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INSTRUMENT CREATION AND MEASUREMENT OF DIGITAL MATURITY OF BATIK INDUSTRY

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Abstract

Research on digital maturity in the batik industry remains scarce. This study aims to address this gap by identifying the key dimensions of digital maturity, developing a reliable measurement instrument, and assessing the current level of digital maturity within the batik industry. Using a quantitative approach, the study examines five dimensions of digital maturity: organizational management and leadership, people and culture, products and services, technology, and operational processes. Digital maturity is assessed across five levels: not ready, initial readiness, intermediate readiness, mature readiness, and fully implemented. The newly developed instrument was tested for validity and reliability, yielding positive results. Findings indicate that the batik industry is at an intermediate level of digital readiness, highlighting the need for continued digital transformation. The proposed assessment model and instrument offer practical tools for measuring digital maturity, which can be adapted for future research and applied across different sectors, including high schools and other small industries.

Keywords: Batik industry, Digital maturity, Digital transformation, Small and medium industries (SMEs).

1. Introduction

Globalization has significantly impacted organizations and businesses worldwide, driven by the rapid development of digital technologies and their widespread applications across various sectors. Digital transformation has become crucial for both public and private organizations, with emerging technologies reshaping the way they operate and compete [1]. The COVID-19 pandemic has further accelerated the adoption of internet-based services, electronic platforms, and digital tools, highlighting the need for companies to integrate digital solutions and provide virtual services and products [2]. As digital technologies continue to evolve, organizations must adapt to remain competitive in an increasingly digitized global market [1, 3, 4].

Small and medium enterprises (SMEs) play a critical role in the economic growth of many countries, often serving as the backbone of national economies [5, 6]. However, digital transformation strategies for SMEs differ significantly from those of larger companies due to their unique characteristics [7]. Large enterprises typically have well-defined strategies for integrating digital technologies into their products, services, and operations, whereas SMEs often lack formalized approaches and rely on new software to address specific challenges [7]. As a result, SMEs require tailored strategies to successfully adopt digital transformation, with a focus on changing mindsets and building the necessary competencies [8].

The concept of digital maturity is essential for SMEs, as it helps assess their readiness for digital transformation, identify areas for improvement, and enhance their competitive advantage [9]. Digital maturity models provide a framework for understanding the current state of an organization's digital capabilities and offer a roadmap for progressing toward higher levels of digital integration [10]. However, research on digital maturity in SMEs, particularly in traditional industries like batik, remains limited. Previous studies have explored digital maturity in various sectors, but the application of digital maturity models in the batik industry is a relatively new area of investigation [11-13].

This study seeks to fill this gap by developing a digital maturity model specifically for the batik industry. The research is novel in its focus on assessing digital maturity within a traditional sector that has not been widely explored from a digital transformation perspective. The study addresses the following research questions: 1) What are the dimensions for assessing the digital maturity of the batik industry? 2) What is the instrument for assessing the digital maturity of the batik industry? 3) Is the instrument valid and reliable? and 4) How is the digital maturity of the batik industry?

2. Research Methods

This study employs a quantitative research approach to develop and assess a digital maturity model specifically for the batik industry. Initially, a review of existing digital maturity models, such as the IMPULS and INDI 4.0 models, was conducted to identify relevant dimensions for small and medium enterprises (SMEs) [12, 13]. These models, tailored for manufacturing and other SME contexts, were synthesized along with previous research [12, 13] to select five key dimensions for the batik industry: Organizational Management and Leadership, People, Training, Culture, Products and Services, Technology, and Organizational Operations. A

digital maturity instrument was developed, comprising 35 variables spread across these dimensions, and measured using a Likert scale. The instrument was piloted with 30 respondents from batik SMEs in Pajang and Sondakan Villages. The validity of the instrument was tested using Pearson Bivariate Correlation, which resulted in 21 valid variables, while 14 invalid variables were discarded. The reliability was assessed using Cronbach's Alpha, ensuring internal consistency.

