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Key Industry 4.0 Organisational Capability Prioritisation towards Organisational Transformation

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Abstract: Industry 4.0 aids organisational transformation powered by innovative technologies and connectivity. In addition to navigating complex Industry 4.0 concepts and characteristics, organisations must also address organisational consequences related to fast-paced organisational transformation and resource efficacy. The optimal allocation of organisational resources and capabilities to large transformational programs, as well as the significant capital investment associated with digital transformation, compel organisations to prioritize their efforts. Hence, this study investigates how key Industry 4.0 organisational capabilities could be prioritized towards organisational digital transformation. Data were collected from 49 participants who had completed a questionnaire containing 26 statement actions aligned to sensing, seizing, transforming and supporting organisational capability domains. By analysing the data, statement actions were prioritized and operationalized into a prototyped checklist. Two organisations applied the prototyped checklist, illustrating unique profiles and transformative actions. The operationalisation of the checklist highlighted its utility in establishing where an organisation operates in terms of digital transformation, as well as what additional steps might be followed to improve its capability prioritisation based on low checklist scores. By understanding the prioritisation of Industry 4.0 capabilities, organisations could ensure that resources are allocated optimally for business value creation based on organisational capabilities prioritisation.

Keywords: digital transformation; Industry 4.0; dynamic capabilities; prioritisation checklist

Citation: Smuts, S.; van der Merwe, A. Key Industry 4.0 Organisational Capability Prioritisation towards Organisational Transformation. *Informatics* **2024**, *11*, 16. https://doi.org/10.3390/informatics11020016

Academic Editor: Antony Bryant

Received: 8 November 2023
Revised: 10 March 2024
Accepted: 27 March 2024
Published: 2 April 2024

1. Introduction

Beyond understanding the concepts and complex characteristics of Industry 4.0, organisations must also manage the organisational outcomes and consequences related to it [1,2]. Industry 4.0 refers to organisational and technological changes enabled by innovative technologies, connectivity and information technology integration driven by customer requirements and the personalisation of customer needs [3,4]. Hence, when embarking on Industry 4.0-related transformation programmes, organisations must consider both the organisational dimension and technological transformation [5,6], both of which require oversight of organisational capabilities, such as organisational strategy, end-to-end business processes, workforce skills and competencies, organisational culture and business model [2,5]. The multi-dimensional nature of organisational capabilities calls for organisations to draw from their proficiencies optimally to ensure the delivery of their strategy, satisfy customers and execute business processes [7–9]. The optimal allocation of organisational capabilities to large transformational programs, as well as the significant capital investment associated with digital transformation, necessitate that organisations prioritize this effort [2].

However, while attempting to leverage organisational capabilities optimally and in a prioritized fashion, organisations experience several barriers [2]. A shortage of financial resources [10], resistance to change [11], lack of planning activities and skills [12], problems with standardisation [13], and technology integration [11] might challenge organisational

digital transformation programmes [14]. In addition, if the transformation programme is not supported by feasibility studies and a business case, then provision to invest in the systems architecture required for the introduction of Industry 4.0 applications, as well as concerns about data ownership and cybersecurity, create a further barrier to Industry 4.0 adoption [2,14].

Based on the opportunities and barriers identified, this research investigates the gap in the implementation of Industry 4.0, emphasizing the need for organizations to manage both organizational and technological aspects of transformation. While acknowledging the multi-faceted nature of organizational capabilities, including strategy, business processes, workforce skills, culture, and business model, the study highlights the challenge of optimal allocation of these capabilities during large-scale transformation programs. The study emphasizes the importance of addressing the barriers to the facilitation of effective Industry 4.0 adoption. Therefore, this paper aims to understand how Industry 4.0 organisational capabilities can be prioritized to support efficient and effective organisational transformation by considering the research question, "How can key Industry 4.0 organisational capabilities be prioritized towards organisational transformation?". By understanding the prioritisation of Industry 4.0 capabilities, organisations could ensure that resources are allocated optimally (aligned to creating business value) and that certain organisational capabilities are prioritized [15,16].

