technology innovation. This study featured three key informants as the primary participants in the co-creation process: a researcher from PRI Y, a director of PT X, and a doctor from Z Hospital as a health expert. All of the informants were identified via the snowball technique, with their consent and based on the recommendations of other informants.

The purpose of analyzing the whole collected data set is to answer research questions and meet the aims of this study. Researchers then transcribed all interview results to facilitate open coding. Based on the concept of the case study, a content analysis of the employed data was conducted. Data analysis results were expected to answer the research question regarding the description of the psychological aspects that are crucial to the success of collaborative research activities for the co-creation of the GLP HFNC-01 product between PRI Y researchers, the PT X team, and doctors at Hospital Z, so that their innovative research products can be used, accepted, and sold to the market, particularly during the COVID-19 pandemic.

III. RESULTS

A. Histories of GLP HFNC-01

The High Flow Nasal Cannula-01 (GLP HFNC-01) is a COVID-19 oxygen therapy device. It is the result of a co-creation partnership between PRI Y and PT X, since 2020 and based in Bandung. (the beginning of the COVID-19 pandemic). The GLP HFNC is the first high-flow nasal cannula manufactured in Indonesia. It is now being sold to customers after passing a series of tests. In developing collaborative research and innovation co-creation activities between research institutions, industry, and consumers, the success of GLP HFNC is a stepping stone for the success of additional innovative products that will be developed in the future.

During the COVID-19 pandemic, the Indonesian medical community urgently needed medical equipment, especially for the treatment and recovery of COVID-19 patients. To resolve this issue, the director of PT X and researchers from PRI Y agreed and launched collaborative research co-creation activities. Ten individuals were committed to collaborating on co-creation research collaborations, including five research teams and five PT X's team members (director, two researchers, and two technicians). Following the formation of a casual acquaintance, the two discussed and launched cooperation endeavors in the domains of study and industry. Since PT X did not have a history of producing medical devices, the first step was to join ASPA (Indonesian Medical Device Manufacturers Association) and identify both potential and problems presented by the fact that practically all medical devices in Indonesia are imported.

As cooperative capital, PT X could carry out advancements in information technology (IT), machinery, and electronics. PT X produces geological and geogenic instruments on its own. Government, through PRI X researchers, has capital assets of human resources in research and institutional legality. They agreed to develop HFNC, and they contacted two doctors from Hospital Z Bandung for assistance on counsel and consultation as well as recommendations for the best research tool. Both parties agreed to perform research on the development of HFNC 01 products. PT X is responsible for all research activities and funding at the workshop. PRI Y research team worked nonstop for three months until the HFNC 01 product was successfully created. Then, PT X registered the HFNC 01 product with the BPFK (Health Facility Inspection Agency) for evaluation. Only five out of the 37 innovators who registered passed. One of the channels was HFNC 01. Then, registering the distribution permit in May was a breeze.

After that, the greatest obstacle was convincing consumers, particularly physicians and hospitals, that the HFNC-01 was effective and more competitive than its rivals. To promote the product, PT X provided three hospitals with HFNC product grants. However, it took a long time to ensure that the technology was safe and usable.

As a leader of the Co-Creation research collaboration team for HFNC 01 products, it is the responsibility of the director of PT X to oversee the research, production, marketing, and

after-sales maintenance operations. He directly took care of all permits until they were ready for market distribution and offered hospitals and physicians that the HFNC 01 device was viable, safe, and competitive. The research team is responsible for assuring the safe and effective operation of the HFNC equipment so that volunteers could complete their duties correctly. The first client from a hospital in Semarang who purchased HFNC 01 was satisfied with the product and referred it to many other hospitals. Within two years, more than 2,000 units were sold. With the greatest populations in Central Java and Yogyakarta, HFNC 01 goods are now widely distributed throughout Indonesia. The success of the HFNC 01, the Indonesian Ministry of Health has entrusted the team with the production of additional HFNC 01 equipment to fulfill the demands of hospitals throughout Indonesia. In addition, there is significant demand for this product from the international market. However, due to manufacturing capacity limitations and the team's resolve to prioritize domestic demands, GLP HFNC 01 production will be prioritized to meet national demand.