After validation, the final instrument was distributed to 49 respondents from 31 batik SMEs in Laweyan, Surakarta. The data collected was analyzed using descriptive statistics to calculate the average scores for each dimension, and a radar chart was used to visualize the digital maturity levels. The scores were weighted according to the significance of each dimension, with People and Culture given the highest weight (30%), followed by Organizational Management, Products and Services, Technology, and Operations (each 17.5%). The overall digital maturity of the Laweyan batik industry was found to be at an intermediate readiness level, with an average score of 3.42, indicating the early stages of digital transformation. While the study successfully developed a reliable measurement instrument, limitations include the small sample size and geographic concentration. Future research could expand the scope to include more regions or explore other traditional industries to further validate the model.

3. Results

3.1. Dimensions of digital maturity of batik industry

The digital maturity model of the batik industry takes the synthesis of digital maturity of the digital maturity model of the industry that is suitable for small and medium industries (in this case taking the IMPULS model and the INDI 4.0 model), and digital maturity research by previous researchers, namely Kuusisto and Yesbebay. The results of the synthesis of the digital maturity of the batik industry are shown in Table 1.

Table 1. Synthesis of digital maturity dimensions of the batik industry.

Dimensions	Kuusisto et al. [12]	Yesbebay et al. [13]	IMPULSE	INDI 4.0
Management and organization	Strategy/organizational development. Business models and business strategies.	Leadership, Strategy	Strategy and Organization.	Management and organization
People, Training and Culture	People and Culture	People	Employee	Society and culture
Products and Services	Customer interface	Product	Smart Products Data Driven Services	Products and Services
Technology, Infrastructure	Information Technology	Technology	Smart Factory	Technology
Digital Operations	How it works	Operation	Smart Operation	Factory Operations

The results of the synthesis of the digital maturity model of the batik industry, it was found that digital maturity involves assessing the following dimensions: (1) Management and Organization of the digital transformation process with subdimensions/indicators: digital strategy, investment, innovation, and leadership; (2) People, Training, Culture according to digitalization needs with subdimensions/indicators: personnel training, cross-sectional collaboration,

culture, openness and readiness for change; (3) Digital-based products and services offered: custom products/services, digitalization, digital services based on customer data; (4) Technology with subdimensions/indicators: IT-based solutions, digitalization, connectivity, automation machines, cyber security; and (5) Digital-based Organizational Operations: SoP, automation, digital supply chain management, information sharing, digital maintenance systems.

This study groups the level of digital maturity following INDI4.0. Digital maturity is divided into 5 levels, namely from level 1 to level 5, namely: Level 1 - Not Ready; Level 2 - Initial Readiness (Have a Plan); Level 3 – Medium Readiness (Starting Digital Transformation); Level 4 – Mature Readiness (Having Digital Transformation); and Level 5 – Already Implementing. Calculation of digital maturity by calculating the average of each dimension, followed by giving weights. The weight of organizational management is 17.5%, people and culture 30%, products and services 17.5%, technology 17.5%, and company operations 17.5%.

3.2. Digital maturity instrument of batik industry

The development of digital maturity instrument of batik industry consists of five dimensions and 35 variables as shown in Table 2. The batik industry research instrument, then made a list of easy-to-understand questions. Each question is assessed using the Likert Scale (1-5).

Table 2. Digital maturity measurement instrument of batik industry.

Dimension	Variable
Management and Organization	X2.1 = Management support X2.2 = Digitalization strategy X2.3 = Investment X2.4 = Special section on digital transformation X2.5. = Innovation
People, Training, Culture	X3.1 = Training X3.2 = Time discipline X3.3 = Willingness to learn X3.4 = Critical and open X3.5 = Open to change X3.6 = Continuous improvement X3.7 = Collaborate X3.8 = High work ethic
Products and Services	X4.1 = Product/service customization X4.2 = Customer data analysis X4.3 = Production performance evaluation X4.4 = Customer service improvement X4.5 = Customer and partner data for new business design X4.6 = Digital technology integrated products
Technology, Infrastructure	X5.1= Cyber security X5.2 = M2M machine-to-machine communication X5.3 = Connectivity between systems X5.4 = ICT tools and applications X5.5 = Digitalization of all areas
Organizational Operations	X6.1 = SOP X6.2 = Digital document storage X6.3 = Data storage on employee computers X6.4 = Data storage in each section/department X6.5 = Data storage in the computer center X6.6 = Automation of production processes X6.7 = Corrective maintenance X6.8 = Preventive maintenance X6.9 = Barcode systems and others on products/components X6.10 = Real-time inventory control X6.11 = Integration of company logistics with suppliers