The rest of this paper is structured as follows: Section 2 provides the background to this research paper; Section 3 describes the research methodology; Section 4 discusses the data analysis and findings, and Sections 5 and 6 conclude the paper.

2. Background

Organisational capabilities enable organisations to be responsive to changes in the business environment as a result of Industry 4.0 and to measure organisational performance against the organisation's strategic objectives [8,17,18]. Therefore, to manage performance against a strategic plan within the context of a fast-changing environment instigated by Industry 4.0, organisations must constantly renew their organisational capabilities to remain relevant [18]. Accordingly, organisations must invest in organisational capability measurement instruments to prioritize revitalisation [19,20].

Section 2 presents an overview of the background for this paper and is divided into three subsections. First, an overview of Industry 4-driven organisational transformation is given, followed by a summary of the relevant organisational capabilities of Industry 4.0. Thereafter, the section presents Industry 4.0-related organisational capability ranking as a capability prioritisation approach for Industry 4.0-driven transformation.

2.1. Industry 4.0-Driven Organisational Transformation

The Fourth Industrial Revolution (Industry 4.0) is a term that describes the current wave of technological innovations transforming various aspects of human life, such as society, economy, environment and organisations [21,22]. The dynamics of society, organisations, production systems and supply networks could change as a result of Industry 4.0-related technologies, which could also present new opportunities and difficulties for enterprises and other industries [23–25].

Industry 4.0-driven organisational transformation investigates how organisations can leverage Industry 4.0 technologies to enhance their performance, competitiveness, and sustainability [26,27]. Moreover, it examines the outcomes and implications of this organisational transformation for various stakeholders, such as employees, customers, suppliers, partners, regulators and society. However, several factors in various sectors influence organisations' adoption and implementation of 4IR technologies for transformation [28]. Olaitan et al. [24] find that the complexity of conceptualising Industry 4.0, conflicting global perspectives of Industry 4.0 and the digital skills gap are barriers to Industry 4.0 technology adoption in higher educational institutes. In the food waste industry, Industry

4.0 technology adoption factors, such as support, access and complexity, were identified as barriers to adoption and organisational transformation [29].

Digital technologies trigger transformation, and organisations are forced to leverage the power and scalability of these digital technologies to integrate them into, and thus transform, their organisations [30–32]. Furthermore, Industry 4.0-driven organisational transformation could highlight opportunities not previously identified within the organisation's domain, e.g., patterns in data might disclose an untapped or new market [32]. According to Vial [32], Industry 4.0-driven organisational transformation could potentially disrupt the competitive landscape (improved and new business models), customer behaviour (conversational interfaces, digital channels) and data (availability, insight) [33,34]. Furthermore, Industry 4.0-driven organisational transformation enables organisational agility and flexibility to respond to external triggers, opportunities and threats [32] by rapidly reconfiguring products, services, customer preferences and business models [35].

2.2. Industry 4.0-Relevant Organisational Capabilities

Once organisations attain a certain level of foundational and Industry 4.0 capabilities, organisations may advance to the implementation and adoption of 4IR technologies [36]. Prospective Industry 4.0 technological capabilities incorporated into organisational transformation relate to legacy operation integration, technology acquisition, technology integration, and prototyping and transforming identification and implementation across the organisation [37]. The ability of an organisation to take an action (such as a choice), execute a series of strategic or operational actions, complete a practised or routine activity, or undertake a collection of routines, such as processes or procedures, is known as Industry 4.0-relevant organisational capabilities [38,39].