B. Individual Intangible Aspect

Analysis of case study phenomena of PRI Y researchers and PT. X's success in performing joint research activities on the co-creation of the GLP HFNC 01 product as the country's first widely marketed and consumer-accepted product.

The study could answer the two research questions and accomplish the study objective by providing an overview of the significant sign of the psychological element in developing and maintaining the sustainability of research co-creation activities involving collaborative innovation.

The actors' mutually supportive and complementary behavior exemplifies the significance of psychological factors in fostering a productive collaborative research co-creation activity in the development of GLP HFNC-01. This was due to the fact that the psychological part of each actor as a person has specific motivations that manifest in their outward actions. These actions describe the personal qualities that were crucial to the success of co-creation collaboration, namely:

In order for a co-creation research partnership to be successful, the players collaborating to complement each other according to their individual capacities and roles must possess strong character. The aforementioned eight psychological elements are the predominant aspects that emerge from the collaboration between the primary actors in co-creation (Table 1). This is an intangible asset that every human resource researcher must evaluate and cultivate. These psychological aspects will shape the individual character of the researcher, who must develop and possess certain competencies. This trait will become a valuable asset for the institute as it expands and develops its research human resource capabilities. When a strong character becomes an intangible component, it will impact and alter the research atmosphere to make it more hospitable and competitive, and researchers will be driven to share this information with other research groups and individuals.

The success factor of the collaborative research co-creation process is an example of an intriguing case study and an illustration of the phenomenon of the process of each actor of the research team, industry team, and professional team, as well as prospective consumers, syncing and agreeing to collaborate based on their capacities and abilities; therefore, be patient to meet the collective agreement's objectives.

Ranjan & Read (2019) discovered that the addition of co-creation value is determined by the psychological characteristics of co-creation collaborators. The success of co-creation activities is heavily influenced by the individual viewpoints of the players, which serve as psychological aspects that construct the dimensions of the intangible features intrinsic to each person. It corresponds to the psychological element that arose in the co-creation phenomenon case study HFNC 01. The psychological feature that appears to be affixed to the individual explains the character that is constructed from the interactions and synergies of each individual actor. Concrete evidence of the rational psychological contract is the ability of numerous individual actors to

Table 1.
Intangible Assets as psychological Aspect to Co-creation

Psychological Aspect	Description	Statement Snippet
Motivation	Every individual in this co-creation collaboration team has the same motive to do so and wants to provide added value from the research activities that will be carried out. Intrinsic motives and mutual support become common motives. In addition, it is based on motivation and social values so it develops on a cooperation agreement.	*"At the beginning of the pandemic, medical equipment was needed and discussed with the director of PT. X to provide research products that have a social impact on society and the country"(PRI Y Researcher)* *"During the pandemic….ventilators that are really needed and in short supply…..there are only 157 local products medical devices and it turns out that almost all of them are OM… Indeed, this research culture in medical devices is still quite far away. Actually, if indeed we start everything from scratch, this is what we feel is really heavy...." .."(Director of PT. X)*
Agreement and commitment	Both parties arose as a result of an agreement and a shared objective of assisting and contributing to the nation in order to provide beneficial outcomes for the COVID-19 pandemic, namely the production of a product required by COVID-19 patients.	*"After discussing it, we decided to do research collaboration with them and ask for recommendations from doctors for advice on what opportunities might be appropriate."(PRI Y Researcher)* *"……decided between the PRI Y team and our PT. X team to join in one location at that time……. At first, we wanted to make an ICU ventilator, but because it was too high, there was input from Dr. I. Let's make a non-invasive one. This type will be needed a lot… Deciding to switch from a ventilator, let's develop HFNC.." .."(Director of PT. X)*
Open minded and seeking information	It is an important character in the process of team interaction and research product development. Characteristics that can assist in maximizing one's potential to generate the proper product based on consumer needs.	*"….2 doctors have contributed to developing and continuing in giving Spirit to local products, so that really helps a lot…… more input to develop HFNC.."(PRI Y Researcher)* *"…actually there is no gap…between us because we are also in our team because maybe we were already used to the research culture at the beginning…. the team merged into one….there is no limit between PRI Y status as civil servants and us who are only industry, so it's true that we are fighting to be one for one goal…".."(Director of PT. X)*
Interpersonal communication skills	It is essential in the process of cooperation and developing relationships, both in the context of personal life and the professional world of work. With the communication technology, communication with team members and customers very easy. The willingness to communicate informally and flexibly influences performance as well. Siregar and Scheffer (2021) investigated the communication components of the collaboration process in students, discovered that students primarily employed asynchronous communication media, such as brief text and Google docs. Incompatible language skills and Internet connectivity are the obstacles. In addition, cultural elements like individuality, masculinity, and power distance influence the capacity and style of communication between individuals.	*"…we communicated intensely… for 6 months in total… intensely, the PRI Y team was on PT. X … PRI Y was still working from home… the beginning of the pandemic was soaring again….so the lockdown…they had a full office in PT. X until it was really…can be accepted by the doctor…as long as after 3 months of selling it, the research process continues…until it is truly qualified…they can accept it."* *"…Communication is important for us…. our communication smooth so far…there are a WhatsApp group via whenever we call, it's also relaxed, what time would it be? What time would it be when there was an error at 1pm at the hospital? So I'll keep in touch…"(PRI Y Researcher)* *" For communication, we are open to researchers and teams to provide input on product development according to the needs of medical workers in the field" (Doctor A)*