3.3. Instrument validity and reliability test

The instrument trial was conducted by distributing thirty questionnaires to respondents, namely batik craftsmen in Pajang Village and Sondakan Village, and several other villages. The results of the validity and reliability test showed that there were seven invalid questions. Based on Fig. 1, there are 21 measurement variables that are stated as valid, while 14 measurement variables are invalid.

Correlations

		X2.1	X2.2	X2.4	X2.5	X3.1	X3.3	X3.4	X3.5	X3.6	X4.2	X4.3	X4.4	X4.5	X4.6	X5.1	X5.4	X5.5	X6.1	X6.6	X6.7	X6.8	TOTAL
X2.1	Pearson Correlation	1	.789**	.427*	.711**	.548**	.572**	.388*	.493**	.390*	-.025	.000	.130	.024	.661**	.389*	.648**	.410*	.346	-.435*	.182	.218	.692**
	Sig. (2-tailed)		.000	.019	.000	.002	.001	.034	.006	.033	.897	1.000	.494	.901	.000	.034	.000	.025	.061	.016	.336	.247	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X2.2	Pearson Correlation	.789**	1	.319	.707**	.546**	.493**	.465**	.465**	.517**	-.058	.000	.122	-.023	.499**	.375*	.535**	.458*	.427*	-.395*	.263	.340	.674**
	Sig. (2-tailed)	.000		.086	.000	.002	.006	.010	.010	.003	.762	1.000	.522	.902	.005	.041	.002	.011	.019	.031	.161	.066	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X2.4	Pearson Correlation	.427*	.319	1	.428*	.603**	-.004	.146	.287	.117	.437*	.472**	.430*	.462*	.398*	.613**	.786**	.325	.462*	-.596**	.402*	.484**	.708**
	Sig. (2-tailed)	.019	.086		.018	.000	.983	.442	.124	.538	.016	.009	.018	.010	.029	.000	.000	.080	.010	.000	.028	.007	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X2.5	Pearson Correlation	.711**	.707**	.428*	1	.578**	.483**	.404*	.283	.448*	.113	.162	.298	.136	.562**	.372*	.594**	.323	.397*	-.382*	.149	.219	.700**
	Sig. (2-tailed)	.000	.000	.018		.001	.007	.027	.130	.013	.552	.392	.110	.474	.001	.043	.001	.082	.030	.037	.432	.245	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X3.1	Pearson Correlation	.548**	.546**	.603**	.578**	1	.244	.178	.410*	.257	.238	.310	.353	.301	.397*	.753**	.611**	.225	.190	-.449*	.245	.263	.705**
	Sig. (2-tailed)	.002	.002	.000	.001		.194	.347	.025	.171	.206	.095	.055	.106	.030	.000	.000	.233	.315	.013	.192	.160	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X3.3	Pearson Correlation	.572**	.493**	-.004	.483**	.244	1	.419*	.419*	.455*	.026	.106	.297	.050	.257	.185	.185	.019	.000	.019	-.180	-.094	.421*
	Sig. (2-tailed)	.001	.006	.983	.007	.194		.021	.021	.012	.892	.576	.111	.793	.171	.327	.327	.920	1.000	.920	.342	.620	.021
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X3.4	Pearson Correlation	.388*	.465**	.146	.404*	.178	.419*	1	.814**	.843**	.361	.374*	.476**	.317	.150	.011	.126	.113	.000	-.158	.211	.255	.555**
