Exploratory Analysis And Identification Of Factors Challenging Digital Transformation In Bio Farma Group

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Abstract.

In the era of Industry 4.0, companies must adapt to remain competitive, including through digital transformation. Bio Farma, a leading vaccine manufacturer in Indonesia and the parent of the state-owned pharmaceutical holding (Bio Farma Group), is undergoing such a transformation. This includes subsidiaries like Kimia Farma, Indofarma, and INUKI. To accelerate this process, Bio Farma established the Directorate of Transformation and Digital to coordinate initiatives across all levels of the organization. This study explores and identifies the main challenges in the company's digital transformation using a mixed-methods approach with an exploratory sequential design. Data were collected from interviews with five key informants and surveys involving 327 employees across the Bio Farma Group.A combination of qualitative and quantitative analysis, including Confirmatory Factor Analysis (CFA), was used to uncover the core challenges. The findings revealed 13 key factors: digital capability, strategy, technology, organization and culture, digital efficiency, digital readiness, customer focus, digital research, investment perception, operations, collaboration, investment review, and digital priority. These challenges extend beyond technical issues to strategic planning, organizational readiness, cultural alignment, collaboration, and investment evaluation. This research provides a strategic reference for managing digital transformation, particularly for state-owned enterprises in the health sector. The results are expected to support Bio Farma Group in formulating effective policies to enhance digital capabilities, strengthen collaboration, improve efficiency, and ensure sustainable digital development.

Keywords: *Digital transformation; challenges; Bio Farma Group and confirmatory factor analysis.*

I. INTRODUCTION

Digital transformation denotes the incorporation of digital technologies into many company or industrial facets to enhance efficiency, productivity, and customer experience [1]. Verhoef et al. [2] delineate three stages of digital transformation: digitisation, digitalisation, and the transformation itself. The imperative for digital transformation has been underscored by external influences, including the progression of digital technology, escalating digital rivalry, and the changing behaviours of digital consumers. These dynamics create significant challenges for organizations, forcing them to adapt to new digital realities and compete with digital-native companies that have established innovative models and strategies.In the healthcare industry, technological advancements have drastically reshaped the landscape. Emerging technologies such as on-demand healthcare, telemedicine, health wearables, disease history analysis, and digital patient portals are revolutionizing the way health services are delivered [3]. Furthermore, technologies such as artificial intelligence (AI), machine learning (ML), big data, blockchain, and the Internet of Things (IoT) facilitate the collecting and analysis of extensive data sets, creating new prospects in drug development and improving patient care [4][5]. By leveraging these technologies, healthcare companies can optimize supply chains, improve product lifecycle management, and boost innovation capacity, ultimately generating greater profit margins and strengthening competitiveness in the market [6]. The COVID-19 pandemic acted as a catalyst that expedited digital transformation across several sectors, especially to ensure business continuity [7].

It prompted shifts in work practices, consumer demands, and the urgency to implement digital solutions. For the healthcare industry, the pandemic created opportunities for new business models, including digital wellness, stronger supply chains, and e-commerce. Bio Farma Group recognized the importance of adapting to these changes and increasing reliance on technology to support operations and meet the growing demand for digital services. Additionally, digital transformation became vital to address increasingly complex cybersecurity challenges.In Indonesia, the pandemic heightened the urgency for Bio Farma Group

to initiate its digital transformation. The company adopted the Golden Triangle approach—People, Process, and Technology—as its initial framework [8]. In terms of people, Bio Farma provided training and development tailored to employees' digital interests and skills. It also restructured teams into small, stream-based units focused on projects like manufacturing, distribution, B2B, B2C, and internal operations. These teams were designed to work collaboratively and make agile, non-hierarchical decisions. For processes, Bio Farma categorized its digital business strategies into enhancers, enablers, and automators—each playing a role in improving information flow, enabling new sustainable business models, or reducing human dependency in operations. From the technology side, the company adopted a cloud-first, API-first, and mobile-first strategy, alongside legacy modernization, to ensure that digital services are robust, scalable, serverless, and responsive to business needs.Currently, Bio Farma Group has implemented various digital initiatives, such as the Medtrack system for tracking production and distribution, enhancing the visibility of its pharmaceutical and non-pharmaceutical supply chain.

The group has also launched B2B and B2C e-commerce platforms—Medbiz and Mediverse—as well as Medevo and Medwell for digital health consultations and daily wellness monitoring [9]. Additionally, significant investments have been made in core digital infrastructure, including ERP system integration across entities, Q100+ implementation for manufacturing batch records, and the development of an API Factory to integrate all digital applications within the group.Despite these advancements, Bio Farma's digital transformation process faces several situations and challenges that must be addressed strategically. These include adapting to digital business models and managing complex technology integration due to numerous overlapping applications across the organization. This condition necessitates advanced systems and technologies capable of integrating all organizational elements to operate efficiently and effectively [10]. Transforming long-standing workflows and perspectives is critical. Furthermore, the limited availability of digital talent in Indonesia remains a key constraint [11]. There is a need for strategic talent mapping and development, along with navigating strict health industry regulations that can hinder transformation. To overcome these issues, Bio Farma Group must craft robust strategies, foster management commitment, and invest in technology, human resources, operations, and customer-centric solutions.The aim of this study is to investigate and assess the issues that impede digital transformation in Bio Farma Group. The findings are expected to support the organization in addressing these challenges and enhancing its performance in an increasingly digital business environment.