Team leadership	This has formed the foundation for the viability of research collaborations involving co-creation. The standard for the success and longevity of the collaboration is the personal comfort of each actor participating in the co-creation research activities. From a sequence of behaviors that are sensed personally when interacting and conversing with each actor, every unique individual of the actor experiences comfort.	*"…we merged… really merged because the condition was very urgent, waiting for the patient, waiting for the doctor, waiting for the nurse, okay… we can do it. We just became one command… I commanded all team of PRI Y as if I were an employee… final decision…"..."(Director of PT. X)* *"We researchers follow the role and focus on product development and listen to all suggestions" (PRI Y' Researcher)*
Teamwork convenience	This has formed the foundation for the viability of initiatives including co-creation and research partnership. The criteria for the success and longevity of the partnership is the personal comfort of each actor engaging in the collaborative research activities of co-creation. As a result of a sequence of actions that are personally experienced when interacting and conversing with each actor, the actor's personal comfort is felt by every individual.	*"..I'm comfortable. Maybe I haven't found the other team yet.. really want to sit together, sit down together, we're all fighting together…. we both struggle together with our team.". (PRI Y Researcher)* *"There is no boundary between researchers and industry. There is no boundary in terms of educational background - between those who hold master's, doctoral degrees and those with vocational high school degrees... we merge into one, and we all work together for the sake of Indonesia... we take off all the clothes we want from PT. X, we want it from PRI Y… what matters is what we can do…" .."(Director of PT. X)* *"…still the same, as the same team…. Which is for the future…. I am comfortable with all team… .."(Director of PT. X)* *"We are open with the research team when asking for the tool's input" (Doctor A)*
Flexibility	The actors' adaptability or flexibility in responding to a diversified environment, agency background, educational level, problem-solving, etc.	*"We often immediately jumped into repairing the error HFNC tool…" (PRI Y Researcher)* *"I immediately urge the doctors at the hospital to immediately use the device." .."(Director of PT. X)* *"We usually communicate and can be contacted at any time within the team and by consumers" .."(Director of PT. X)* *"We are easy to contact the manufacturer to ask for help and service to them at any time" (Doctor A)*
Conflict management	The capacity of actors to manage all teamwork-related disputes in order to achieve joint goals.	*"…so there's no gap, we're comfortable… that means it's really smooth… if it's from a collaboration perspective… we support each other, even if there's a little conflict. It's actually just a conflict with the new product, sir.." (PRI Y Researcher)* *"Even if there is a conflict, yes, the selection of a technical system means that we can find a solution together and we are both comfortable. No one is stubborn, wants to win. Basically, my idea must be initiated, yes, but we are both looking for a solution. Solutions with deliberation and consensus, all teams who are directly involved with the team at that time, continue to monitor and continue to provide advice…. all these ideas can work well.." (Director of PT. X)*

develop and foster continuous engagement with agreement and commitment to collaborative co-creation.