Organisations leverage different sets of Industry 4.0-relevant capabilities depending on their value chains, business models, digital maturity and innovation capacity [40,41]. Erol et al. [42] focus on the industrial sector's leveraging of organisational capabilities such as product digitisation, automation, real-time data sharing and network integration. Mrugalska and Wyrwicka [43] highlight the impact of the human–machine connection and collaborative work processes, work management, organisational planning and reskilling the workforce to adapt to newly created jobs [44]. Smuts et al. [38] identified 14 key organisational capabilities and operationalized these capabilities by mapping them to the dynamic capabilities: sensing (strategic leadership, external drivers and data value), seizing (decision-making, technology features, software services and solutions) and transforming (business model, process optimisation, product efficacy, organisation and the customer), as defined by Teece [45]. Three Industry 4.0 organisational capabilities, namely employees, skills and expertise, and communication, were relevant across all three dynamic capabilities and described as supporting capabilities [28,38]. By applying Industry 4.0 organisational capabilities, organisations will be able to consider the end-to-end impact of Industry 4.0 and address action plans to sustain or create new business value [8,41,46].

2.3. Prioritising Industry 4.0 Organisational Capabilities for Industry 4.0-Driven Transformation

Industry 4.0 organisational capability prioritisation for Industry 4.0-driven transformation aims to identify and assess the key organisational capabilities required to adopt and implement 4IR technologies [25,47]. Industry 4.0 organisational capability prioritisation is the process whereby organisations assess their existing levels of performance and readiness for Industry 4.0 in order to identify any shortcomings [37]. By prioritising organisational capabilities according to their importance and urgency, organisations can prioritize their actions and allocate resources more effectively. Moreover, Industry 4.0 organisational capability ranking can help organisations align their strategies, business models, processes, products, services and culture with Industry 4.0 vision and goals [48,49].

Organisations apply different mechanisms to prioritize Industry 4.0-related capabilities, varying from an organisational context-specific, weighted prioritisation matrix [50] to an Industry 4.0 readiness assessment [24]. Tsiligiris and Bowyer [51] explored the impact

of Industry 4.0 on personal and skills qualities and proposed a conceptual accounting education framework, while Kamaruzaman et al. [52] presented a conceptual framework for the development of Industry 4.0 skills for engineering graduates. Organisational capabilities and the efficacy of such capabilities depend on whether organisations dynamically adjust in order to maintain value creation in the organisation sustained by relevant capabilities [53,54]. Although dynamic capabilities are acknowledged as an important facilitator of digital transformation, the inherent challenges and appropriate strategies for developing these capabilities must be investigated [55]. Scuotto et al. [54] report on the paucity of research studies linking innovations with capabilities; hence, this paper aims to investigate a dynamic mechanism for Industry 4.0 organisational capability prioritisation towards organisational transformation.

2.4. Summary

Several gaps in knowledge concerning Industry 4.0-driven organizational transformation and the prioritization of organizational capabilities have been identified. Firstly, there is a recognition of barriers hindering Industry 4.0 adoption, including the complexity of conceptualizing Industry 4.0, conflicting global perspectives, and the digital skills gap. However, the specific challenges within various sectors beyond higher education and the food waste industry remain unclear. Secondly, while Industry 4.0-relevant organizational capabilities are mentioned in the literature, there is a lack of clarity on how different organizations leverage these capabilities based on their unique characteristics, such as value chains, business models, digital maturity, and innovation capacity.

Thirdly, there is a recognized need to delve deeper into dynamic capabilities and their role in digital transformation. Despite acknowledging their importance, there is a gap in understanding the challenges and strategies for developing dynamic capabilities, as well as their connection with innovation. Fourthly, various mechanisms are proposed for prioritizing Industry 4.0-related capabilities, such as readiness assessments and weighted prioritization matrices. However, there is a lack of consensus on the most effective approach across different organizational contexts.

Finally, there is a reported scarcity of research studies linking innovations with capabilities, highlighting a gap in understanding how innovation and capabilities intersect within the context of Industry 4.0-driven transformation. Addressing these gaps could significantly enhance the understanding and implementation of Industry 4.0-driven organizational transformation and capability prioritization, ultimately facilitating more effective adaptation to the challenges and opportunities presented by the Fourth Industrial Revolution.