II. METHODS

This study employs a mixed methods approach, integrating qualitative and quantitative procedures for a thorough investigation of the research problem. According to Creswell & Creswell [12], mixed methods research can be categorized into two primary models: convergent and sequential. In the convergent model, researchers collect and analyze qualitative and quantitative data simultaneously, merging the findings to better understand the research issue. However, this study utilizes the sequential model, which involves conducting one phase of data collection and analysis first—typically qualitative—followed by the quantitative phase, which builds upon the findings of the initial stage. This exploratory sequential design is particularly effective when the research seeks to explore a complex phenomenon where preliminary qualitative insights are necessary to guide the development of a robust quantitative instrument. By first uncovering in-depth insights from selected informants, the researcher is better positioned to construct survey items that are contextually relevant and aligned with the lived experiences of participants involved in digital transformation at Bio Farma Group.

Qualitative method

The qualitative method in this research relies on semi-structured interviews, a technique suitable for gaining deep, nuanced understanding from participants [12]. The interviews were conducted with five senior leaders at Bio Farma Group, selected through purposive sampling to ensure that each informant had direct involvement in or deep understanding of the company's digital transformation process. The criteria for selection included individuals who initiated, contributed to, or currently manage the transformation process. The selected informants held strategic roles such as Vice President of Digital & IT, Vice President of SBU

Digital Services Ecosystem & Enterprise IT, Chief Product Officer, Chief Operating Officer, and Chief Technology Officer within the Digital Services Ecosystem division. In cases where the primary informants were unavailable, substitute candidates from the same division were considered. The interview questions were developed based on key variables such as organization and culture, digital transformational leadership, technology, operations, customer, strategy, and human resources. To ensure the validity of the qualitative data, triangulation of data sources was employed by interviewing multiple senior leaders from the same organizational context. The analysis followed the model of Miles and Huberman (1994) as cited in Sekaran & Bougie [13], consisting of three key steps: data reduction, data display, and conclusion drawing. This structured process allows for systematic identification of themes and patterns that inform the next stage of the study.

Quantitative method

In the quantitative phase, the research operationalized variables identified during the qualitative analysis, reflecting the nature of the exploratory sequential design. These variables were transformed into measurable indicators and used to construct a survey questionnaire. The study population for this phase consisted of all 1,782 employees of Bio Farma Group [14], from which a stratified random sample of 327 respondents was drawn. Stratified random sampling was selected to ensure that different employee groups, defined by relevant characteristics, were proportionally represented [13]. The questionnaire, as defined by Sekaran & Bougie [13], is a pre-formulated set of written questions with defined answer options, enabling efficient and standardized data collection. The quantitative data were then analyzed using factor analysis techniques specifically Confirmatory Factor Analysis (CFA), to explain the relationships among the original variables. Variables with high correlations form identifiable patterns, resulting in the emergence of new underlying factors. Through this rigorous process, the study aims to validate key challenge factors in Bio Farma's digital transformation journey and provide actionable insights grounded in both empirical data and organizational context.

III. RESULT AND DISCUSSION

Qualitative Research Method Results

Perspectives of Sources in Identifying Digital Transformation Challenges

The research was conducted by collecting information on the perspectives of the informants in understanding the challenges faced and felt during Bio Farma's digital transformation to support the sustainability of its business. By understanding the challenges of digital transformation as seen from 7 (seven) variables with 21 (twenty-one) indicators. Challenge statements that have similar meanings need to be eliminated to avoid redundant data. The explanation of which challenge statements are eliminated is as follows:

Table 1. Identifying Challenges That Have Similarities

Variable	Indicator	Challenge	Justification	Selected Challenges
Organization & Culture	Organizational structure	Determining the right form of organizational structure according to the business	Reflects a fundamental strategic step in ensuring the organizational structure supports overall business needs.	✓
		Organizational restructuring according to the required form of structure	More technical and operational, namely the next step after the organizational structure is determined.	X
		Formulation of the form of organizational structure	It has a similar meaning to "Determining the right organizational structure according to the business". However, this challenge statement is more specific to the IT Division only.	X
	Governance	Alignment of governance between holding and its subsidiary entities	Focuses on the main strategic need to align governance between the holding and subsidiaries.	✓
		Clarity of the role of holding and subsidiaries in business operations	Specific and is part of a larger challenge, namely governance alignment.	X