The phenomenon of HFNC 01's success as a result of co-creation innovation research exemplifies how De Silva et al. (2020) co-creation success factors highlight the traits of persons who can create and carry out successful and sustained co-creation activities. De Silva et al. (2020) identified four important success components of co-creation activities.

Decision to Engage in Co-creation

Operationally identifying the roles of actors encountering obstacles; motivation; how to respond to problems; and incentives required or received (which is an aspect of personal). Team leadership, the same intrinsic motivation, seeking information, and being receptive to input and information that aids their performance process are among the personal characteristics revealed in the phenomena of the success of the HFNC-01 co-creation by the actors. All of these psychological factors cause the traits of the actors to complement one another and foster personal interaction so that they are willing and committed to collaborating. A resemblance of drive and personal qualities attracts each other and provides the chemistry necessary for co-creation activities involving professional work in collaborative innovation research.

Input to co-creation by actors

Actors contribute to existing resources in the form of tangible and intangible assets owned by individuals or institutions to the co-creation process in order to solve challenges and attain common goals. This phenomenon demonstrates that the industry possesses concrete assets that may be used as the primary support for the success of the co-creation process, including facilities and cash to run the project until the product is completed and distributed. All financial assistance and physical facilities are provided by the industry, which is committed to assisting the research team in developing breakthrough goods. In this instance, researchers are the most valuable resource for conducting research, producing objects, and learning about technological innovation as immaterial.

Managing co-creation

This factor emphasizes the utilization of complementary actors to generate business and social value shared by all parties. Management of co-creation on the psychological component as an intangible aspect refers to the ability of leaders to manage their resources to assist and solve co-creation-related issues. PT X will set the strategic direction of the partnership process until the public accepts the marketing of HFNC 01 products in his capacity as team leader. Everyone is participating in a manner commensurate with their positions and capacities so that the collaboration runs smoothly and everyone is aware of what is happening.

Scope of the desired commercial and social ideals

This factor encompasses innovation, reach, and the product's better worth. In the co-creation process, the PRI Y Research Team, PT X Team and doctors played complementary roles. The PRI Y research team was primarily responsible for the research and development of tools, whilst the PT X research team contributed to the machine and IT development process and provided complete facility and financing support. Every contribution such as the input and recommendations of doctors as experts, feasibility testing, and tool safety assessment is important to the success of the HFNC 01 co-creation until it was accepted by the general public. The commercial value of HFNC 01 methods and products provide alternatives and input for creating competitive local medical devices to fulfill the needs of Indonesian and international hospitals. As for the social aspect of HFNC products, the success of HFNC 01 in addressing the demand for more cost-effective medical device ventilators in Indonesia can benefit research institutions and businesses.

Based on the data analysis, it can be stated that an individual's capacity to generate possibilities for collaboration and to build cooperation in collaborative research on co-creation innovations is significantly influenced by

his or her psychological qualities. This indicates that the psychological components of persons are complementary and have the same motivation, resulting in awareness and commitment to developing cooperative conduct to attain mutually agreed-upon goals. The capability and motivation to build collaborative research collaborations for co-creation innovations can be found in the psychological components that let the individual personalities of the actors establish and sense psychological connections with one another.

IV. DISCUSSION

According to Prahalad and Ramaswamy (2004), co-creation is a pattern of joint collaboration between industrial enterprises and customers that engage, learn, share knowledge, and integrate their respective resources to develop and enhance products. In the meantime, Roser and Samson (2009) clarify that co-creation is not only a partnership between industry and customers but also a form of collaboration among co-creation players (researchers). Consumer desires and demands, along with the capacity of industry and research players to create new product values, motivate collaborative research collaborations with the industry to create new product innovations with added value (Vargo et al.,2008). Arroyave et al. (2020) studied the significance of collaborative activities between universities and various agencies for developing a shared value system to promote environmental innovation and enhance business performance. They discovered that shared value creation promotes operational flexibility and generates environmental innovation and boosts sales and corporate profits.