	Sig. (2-tailed)	.034	.010	.442	.027	.347	.021		.000	.000	.050	.042	.008	.087	.428	.952	.509	.553	1.000	.405	.264	.174	.001
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X3.5	Pearson Correlation	.493**	.465**	.287	.283	.410*	.419*	.814**	1	.671**	.361	.374*	.476**	.317	.263	.354	.240	.113	.000	-.293	.211	.255	.625**
	Sig. (2-tailed)	.006	.010	.124	.130	.025	.021	.000		.000	.050	.042	.008	.087	.160	.055	.202	.553	1.000	.116	.264	.174	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X3.6	Pearson Correlation	.390*	.517**	.117	.448*	.257	.455*	.843**	.671**	1	.325	.345	.457*	.393*	.208	.179	.074	.062	.000	-.187	.178	.226	.570**
	Sig. (2-tailed)	.033	.003	.538	.013	.171	.012	.000	.000		.080	.062	.011	.032	.270	.344	.699	.743	1.000	.321	.348	.229	.001
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X4.2	Pearson Correlation	-.025	-.058	.437*	.113	.238	.026	.361	.361	.325	1	.959**	.872**	.958**	.105	.343	.343	-.110	.000	-.395*	.474*	.501**	.592**
	Sig. (2-tailed)	.897	.762	.016	.552	.206	.892	.050	.050	.080		.000	.000	.000	.580	.063	.063	.561	1.000	.031	.008	.005	.001
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X4.3	Pearson Correlation	.000	.000	.472**	.162	.310	.106	.374*	.374*	.345	.959**	1	.919**	.922**	.000	.382*	.382*	-.181	.000	-.362*	.460*	.482**	.616**
	Sig. (2-tailed)	1.000	1.000	.009	.392	.095	.576	.042	.042	.062	.000		.000	.000	1.000	.037	.037	.338	1.000	.049	.011	.007	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X4.4	Pearson Correlation	.130	.122	.430*	.298	.353	.297	.476**	.476**	.457*	.872**	.919**	1	.844**	.111	.370*	.370*	-.166	.000	-.366*	.318	.326	.659**
	Sig. (2-tailed)	.494	.522	.018	.110	.055	.111	.008	.008	.011	.000	.000		.000	.560	.044	.044	.379	1.000	.047	.087	.079	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X4.5	Pearson Correlation	.024	-.023	.462*	.136	.301	.050	.317	.317	.393*	.958**	.922**	.844**	1	.126	.430*	.353	-.121	.000	-.395*	.450*	.478**	.614**
	Sig. (2-tailed)	.901	.902	.010	.474	.106	.793	.087	.087	.032	.000	.000	.000		.506	.018	.056	.523	1.000	.031	.013	.008	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X4.6	Pearson Correlation	.661**	.499**	.398*	.562**	.397*	.257	.150	.263	.208	.105	.000	.111	.126	1	.276	.552**	.464**	.369*	-.437*	.055	.203	.559**
	Sig. (2-tailed)	.000	.005	.029	.001	.030	.171	.428	.160	.270	.580	1.000	.560	.506		.140	.002	.010	.045	.016	.771	.281	.001
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X5.1	Pearson Correlation	.389*	.375*	.613**	.372*	.753**	.185	.011	.354	.179	.343	.382*	.370*	.430*	.276	1	.510**	.041	.187	-.456*	.219	.291	.621**