3. Materials and Methods

This study primarily sought to understand how Industry 4.0 organisational capabilities could be prioritized towards organisational transformation. A survey strategy was used to achieve this objective. Data were collected through a questionnaire consisting of three sections: (1) demographic questions, (2) content statements using a Likert scale of 1 (totally disagree) to 5 (totally agree) and (3) an open-ended question. The purpose of the open-ended question was to ensure that respondents could capture any additional comments not captured within the content statements. Table 1 depicts 26 unprioritized statements denoted by statement number allocated to the four dynamic capability columns of sensing, seizing, transforming and supporting, which participants can rate to prioritize organisational capabilities. The 26 statements were designed per the organisational capability framework [38], highlighting the sensing, seizing, transforming and supporting dynamic capabilities, as adapted from Mikalef and Pateli [56], and based on the definition of dynamic capabilities [45]. Smuts et. al. [38] identified a framework of 14 Industry 4.0 organisational capabilities and operationalized these capabilities by mapping the framework to dynamic capabilities [45] sensing (strategic leadership, external drivers, data value), seizing (decision making, technology features, software services and solutions) and transforming (business model, process optimization, product efficacy, organisation, customer).

These 14 organisational capabilities were applied to enrich the 26 statements proposed Mikalef and Pateli [56], and to categorize the statements into sensing, seizing, transforming and supporting. These organisational dynamic capabilities were utilized to ensure that organisations incorporate capabilities across the entire dynamic capability spectrum.

Table 1. Data collection questionnaire statements to be rated by respondents.

Organisational Dynamic Capabilities			
Sensing	**Seizing**	**Transforming**	**Supporting**
1. Scanning the environment and identifying new business opportunities	8. Improve coordination with customers, business partners and distributors	17. Access data and other valuable resources from business partners in real time	4. Ensure business continuity by developing greater reactive and proactive strength
2. Review product and services development efforts to ensure they align with customer requirements	9. Ensure work outputs are synchronized across functional units and business partners	18. Aggregate relevant information (e.g., operating information, business customer performance) from business partners, suppliers and customers.	7. Improve coordination among different functional activities
3. Implementing suggestions for new products and improving existing products or services	11. Synchronize tasks and activities with functional units across different locations	19. Collaborate in demand forecasting and planning with business partners	10. Reduce overlapping and unnecessary activities performed by different operational units
5. Understand how the competitive landscape evolves	12. Effective operations management in real time	20. Streamline business processes with suppliers, distributors and customers	13. Identify, evaluate and import new information and knowledge
6. Gather business intelligence important to us	14. Transform existing information into new knowledge	21. Collecting and incorporating important key partner information	26. Adapt internal resource and competence profiles
	15. Assimilate new information and knowledge	22. Easily adjusting for and responding to unexpected changes	
	16. Apply accumulated information and knowledge to assist decision-making	23. Optimize the onboarding and termination of business partners	
		24. Adjust business aligned to our business priorities	
		25. Revise business processes in support of new productive outputs	

The study utilized purposive sampling [57] to identify initial respondents, after which it applied snowballing [57] to increase the number of participants. Initially, respondents were identified as individuals at any level within their organisations (e.g., executive, senior manager, etc.) who work in technology-driven organisations in various industry sectors. The questionnaire was captured as a Google Form, and an email containing the URL was shared with the respondents.

Individuals at any job level within technology-driven organisations were initially targeted using purposive sampling. Snowballing was used to increase the number of participants. A total of 49 respondents completed the questionnaire; the results were analyzed using descriptive statistics (mean, median and mode) and are described in the next section. Table 2 depicts the demographic profile of the respondents.

As shown in Table 2, respondents represented a wide range of industry sectors, of which 21 (42.9%) were from the communication and information technology sector, while the financial sector was represented by 10 (20.4%) respondents. Six respondents (12.2%) indicated the education sector as their industry sector, while three respondents (6.1%) indicated the mining sector. Three respondents (6.1%) indicated their sector as 'other' and specified it as IT distribution and security, real estate and banking, respectively.

Table 2. Demographic information for participants.