	Culture of innovation	Room for employee innovation	Focus on the initial steps and foundations needed to create a culture of sustainable innovation.	✓
		Space for employees to explore and think outside the routine of work	Part of "Room or space for employee innovation". Providing exploration space for employees is one step to form an innovation space, so it is more suitable as a component of the main challenge.	X
Strategy	Investment	Measurable digital investment calculation standards	Emphasizes the importance of setting measurable standards for digital investment. It is a fundamental step to ensure efficient and effective allocation of funds in investing in digital technology	✓
		No clear standards for calculating digital investment	Has a similar meaning to "Measurable digital investment calculation standards.	X
Technology	Adoption of technology	Exploration stage if there is new technology	Reflects the strategic need to open up opportunities for exploring new technologies as part of the adoption process.	✓
		Open to collaboration in adopting new technology	Collaborative approach as part of the technology adoption strategy. The main focus remains on the exploration stage as a more fundamental initial step.	X
	Technology integration	Integration of business processes from upstream to downstream	The main strategic issues that affect the efficiency and smoothness of the organization's operations as a whole.	✓
		Alignment of holding business processes to its subsidiaries	The scope of the challenge is more specific, namely only in the relationship between the holding and subsidiaries.	X
Operations	Business operations	Digital technology that is still fragmented	The scope of the challenge is more specific, only from the digital technology side but does not talk about the data level.	X
		Integrated technology and data	The main strategic problem in business operations, namely the fragmentation of digital technology and existing data. Asynchrony can hinder the efficiency of work processes, reduce productivity, and increase operational costs.	✓
		There are still separate systems within a single business process	It has a similar meaning to the challenge of “Digital technology is still fragmented”.	X
Customer	Customer satisfaction	Improving performance and availability of digital products/services	The main need to ensure that digital products and services perform well and are always available to customers.	✓
		Availability of stable digital services	This statement is already covered in the more comprehensive challenge of "Improving the performance and availability of digital products/services."	X
	Customer trust	Mechanisms for handling technical problems that need to be improved	Part of the customer care service function that can be improved simultaneously in the optimization process.	X
		Optimization of customer care services	Has a direct impact on customer relationships because the system is already running.	✓
Digital Transformational Leadership	Aligning digital transformation leadership style with corporate strategy	Top management priorities and concerns	The role of top management is crucial in aligning digital transformation strategies with the company's vision and mission	✓
		Strong vision and commitment from CEO towards digital initiatives	The scope of the challenge is narrower, only focusing on the CEO.	X

	Employee empowerment	Lack of support from key users to be role models	Only focusing on the role of key users as role models, in the sense of certain employees only.	X
		Change management programs that encourage employees to contribute	The challenge is broader and includes important elements such as managing resistance to change, not only involving key users but all employees in the company to actively contribute.	✓
	Digital skills and understanding	Adequate education and training on digital technologies relevant to the job	It is an excellent program to improve employee skills and understanding of digital technology that is relevant to each employee's duties.	✓
		Need for effective and relevant training methods for various levels of employees	More focused on how training should be carried out. The challenge is only part of the training program design, even if the training is carried out by the company.	X
Human Resource	Collaborative	Building a digital mindset in employees	Similar challenges but only focused on the difficulty of building a digital mindset.	X
		Mindset that understands that the digitalization process requires collaboration	Ensure that all employees understand the importance of collaboration in the digitalization process. Understanding is not only in building a digital mindset, but also in creating a teamwork culture that supports digital transformation as a whole.	✓
	Digital skill	Defining employee digital skill needs	More strategic challenges because they will be one of the foundations for all digital development initiatives in the company.	✓
		Talent development design focused on improving digital skills	Oriented towards implementing talent development. This step will be more effective if digital skill needs have been identified in advance so that talent development can be arranged based on clear needs.	X
	Digital talent	Understanding talent needs	Understanding digital talent needs required.	✓
		Understanding talent needs	The statement is the same as "Understanding talent needs".	X
		The need for clarity of career paths and development	The statement is broadly represented by "Understanding talent needs".	X

Source: Data Processed by Author (2024)

The results of the elimination of challenge statements in Table 1 show 18 (eighteen) challenges that have similarities with other challenges. In accordance with the research model used, namely exploratory sequential design, the digital transformation challenge data identified in table will be confirmed with Bio Farma employees. Confirmation is carried out through a questionnaire provided by the researcher with the addition of preliminary questions to determine the identity of the employee, then continued with an analysis of the challenge factors using a Likert-type scale of 1-4, the research of which is discussed in detail in the quantitative stage.