	Sig. (2-tailed)	.034	.041	.000	.043	.000	.327	.952	.055	.344	.063	.037	.044	.018	.140		.004	.828	.322	.011	.245	.118	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X5.4	Pearson Correlation	.648**	.535**	.786**	.594**	.611**	.185	.126	.240	.074	.343	.382*	.370*	.353	.552**	.510**	1	.373*	.561**	-.705**	.387*	.380*	.742**
	Sig. (2-tailed)	.000	.002	.000	.001	.000	.327	.509	.202	.699	.063	.037	.044	.056	.002	.004		.042	.001	.000	.034	.038	.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X5.5	Pearson Correlation	.410*	.458*	.325	.323	.225	.019	.113	.113	.062	-.110	-.181	-.166	-.121	.464**	.041	.373*	1	.444*	-.082	.366*	.401*	.384*
	Sig. (2-tailed)	.025	.011	.080	.082	.233	.920	.553	.553	.743	.561	.338	.379	.523	.010	.828	.042		.014	.667	.047	.028	.036
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X6.1	Pearson Correlation	.346	.427*	.462*	.397*	.190	.000	.000	.000	.000	.000	.000	.000	.000	.369*	.187	.561**	.444*	1	-.222	.450*	.472**	.420*
	Sig. (2-tailed)	.061	.019	.010	.030	.315	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000	.045	.322	.001	.014		.239	.013	.008	.021
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X6.6	Pearson Correlation	-.435*	-.395*	-.596**	-.382*	-.449*	.019	-.158	-.293	-.187	-.395*	-.362*	-.366*	-.395*	-.437*	-.456*	-.705**	-.082	-.222	1	-.133	-.122	-.505**
	Sig. (2-tailed)	.016	.031	.000	.037	.013	.920	.405	.116	.321	.031	.049	.047	.031	.016	.011	.000	.667	.239		.483	.520	.004
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X6.7	Pearson Correlation	.182	.263	.402*	.149	.245	-.180	.211	.211	.178	.474**	.460*	.318	.450*	.055	.219	.387*	.366*	.450*	-.133	1	.843**	.553**
	Sig. (2-tailed)	.336	.161	.028	.432	.192	.342	.264	.264	.348	.008	.011	.087	.013	.771	.245	.034	.047	.013	.483		.000	.002
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
X6.8	Pearson Correlation	.218	.340	.484**	.219	.263	-.094	.255	.255	.226	.501**	.482**	.326	.478**	.203	.291	.380*	.401*	.472**	-.122	.843**	1	.628**
	Sig. (2-tailed)	.247	.066	.007	.245	.160	.620	.174	.174	.229	.005	.007	.079	.008	.281	.118	.038	.028	.008	.520	.000		.000
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30
TOTAL	Pearson Correlation	.692**	.674**	.708**	.700**	.705**	.421*	.555**	.625**	.570**	.592**	.616**	.659**	.614**	.559**	.621**	.742**	.384*	.420*	-.505**	.553**	.628**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.021	.001	.000	.001	.001	.000	.000	.000	.001	.000	.000	.036	.021	.004	.002	.000	
	N	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30	30