Industry Sector of Participants	Number	%	Participant Level in the Organisation	Number	%
Aviation	2	4.1%	Researcher	1	2.0%
Human Resources	2	4.1%	Project Manager	1	2.0%
Logistics	2	4.1%	General Employee	5	10.2%
Mining	3	6.1%	Specialist	9	18.4%
Other	3	6.1%	Junior Management	4	8.2%
Education	6	12.2%	Middle Management	2	4.1%
Financial Sector	10	20.4%	Senior Management	15	30.6%
Information and Communication Technology Sector	21	42.9%	Executive	12	24.5%
	49	100%		49	100%

All employee levels within an organisation were represented, with 12 (24.5%) at the executive level, 15 (30.6%) at the senior management level and 2 (4.1%) at the middle management level. Nine respondents (18.4%) stated their level in the organisation as that of a specialist.

4. Data Analysis and Findings

Figure 1 provides an overview of the questionnaire findings. Likert scale numbers 1 and 2 (totally disagree and disagree) were considered negative responses, combined (totalled) and shown in red. Likert scale number 3 was considered a neutral response and indicated in amber. Lastly, Likert scale numbers 4 and 5 (agree and totally agree) were considered positive responses, combined (totalled) and depicted in green.

Overall, the respondents view all organisational capabilities as important with Statement 5, "Understand how the competitive landscape evolves" and Statement 2, "Review product and services development efforts to ensure they align with customer requirements", receiving the most positive ratings, whereby 78% (N = 38/49) agreed with this statement. Statement 11, "Synchronize tasks and activities with functional units across different locations", is the most negatively rated question, whereby 35% (N = 17/49) disagreed with this statement. The most neutrally rated statements are Statement 7, "Improve coordination among different functional activities", and Statement 9, "Ensure work outputs are synchronized across functional units and business partners", with 35% (N = 17/49) of respondents rating both statements neutrally. Further, no respondent opted to answer the open-ended question.

The descriptive statistics include the mean, median, mode and standard deviation for the dataset. Mean is the average of the data points for each statement [58], median is the middle value of the list of responses for each statement [58], and mode is the value that occurs most often [58]. A deviation from the mean is given by the standard deviation shown in Figure 2 for the dataset [58]. A standard deviation greater and equal to 1 indicates a relatively high variation, while a standard deviation less than 1 could be considered low. A low standard deviation indicates that the data points tend to be very close to the mean; a high standard deviation indicates that the data points are spread out over a large range of values [58]. Figure 2 shows the standard deviation for this dataset.