Quantitative Method Research Results

Validity Test

Items are declared valid if the calculated r value is > r table, where the calculated r is the value in the Corrected Item-Total Correlation and r table is a statistical provision with n 327 and alpha 0.05, the r table is 0.113. Validity testing uses 327 samples with the following results:

Table 2. Validity Test Results

Item	Construct Validity	Description
Item1	0,518	Valid
Item2	0,466	Valid

Item3	0,230	Valid
Item4	0,427	Valid
Item5	0,325	Valid
Item6	0,447	Valid
Item7	0,356	Valid
Item8	0,326	Valid
Item9	0,388	Valid
Item10	0,482	Valid
Item11	0,629	Valid
Item12	0,633	Valid
Item13	0,262	Valid
Item14	0,270	Valid
Item15	0,224	Valid
Item16	0,549	Valid
Item17	0,579	Valid
Item18	0,359	Valid
Item19	0,362	Valid
Item20	0,330	Valid
Item21	0,423	Valid
Item22	0,468	Valid
Item23	0,332	Valid
Item24	0,388	Valid
Item25	0,649	Valid
Item26	0,489	Valid
Item27	0,621	Valid
Item28	0,610	Valid
Item29	0,396	Valid
Item30	0,358	Valid
Item31	0,456	Valid
Item32	0,614	Valid
Item33	0,402	Valid
Item34	0,559	Valid
Item35	0,377	Valid
Item36	0,420	Valid
Item37	0,411	Valid
Item38	0,405	Valid
Item39	0,405	Valid
Item40	0,354	Valid
Item41	0,495	Valid
Item42	0,459	Valid
Item43	0,606	Valid
Item44	0,547	Valid
Item45	0,675	Valid
Item46	0,527	Valid
Item47	0,603	Valid
Item48	0,610	Valid
Item49	0,259	Valid
Item50	0,579	Valid
Item51	0,292	Valid
Item52	0,494	Valid
Item53	0,655	Valid
Item54	0,455	Valid

Source: Data Processed by Author (2025)

From the data above, it can be seen that all items have a calculated r > 0.113, so all items are declared valid.

Reliability Test

Table 3. Reliability Test Results

Variable	Cronbach's Alpha	Description
X1	0,727	Reliable
X2	0,679	Reliable
X3	0,674	Reliable
X4	0,747	Reliable
X5	0,705	Reliable
X6	0,798	Reliable
X7	0,723	Reliable

Source: Data Processed by Author (2025)

Based on the results of the reliability test, the Cronbach's Alpha value for each variable was > 0.60, which indicates that the statements in the questionnaire measuring instrument have shown their consistency, so that the instrument used to measure the variables is declared reliable.

Descriptive analysis

In this study, descriptive analysis was conducted based on the results of a questionnaire aimed at determining the perceptions of 327 respondents who are employees of PT Bio Farma (Persero) on variables such as organization & culture, strategy, technology, operations, customers, digital transformational leadership, and human resources. The questionnaire instrument was compiled using an interval scale from 1 to 4, as follows:

1 = Strongly Disagree
2 = Disagree
3 = Agree
4 = Strongly Agree

Table 4. Descriptive analysis Result

Variable	The largest scale value in the interval	Description
Organization & Culture (X1)	4	Strongly agree
Strategy (X2)	4	Strongly agree
Technology (X3)	4	Strongly agree
Operations (X4)	3	Agree
Customer (X5)	4	Strongly agree
Digital Transformation Leadership (X6)	3	Agree
Human Resource (X7)	4	Strongly agree

Source: Data Processed by Author (2025)

Factor Analysis

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.898
Bartlett's Test of Sphericity	Approx. Chi-Square	7025.586
	df	1431
	Sig.	.000

Fig 1. Results of KMO and Bartlett's Test

According to Fig 1, the KMO and Bartlett's test findings revealed a significance value of 0.000 (<0.05), showing a substantial connection among the variables. The KMO MSA score was 0.898 (>0.5), indicating that the data was appropriate for subsequent analysis. The subsequent Anti Image Correlation test demonstrated that all variables possessed MSA values beyond 0.5, signifying their suitability and significance for incorporation in the factor analysis. The subsequent table presents the MSA value for each statement item.

Table 5. MSA Results for Each Statement Item

Indicator	Anti-Image Correlation	MSA Value
Item1	0,911	Fulfilled
Item2	0,882	Fulfilled
Item3	0,745	Fulfilled
Item4	0,841	Fulfilled
Item5	0,832	Fulfilled
Item6	0,921	Fulfilled
Item7	0,841	Fulfilled
Item8	0,791	Fulfilled
Item9	0,879	Fulfilled
Item10	0,889	Fulfilled
Item11	0,949	Fulfilled
Item12	0,917	Fulfilled
Item13	0,774	Fulfilled
Item14	0,846	Fulfilled
Item15	0,826	Fulfilled
Item16	0,911	Fulfilled
Item17	0,912	Fulfilled
Item18	0,790	Fulfilled
Item19	0,882	Fulfilled
Item20	0,808	Fulfilled
Item21	0,913	Fulfilled
Item22	0,893	Fulfilled
Item23	0,864	Fulfilled
Item24	0,856	Fulfilled
Item25	0,957	Fulfilled
Item26	0,897	Fulfilled
Item27	0,944	Fulfilled
Item28	0,927	Fulfilled
Item29	0,847	Fulfilled
Item30	0,880	Fulfilled
Item31	0,888	Fulfilled
Item32	0,936	Fulfilled
Item33	0,864	Fulfilled
Item34	0,929	Fulfilled
Item35	0,817	Fulfilled
Item36	0,853	Fulfilled
Item37	0,874	Fulfilled
Item38	0,916	Fulfilled
Item39	0,865	Fulfilled
Item40	0,782	Fulfilled
Item41	0,901	Fulfilled
Item42	0,911	Fulfilled
Item43	0,947	Fulfilled
Item44	0,913	Fulfilled