Reliability Statistics

Cronbach's Alpha	N of Items
.884	21

Fig. 1. Validity and reliability test.

3.4. Digital maturity measurement of batik industry

A total of 49 respondents filled out and returned the questionnaire. The respondents came from 31 small batik industries in Laweyan. Respondent data are shown in Table 3.

The average calculation of each dimension is shown in Table 4, the digital maturity radar chart of the batik industry is depicted in Fig. 2.

Table 3. Respondents based on: Age, gender, education, employee status.

	Number of people	Percentage (%)
Age (Years)		
- < 20	1	2
- 20 – 29	14	28,6
- 30 – 39	9	18,4
- 40 – 49	12	24,5
- 50 - 59	8	16,3
- 60 - 69	5	10,2
Gender		
- Male	26	53,0
- Female	23	47
Education		
- Junior High School	1	2
- Senior High School	13	26,6
- Diploma and Bachelor	34	69,4
- Postgraduate	1	2
Employee Status		
- Owner/Manager	6	12,2
- Employee	43	87,8

Table 4. Average value of digital maturity dimensions of the Batik industry.

No.	Dimension	Average
1	Management and Organization	3,36
2	People and Culture	3,77
3	Products and Services	3,77
4	Technology	2,56
5	Organizational Operations	3,39
6	Digital maturity value of Laweyan Surakarta batik industry	3,42

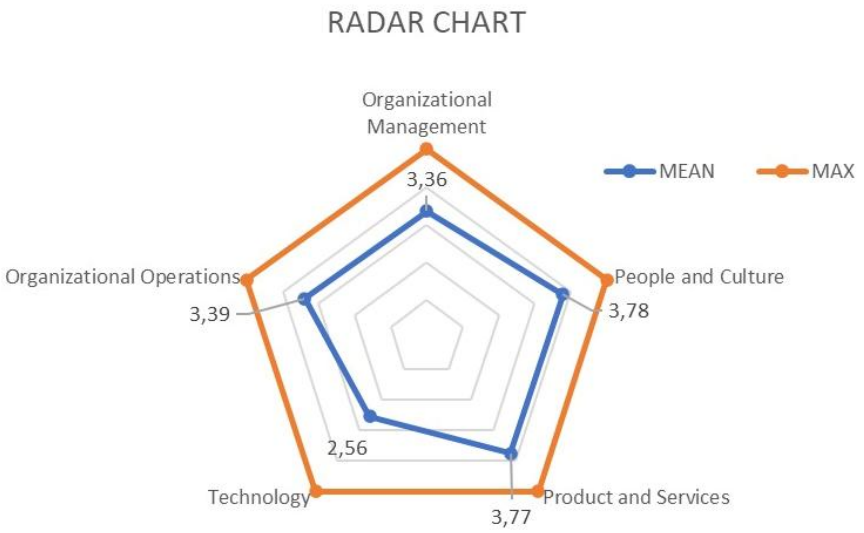

Fig. 2. Radar chart of digital maturity of batik industry.

4. Discussion

The results of this study provide important insights into the digital maturity of the batik industry, specifically addressing RQ1 regarding the dimensions of digital

maturity. The findings confirm that five key dimensions-organizational management and leadership, people, training, and culture, products and services, technology, and organizational operations-are relevant to assessing digital maturity in the batik industry, consistent with previous research on SMEs and digital transformation [11-13]. These dimensions align with models such as IMPULS and INDI 4.0, which have been applied in other manufacturing and small business contexts [11]. This indicates that even traditional industries like batik, which are often seen as low-tech, require comprehensive frameworks for digital transformation that consider both human and technological factors.

In response to RQ2 and RQ3, the study successfully developed and validated a digital maturity measurement instrument tailored to the batik industry. The instrument, which comprises 21 valid variables after the testing phase, proved reliable based on Cronbach's Alpha analysis. This offers a robust tool for assessing digital maturity across multiple dimensions.

The high weight given to the People, Training, and Culture dimension (30%) highlights the importance of human factors in the digital transformation process, particularly in SMEs where employee skill sets and openness to change can be critical to the success of digital initiatives [9]. This finding is consistent with research by González-Varona et al. [9], which emphasized the need for SMEs to focus on developing digital competencies among their workforce to improve competitiveness.

Finally, in addressing RQ4, the study found that the digital maturity of the batik industry in Laweyan, Surakarta, is at an intermediate readiness level with a score of 3.42. This suggests that while there has been progress toward digital transformation, particularly in areas such as People, Training, and Culture and Products and Services, significant gaps remain, especially in Technology and Organizational Operations, which scored lower.

The results are consistent with challenges identified in other SME sectors, where technological adoption and operational integration often lag due to limited resources and expertise [14]. The study contributes to the growing body of literature on digital transformation in traditional industries, offering a practical tool for measuring digital maturity while highlighting areas for improvement, particularly in technological infrastructure and operational processes.

5. Conclusion

This study developed and validated a digital maturity model tailored to the batik industry, identifying five key dimensions: organizational management and leadership, people, training, and culture, products and services, technology, and organizational operations. The results show that the batik industry in Laweyan, Surakarta, is at an intermediate level of digital readiness, with the People and Culture dimension demonstrating the highest preparedness. However, areas such as technology and organizational operations need further improvement to advance digital transformation. The validated instrument offers a practical tool for assessing digital maturity, providing industry stakeholders with insights to guide digital initiatives. Future research should expand the model to other regions and traditional industries to enhance its applicability and generalizability.

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