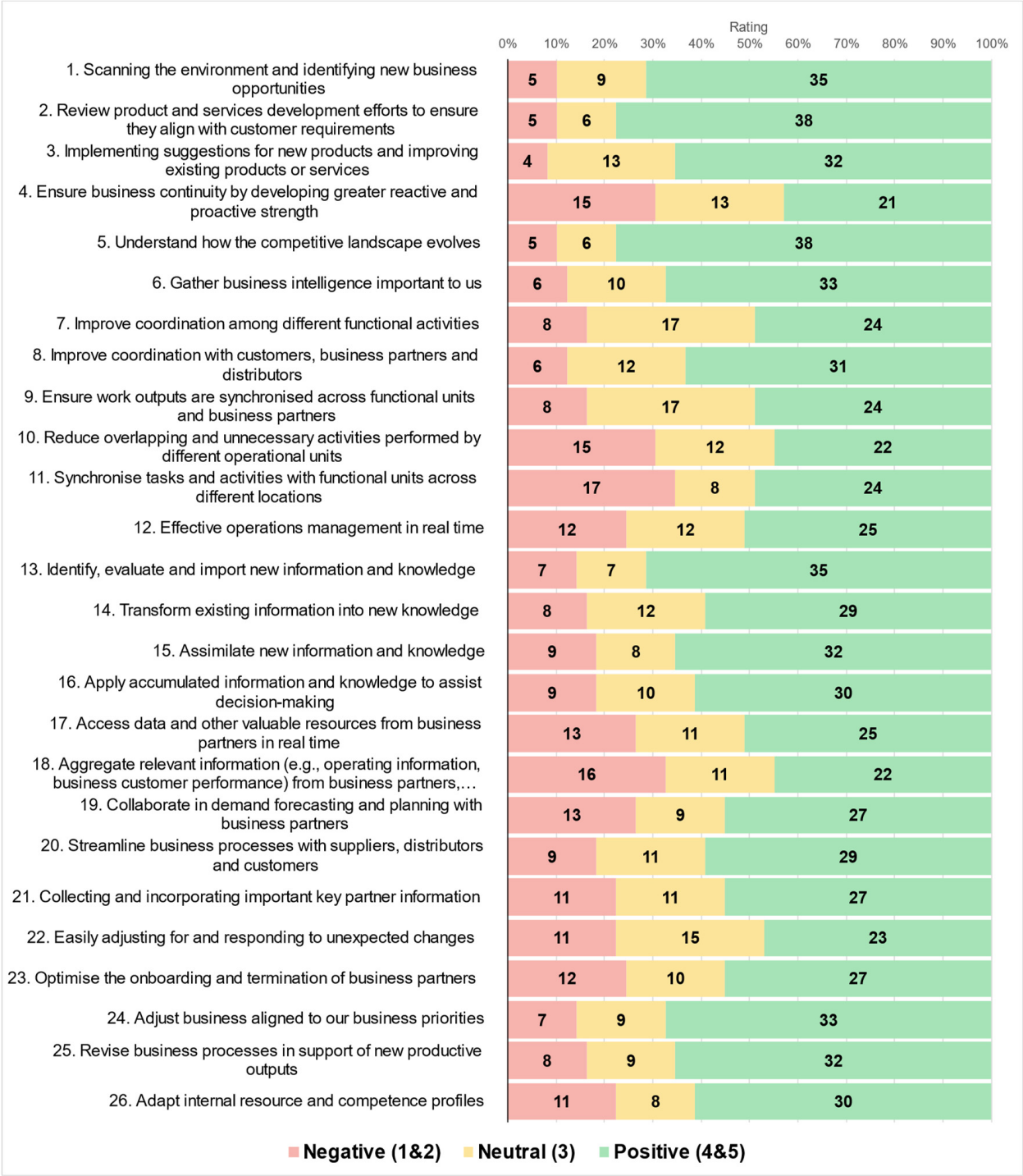

Figure 1. Consolidated overview of questionnaire responses.

The standard deviation is only below 1 for Questions 24, 9 and 2, indicating that the respondents are in general agreement about these statements. For all other statements, the standard deviation is above 1, with statements 13, 14, 16, 17, 19, 20 and 21 having a standard deviation of more than 1.2, indicating that respondents' opinions were not highly correlated.

The 26 mean values were extracted as a separate dataset to prioritize the statements, and further quantitative data analysis was performed on the distribution of these values. For this new dataset, the mean is 3.57, the median is 3.59, and the standard deviation is 0.239. Statistical analysis revealed a confidence level of 0.0917 [58–60] using a confidence

level percentage of 95%. Applying this confidence level to the mean value (3.57) of the new dataset consisting of the 26 mean values of the statements presented an upper bound of 3.66 and a lower bound of 3.48. This created three distinct regions for categorising the data. First, mean values above the upper boundary are designated as most important since these statements received the most positive ratings from the participants (denoted in green). Second, mean values between the upper and lower boundaries are designated as of medium importance as they received the most neutral responses from participants (shown in amber). Lastly, statements below the lower boundary are designated as least important since they received the most negative responses from participants (denoted in red). Table 3 displays the prioritization of the statements.