Item45	0,937	Fulfilled
Item46	0,918	Fulfilled
Item47	0,934	Fulfilled
Item48	0,943	Fulfilled
Item49	0,764	Fulfilled
Item50	0,919	Fulfilled
Item51	0,803	Fulfilled
Item52	0,895	Fulfilled
Item53	0,953	Fulfilled
Item54	0,898	Fulfilled

Source: Data Processed by Author (2025)

According to the MSA data results, all items in the study's questionnaire possess a value > 0.5. This signifies that the Anti Image Correlation value in all statements has satisfied the eligibility criteria and may proceed to the subsequent step of analysis. The test need not be repeated, as all items have satisfied the set criteria and are suitable as responses for the ongoing research.

Tabel 6. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	12.024	22.266	22.266	12.024	22.266	22.266
2	5.112	9.467	31.734	5.112	9.467	31.734
3	2.026	3.752	35.486	2.026	3.752	35.486
4	1.801	3.336	38.822	1.801	3.336	38.822
5	1.687	3.125	41.946	1.687	3.125	41.946
6	1.476	2.733	44.679	1.476	2.733	44.679
7	1.436	2.659	47.338	1.436	2.659	47.338
8	1.354	2.507	49.845	1.354	2.507	49.845
9	1.239	2.294	52.139	1.239	2.294	52.139
10	1.186	2.195	54.335	1.186	2.195	54.335
11	1.080	1.999	56.334	1.080	1.999	56.334
12	1.032	1.910	58.244	1.032	1.910	58.244
13	1.023	1.895	60.139	1.023	1.895	60.139
14	0.980	1.815	61.955			
15	0.957	1.773	63.727			
16	0.944	1.748	65.475			
17	0.881	1.631	67.107			
18	0.829	1.536	68.643			
19	0.811	1.501	70.144			
20	0.777	1.439	71.583			
21	0.774	1.433	73.016			
22	0.764	1.415	74.431			
23	0.725	1.342	75.774			
24	0.676	1.252	77.025			
25	0.658	1.219	78.245			
26	0.643	1.190	79.435			
27	0.612	1.133	80.568			
28	0.589	1.092	81.660			

29	0.586	1.086	82.746
30	0.563	1.042	83.788
31	0.540	1.000	84.788
32	0.528	0.977	85.765
33	0.505	0.936	86.700
34	0.495	0.917	87.617
35	0.479	0.887	88.505
36	0.458	0.847	89.352
37	0.437	0.809	90.161
38	0.434	0.803	90.964
39	0.420	0.778	91.742
40	0.394	0.729	92.472
41	0.387	0.716	93.188
42	0.371	0.688	93.875
43	0.351	0.650	94.525
44	0.345	0.639	95.164
45	0.320	0.592	95.756
46	0.311	0.576	96.332
47	0.300	0.555	96.887
48	0.288	0.534	97.421
49	0.278	0.514	97.935
50	0.264	0.488	98.424
51	0.242	0.448	98.871
52	0.223	0.414	99.285
53	0.197	0.365	99.650
54	0.189	0.350	100.000

Source: Data Processed by Author (2025)

The study revealed 13 components with eigenvalues over 1, as indicated in the table. The 13 factors cumulatively account for 60.139% of the total variance, demonstrating that the component structure adequately captures over 60% of the variability among items. This indicates that the approach is suitable for identifying the primary factors affecting digital transformation issues at Bio Farma. The number of factors was checked using the scree plot, which depicts the relationship between the extracted factors and their respective eigenvalues, as illustrated in Fig 2.

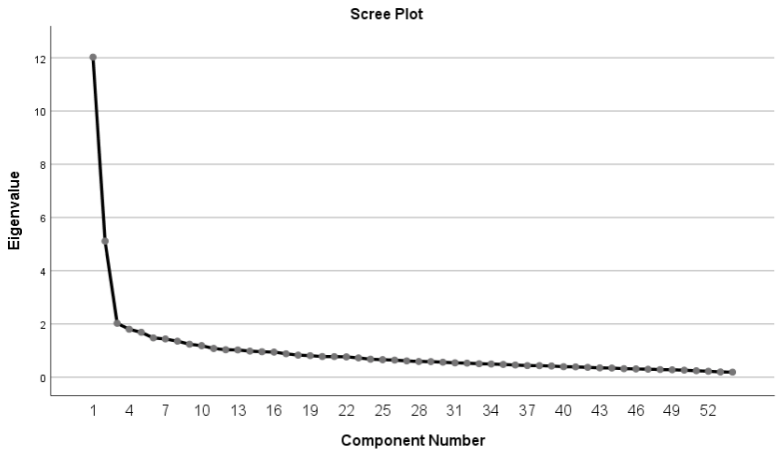

Fig 2. Scree Plot

Fig 3 displays the results of factor grouping based on eigenvalue. Factors with higher eigenvalues occupy higher positions in the graph, while 13 factors are recorded as having eigenvalues above 1.0. The items located along the descending line are items with eigenvalues below 1.0.