In addition to the research team and industry, professional doctors also participated in the HFNC 01 co-creation research partnership activity before, during, and after its successful completion. Consistent with research by Siddique et al. (2021), explaining the significance of user participation in positively influencing the development of web-based online service goods. In addition, too many actor roles for the customers can cause an excess of conflicts. When a product is widely marketed, the job of potential customers as actors is to provide value to suggestions and recommendations required by potential consumers.

Psychological aspects of the actors who collaborate in co-creation paint a picture of the existence of a psychological contract of relations as the basis for a positive relationship with members able to trust each other and a sense of belonging to the organization, which in turn results in a high propensity to contribute knowledge (Liu et al., 2021; Abdullah et al., 2011; Forsman, 2014). Individuals' behavior and beliefs regarding their involvement with other people to contribute and commit to teamwork or organization can be explained by the psychological contract, which is an implicit attachment that plays a significant role in the involvement of individuals in the organization to achieve the expectations of others and meet their own expectations (Levinson et al., 1962). Riikka & Lams (2014) demonstrate that psychological contracts can be used to characterize psychological elements of actors that can promote intrinsic motivation to share information and link both commitments to participate in group collaboration (Wei et al., 2018; Bi, 2019).

The HFNC 01 co-creation phenomena demonstrated the psychological interaction between the engaged actors. It demonstrated a beneficial association between trust and collaboration for the exchange of mutual knowledge (Abdullah et al., 2011). Workers with a strong sense of organization are characterized by a helpful attitude and the ability to regularly make objective decisions (Smidts, et al., 2000). In addition, Masteron &Stamper (2003) and Epitropaki (2013) indicate that attachment is individual and involves perceptions that help individuals accept themselves as an organization or group member. Their sense of what they require as members of an organization or group is defined by the psychological contract (Epitropaki, 2013). In fact, the psychological contract turned out to be a significant factor in providing actors with comfort and identifying organizations; perceptions had a positive effect on support and the relationship between other positive behaviors that support organizational success, such as organizational citizenship behaviors (OCBs) (Zagenczyk et al., 2011; Ahmad & Zafar, 2018).

Furthermore, Liu et al. (2021) affirm that the success of co-creation collaboration is greatly influenced by the intangible component of the actor's function, which explains the psychological importance of the contract between the actors. The psychological contract is the consequence of the psychological features of the actors that impact their behavior, improve their willingness and involvement in co-creation, and contribute to collaborative co-creation activities.

According to De Silva & Wright (2019), co-creation collaboration activities are geared toward business endeavors that offer value to social aspects. Using a method based on open innovation, the development of entrepreneurial behavior seeks to differentiate itself in various ways.

De Silva & Wright (2019) and Grassann et al. (2010) stated that the objective of technology innovation from co-creation efforts is to facilitate the development of social values. In addition, the added value will be affected by the participants in the co-creation activities, particularly concerning the social component being addressed. The more diverse the backgrounds of the players participating in co-creation research cooperation activities, the closer and simpler it will be to produce and impact innovation outcomes (Laursen & Foss, 2003), and the greater the value creation will be (Lee et al., 2011). The primary functions of the players involved in collaborative research activities, co-creation, have reciprocal effects on the production and addition of business and social value to the undertaking. To co-create value, the actors will exchange and collaborate depending on the resources, networks, and other tangible and intangible assets they possess.

González-Santa Cruz et al. (2020) show their research on the Ecuadorian cooperative phenomenon about the significance of tailoring the qualities and needs of service content to external clients. As a result, shared value creation, innovation, engagement, and loyalty-related characteristics, among others, will have a beneficial influence. Peris-Ortiz et al. (2017) claimed that establishing dynamic capacities for creating creative products through co-creation activities requires company members and business executives to have a strong, intimate relationship based on mutual trust and understanding. In the twenty-first century, organizations are continuously adjusting their mentalities and searching for new ways to regenerate employee potential in the interest of innovation and competition. In this regard, they met the requirements of the new environment and implemented more effective and interactive competitive strategies, such as fostering cooperation, promoting resource/competency exchange relationships, and developing networks via communication platforms and virtualization. Administrative operations are continuously transforming from isolated to interactive processes. Consequently, a deeper psychological and social perspective is required to comprehend the genuine value and the combined effects of shared value production activities. Organizational studies should consider the holistic view of stakeholders and their setting as co-creators of essential values' requirements to be excellent and competitive for a deeper understanding.