Table 7. Reference Factor Loading

Factor Loading	Number of Samples
0.30	350
0.35	250
0.40	200
0.45	150
0.50	120
0.55	100
0.60	85
0.65	70
0.70	60
0.75	50

In a study conducted involving 327 employees as respondents, the minimum factor loading value was determined to be 0.311. The study was then continued by rotating using the SPSS version 25 program. At this stage, the suppress small coefficients setting was set to 0.311 to filter out questionnaire items that had low factor loading values. The goal is to make it easier to read the rotation results table and to facilitate the process of grouping items based on their respective factor loading values.

Table 8. Rotated Component Matrix Results

Rotated Component Matrix													
	Component												
	1	2	3	4	5	6	7	8	9	10	11	12	13
Item1		0.335				0.363							0.314
Item2		0.442		0.395		0.371							
Item3													0.763
Item4		0.689											
Item5		0.666											
Item6		0.426						0.371					
Item7				0.639			0.379						
Item8				0.807									
Item9				0.664									
Item10		0.574											
Item11	0.716												
Item12	0.543	0.394											
Item13									0.789				
Item14												0.718	
Item15					0.462				0.362				
Item16	0.347												
Item17	0.755												
Item18								0.695					

Item19		0.32	0.494										
Item20			0.769										
Item21			0.618										
Item22	0.428	0.308						0.405					
Item23		0.477	0.296					0.369					
Item24			0.698										
Item25	0.685												
Item26	0.525												
Item27	0.655												
Item28	0.724												
Item29					0.699								
Item30					0.569								
Item31						0.334			0.33				
Item32	0.756												
Item33												0.443	
Item34	0.719												
Item35									0.334	0.599			
Item36			0.362							0.382			
Item37										0.608			
Item38	0.335												
Item39							0.691						
Item40							0.712						
Item41						0.351	0.414		0.324				
Item42	0.373					0.419					-0.348		
Item43	0.709												
Item44	0.393					0.578							
Item45	0.745												
Item46	0.634												
Item47	0.740												
Item48	0.802												
Item49											0.686		
Item50	0.642												
Item51						0.675							
Item52					0.358	0.296	0.294				0.363		
Item53	0.642												
Item54	0.426										0.355		

Source: Data Processed by Author (2025)

The suitability of an item in factor analysis is determined by its factor loading value, which indicates how strongly the item contributes to the formed factor. In this study, a minimum loading threshold of 0.55 was applied, based on guideline in [15], which states that a good item should have a loading of at least 0.55. Items with loadings below this threshold were considered for elimination to ensure the factor structure remains clear and construct-valid. The researcher conducted one iteration by removing 18 items with loadings below 0.5, including items 1, 2, 6, 12, 15, 16, 19, 22, 23, 26, 31, 33, 36, 38, 41, 42, 52, and 54. A second iteration was then carried out to reconfirm the 13 previously formed factors, with the excluded items removed to optimize the model further.

Factor Grouping and Naming Process

Table 9. Factor Loading Grouping

Item	Component												
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**
Item11	0,716												
Item17	0,755												
Item25	0,685												
Item27	0,655												
Item28	0,724												
Item32	0,756												
Item34	0,719												
Item43	0,709												
Item45	0,745												
Item46	0,634												
Item47	0,74												
Item48	0,802												
Item50	0,642												
Item53	0,642												
Item4		0,689											
Item5		0,666											
Item10		0,574											
Item20			0,769										
Item21			0,618										
Item24			0,698										
Item7				0,639									
Item8				0,807									
Item9				0,664									
Item29					0,699								
Item30					0,569								
Item44						0,578							
Item51						0,675							
Item39							0,691						
Item40							0,712						
Item18								0,695					
Item13									0,789				
Item35										0,599			
Item37										0,608			
Item49											0,686		
Item14												0,718	
Item3													0,763

Source: Data Processed by Author (2025)

Following the outcomes of the statement item grouping, the researcher proceeded to designate a name for each factor. The nomenclature is derived from the substance of each statement item and the interrelation among items within a singular factor group. The subsequent results pertain to the classification and designation of factors ranging from factor 1 to factor 13:

- Digital Capability: Comprising 14 items, this is the most dominant factor, reflecting the company's internal readiness for digital transformation. It emphasizes the importance of both technological infrastructure and human resource competence in successfully adopting and utilizing digital tools.
- Strategy: Consisting of 3 items, this factor highlights the need for alignment between digital initiatives, corporate governance, and business models. A lack of strategic direction can hinder transformation efforts, making strategic clarity and direction essential.
- Technology: With 3 items, this factor focuses on the quality and suitability of technologies used. It stresses that technology must not only function properly but also provide competitive advantages and support the company's overall objectives.
- Organization & Culture: Comprising 3 items, this factor illustrates the importance of organizational culture in supporting innovation and openness to change. A strong, adaptive culture encourages employee involvement and smooth digital implementation.
- Digital Efficiency: This factor includes 2 items and centers on how well digital technologies are used to improve business process efficiency. Effective digital systems contribute directly to operational sustainability and competitiveness.
- Digital Readiness: With 2 items, this factor measures how prepared employees are for digital change. Readiness includes understanding, involvement in implementation, and adaptability, making it a key factor in transformation success.
- Customer: Also made up of 2 items, this factor focuses on digital user experience and service quality. Meeting user needs and ensuring system responsiveness and security are vital for stakeholder satisfaction.
- Digital Research: This single-item factor highlights the role of continuous research and innovation in identifying relevant technologies aligned with business development and transformation needs.
- Investment Perception: Another single-item factor, it captures how the company views digital initiatives—either as strategic investments or costs. This perception influences the level of commitment and resource support provided.
- Operations: With 2 items, this factor refers to the performance of digital services, particularly in complaint handling and ease of access. Operational reliability and responsiveness shape user trust and service effectiveness.
- Collaboration: A one-item factor emphasizing that digital transformation must involve collaboration across units. Cross-functional teamwork is essential for successful, integrated change.
- Investment Review: This factor, also with one item, highlights the need for evaluating digital investments to ensure they support strategic goals and deliver measurable results.
- Digital Priority: A single-item factor that reflects the organization's commitment to making digitalization a core component of its business growth strategy, rather than treating it as an optional enhancement.

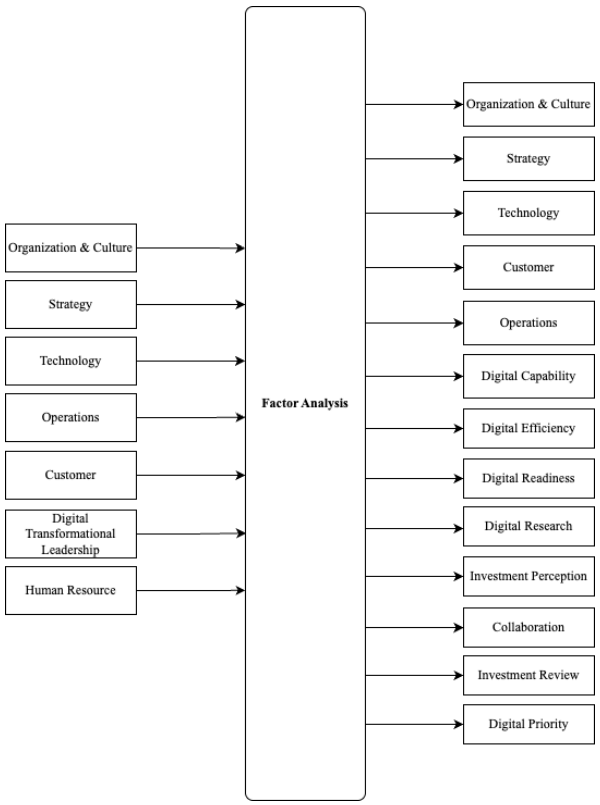

Fig 3. Results of Grouping Formed Factors

Discussion

Digital Capability

The survey of 327 PT Bio Farma (Persero) employees revealed that digital capability is the most dominant factor in the digital transformation challenges, indicated by the largest number of items (14) and the highest level of agreement (50.2% on item HR6). Most employees agreed on the importance of enhancing digital competencies in both technology and human resources to support digital transformation. Interviews with Mr. Tito Daniswara (COO) confirmed that internal digital capability needs equal distribution across units. This aligns with Bagaskara & Noviaristanti [16], who emphasized stakeholder capability as a key barrier to transformation. Similarly, Slavković et al. [17] found digital capability to be positively related to transformation success.

Strategy

Findings on the strategy factor indicate that most employees (65.1% agreement on item OC4) perceive the alignment between digital strategy, business direction, and governance as crucial. Interviews with Mr. Ervan Belyadi Suryadi (VP Digital & IT) and Mr. OT Ponangsera (CPO) stressed challenges in harmonizing governance and integrating digital strategies with existing business models. These views are supported by Jamaludin & Hasan Basari [18], who argued that well-formulated digital strategies are essential for extracting value from digital initiatives and ensuring transformation coherence.

Technology

For the technology factor, 70.3% of respondents strongly agreed (item T8) that Bio Farma's current systems are mature and support operations and transformation effectively. Interviews revealed strategic concerns regarding the unique value and suitability of technologies used, with insights from Mr. Ervan Belyadi, Mr. OT Ponangsera, and Mr. Rachmat Hariyanto pointing to integration challenges. These findings align with Beath & Mocker [19] and Vial [20], who noted that strategic selection and readiness of technology are critical for successful digital transformation.