One of the actors stated, based on the findings of a case study regarding collaborative research collaboration activities, that the failure of innovation research products between R&D institutions/universities and industry was the result of a disconnect between research and industrial activities and the needs of consumers in the targeted market, as stated in the statement following:

> "...Why do many research products fail? Many failed because …. that was because we didn't sit in one place between industry and researchers or R&D institutions sitting under the same roof starting from zero, because if we were to do it ourselves, for example, R&D institutions used to work on the ground. The research side after that was handed over to the industry…"(Director of PT X)

Individual characters that reflect the positive psychological aspects of each individual researcher who is able to be attractive and establish relationships with other parties are required for success in establishing collaborative research collaborations on co-creation activities between researchers and external parties both

from industry and consumers. This is a statement from industry actors from the director of PT X:

> "The point is only one; don't be a stubborn researcher."

> "I've had a discussion with someone who already holds a Doctoral Degree ... true from a theoretical point of view, but you need to listen to voices from the market side from the feasibility side. It's easy to make or not, the concept is applied, and it's really beneficial or not for the community... So sometimes the chemistry is possible I don't really mean the researcher... the researcher is quite close, right. As long as the researcher just listens to what the industry wants, we'll both collaborate. We don't want to win our own ideas. We're both going through deliberation and consensus."

To establish and maintain a sustainable collaboration, the essential characteristics are an open mind to input and suggestions from other parties, objective and practical perspective, and good interpersonal communication skills to foster the cooperation between the actors. This was also confirmed in a recent study by Romadona & Setiawan (2019) about communication in a research organization. In addition, researchers must possess interpersonal communication skills for their future career advancement (Romadona, 2016). In the realm of research, researchers should be able to listen to and know the problems and needs of the community as potential consumers of research products. This means that from the start, it takes the ability of researchers to sit together with industry and potential consumers and communicate ideas so that the research results are useful and answer the needs of the community.

Furthermore, the success of product innovations as a result of the research co-creation collaboration activities should be managed properly before deciding on the topic or ultimate goal of the activity. Both researchers and industry actors should involve the potential consumers within certain scientific capacity and provide input and recommendations for developing and providing market opportunities in the future. This is in line with the statement:

> "….collaboration from the beginning, so that it didn't end at the end, but directly collaborated with industrial partners…..how was the market and what about competitors' prices.."(Director of PT. X)

> "… We are developing a therapeutic tool for the heart called EJP, which is approved by HK Hospital and proposed by a cardiologist who is also the chairman of the Indonesian Cardiac Specialist Association. …. same distributor… "(PRI Y Researcher)

> "….hopefully PRI Y can have a hospital partner or a specialist with a strong specialist association….. during research collaboration… It has been guaranteed by the user that if this is successful, the user is also responsible for the sale and guarantees that this tool can truly can be used properly so that it doesn't work alone. If these 3 important collaborations, R&D and industry, continue like this, surely it will work out in the end." (Director of PT X)

The success of co-creation research collaboration activities on HFNC 01 products involved several actors, which can be described as follows:

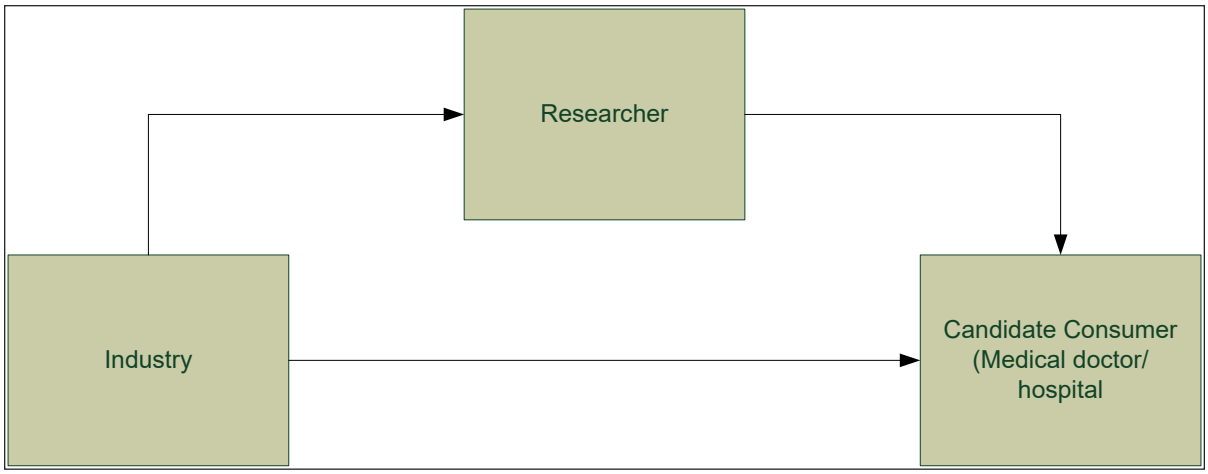

Fig. 2. Actors of co-creation research collaboration activities on HFNC 01

Based on the description of the successful collaboration of research activities for HFNC 01 products involving three major collaborating actors, namely the individual PRI Y research team, the director of PT X, and a team of PT X and professional doctors from the Hospital, each of these actors describe the triple helix relationship between research institutions or academics, industry, and consumers (Figure 2). The co-creation research collaboration network demonstrated the existence of an implicitly felt psychological contract that links the actors to support their commitment and participation in the activity. The three primary players must be involved in research partnership activities to be successful, supported, and accepted by the community as consumers of the research output.

In accordance with the findings of Nájera-Sánchez et al. (2020), co-creation must involve academics, industry, and consumers for joint research activities to be successful. Co-creation of value will be developed and enhanced through innovative efforts centered on consumer requirements, service delivery, and the socioeconomic sector. This article describes the phenomena of the success of collaborative research activities for the co-creation of creative products. GLP HNFC 01 outlines the roles, abilities, and skills that actors who collaborate must possess. Focusing on development and establishing a climate of collaborative research co-creation in R&D institutions and universities with industry parties requires psychological factors of individual actors that government should consider. This personal factor is an intangible aspect of conduct that must exist as a precursor to establishing and developing a collaborative research climate in Indonesia, which is rarely considered at present. This feature is commonly referred to as the soft skills aspect or, in the context of human resource management, soft competencies.

An important finding of this study is that the success of the collaborative activity of co-creation of the HNFC-01 innovation product to treat COVID-19 patients is dependent on the personality of the main or principal players in accomplishing the collaboration's success. This is evident from all of the actors' assertions that moving on to the same social motivation and a shared commitment to working together. The mutual commitment in sustaining the collaboration is exemplified by the actors' open-minded personality, interpersonal communication, information-seeking, and team leadership.

V. CONCLUSION

This study confirms the significance of psychological factors in determining and fostering such collaborative SIC activities. Every actor has a psychological feature that is intrinsic to cooperative activity. The players involved in the co-creation clearly demonstrated that psychological characteristics have significant impacts on the process, such as motivation, commitment, open-mindedness, information-seeking, team

leadership, interpersonal communication skill, and teamwork. As De Silva et al. (2019) described, the psychological factor, as an intangible aspect, plays a vital part in the effective collaboration of co-creation activities in teamwork management.

This study are limited to reviewing only one case study of the HFNC 01 phenomenon as the first medical device in Indonesia to be successfully produced, marketed, and accepted by all of its consumers and to receive government support to aid in the healing process for COVID-19 patients during the pandemic. This research is limited by its comprehension and review of the psychological features of each actor who plays a role in co-creation research cooperation activities and can interact and engage in teamwork from a single perspective using a case study. Due to the constraints of this study, it cannot be generalized. However, this research provides credence to De Silva et al. (2020)'sco-creation theory about emphasizing the relevance of the impact of the individual's personal character as an intangible factor that determines the success of co-creation activities.

Future research should quantify psychological aspects' role in maining SIC's sustainability. In addition, the following study also needs to increase the number of case studies to create multi-case studies that can be generalized more broadly.

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