Organization & Culture

Survey responses showed that 78.3% of employees strongly agreed (OC7) on the importance of an innovation-driven and adaptive organizational culture in supporting transformation. Interviews with Mr. Ervan Belyadi and Mr. Tito Daniswara emphasized the need for an innovation-friendly environment and

overcoming cultural complacency. This corresponds with Gagan Deep [21] who identified organizational culture as a determinant of transformation success, especially in enabling openness and ideation.

Digital Efficiency

Most employees (62.7%, item O5) strongly agreed that digital tools should enhance efficiency and streamline operations. Interviewees like Mr. Rachmat Hariyanto and Mr. OT Ponangsera underlined prioritizing impactful pain points and continuous monitoring to avoid inefficiencies. Liang & Yubin [22] similarly emphasized digital efficiency as a strategic element for operational success, with Tesla as a case study for simplifying processes and shortening production cycles.

Digital Readiness

Survey results show 69.4% of employees strongly agreed (HR4) on the importance of digital readiness for digital transformation. Interviews with Mr. Tito Daniswara and Mr. OT Ponangsera highlighted direct involvement and the need to close knowledge gaps, particularly related to digital. These findings are in line with Odeh & Shamieh [23], who advocated for role-oriented involvement to foster readiness in healthcare digital transformation, emphasizing hands-on experience for adaptive success.

Customer

A total of 69.1% of respondents strongly agreed that customer orientation, especially service quality and data protection, is critical in digital transformation. Mr. Tito Daniswara and Mr. Rachmat Hariyanto emphasized the importance of user experience optimization and digital security. Warren [24] supported this view, arguing that customer-centric approaches and strong data protection foster trust and loyalty in digital platforms, particularly in Islamic banking contexts.

Digital Research

Although supported by 51.7% of respondents, digital research requires stronger internal adoption. Interviewee Mr. Ervan Belyadi highlighted the need for sustained R&D investment to develop internally relevant digital solutions. This aligns with Guo et al. [25], who concluded that in-house R&D ensures innovation continuity and strengthens core digital competencies over reliance on outsourcing.

Investment Perception

With 63.6% strong agreement, investment perception plays a vital role in viewing digital initiatives as strategic assets rather than cost burdens. Mr. Ervan Belyadi emphasized building a mindset of digital as long-term investment. This supports Bulavko et al. [26], who found that recognizing digitalization as a value-adding investment increases industrial growth potential and innovation capacity.

Operations

A strong majority (71.6% on item C6) agreed that operational performance—speed, availability, and responsiveness—is essential for digital transformation. Mr. Rachmat Hariyanto and Mr. Ervan Belyadi underscored after-sales service improvement and complaint management. Sima et al. [27] developed the Synchronous Model to accelerate customer response times in manufacturing, resonating with Bio Farma's focus on improving digital operational agility.

Collaboration

Collaboration was valued by 50.2% of respondents (HR2), highlighting its necessity for comprehensive transformation. Mr. Rachmat Hariyanto stressed the importance of building a collaborative mindset and cross-functional communication to avoid fragmented digital initiatives. Ahmad et al. [28] echoed this by asserting that dismantling organizational silos is essential for unified digital transformation, supporting Bio Farma's insight that structured collaboration enables organizational alignment.

Investment Review

Employees (65.1% on item S5) agreed that monitoring digital investment is crucial to maintain alignment with business goals. Mr. Rachmat Hariyanto asserted evaluation mechanisms to avoid misaligned or ineffective investments. Ononiwu et al. [29] similarly stated that aligning digital investment with corporate strategy enhances transformation effectiveness, reinforcing the need for strategic integration of digital spending.

Digital Priority

Although relatively lower (42.2% on OC3), responses indicate growing recognition of digitalization as a core strategic priority. Mr. Rachmat Hariyanto advocated shifting digital from a support role to a strategic pillar. Dubey et al. [30] support this view, noting that treating digital transformation as a top priority enhances competitive advantage and supply chain sustainability—validating the gradual shift in mindset at Bio Farma.

IV. CONCLUSION

Based on in-depth interviews guided by 21 indicators across 7 key variables, this study identified 72 specific digital transformation challenges faced by PT Bio Farma (Persero). After eliminating 18 overlapping or redundant items, 54 distinct challenges were categorized, ranging from organizational structure and cultural readiness to innovation, business process alignment, technological integration, and employee digital capabilities. These findings address the first research question by mapping out the diverse internal and external factors that hinder digital transformation within the company, including structural governance conflicts, investment mindsets, insufficient R&D, and employee skill gaps.To answer the second research question, a quantitative analysis using SPSS revealed the emergence of 13 consolidated factors contributing to digital transformation challenges. The most dominant was digital capability, followed by strategy, technology, and organizational culture. Other influential factors included digital efficiency, digital readiness, customer, digital research, investment perception, operations, collaboration, investment review, and digital priority. These findings confirm that successful transformation requires holistic readiness across technical, cultural, strategic, and human dimensions, with digital capability and alignment between business strategy and digital initiatives being critical drivers of change.

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