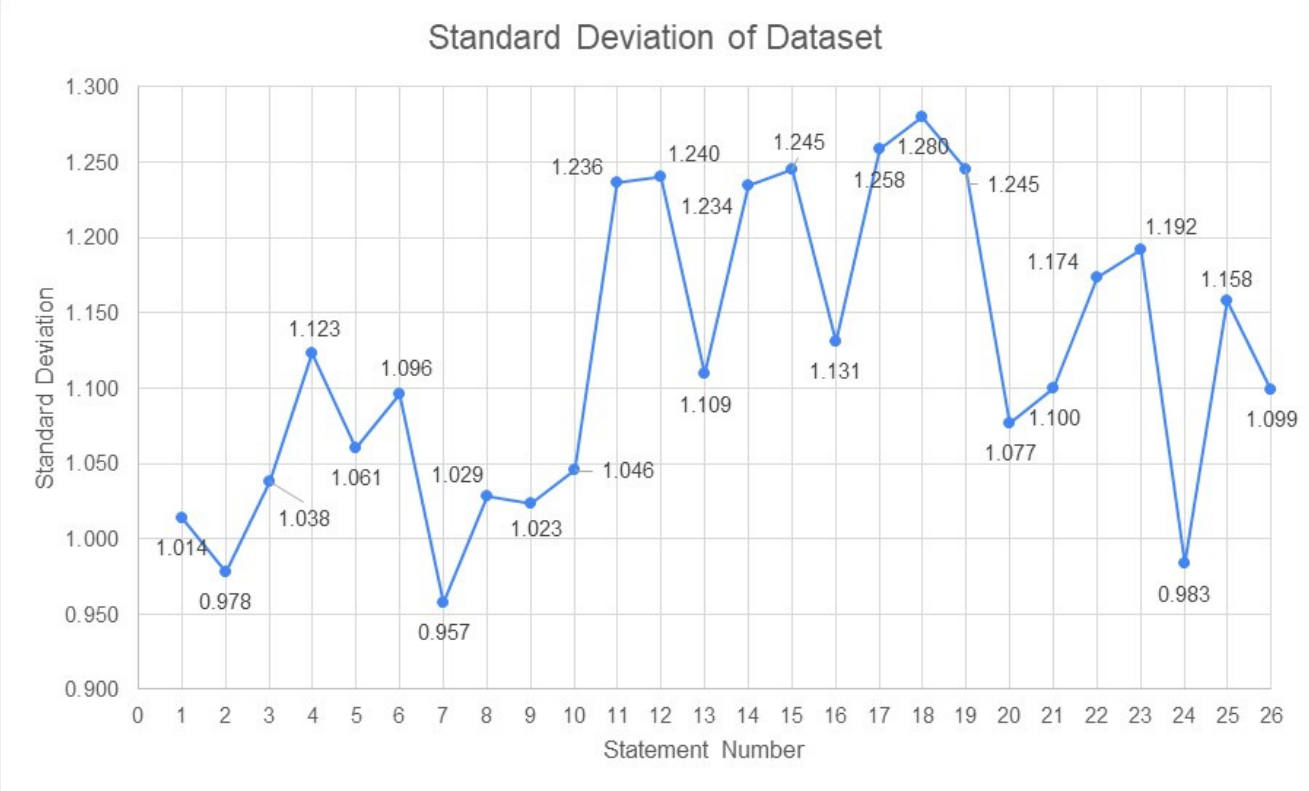

Figure 2. Standard deviation of the dataset.

Table 3. Statement number, mean value for that statement and the colour coded priority.

Statement	Mean Value	Statement	Mean Value
1	3.82	14	3.65
2	3.96	15	3.69
3	3.92	16	3.63
4	3.22	17	3.29
5	4.00	18	3.16
6	3.92	19	3.31
7	3.43	20	3.61
8	3.67	21	3.45
9	3.49	22	3.45
10	3.22	23	3.51
11	3.37	24	3.69
12	3.41	25	3.69
13	3.76	26	3.57

Table 3 presents the statement number, mean value and colour-coded priority for that statement. Green indicates statements with the highest priority, yellow indicates statements

with medium priority, and red indicates statements with the lowest priority. The statements can now be grouped into the three priority groups depicted in Table 4.

Table 4. Priority grouped statements.

Priority	Statement
High	1. Scanning the environment and identifying new business opportunities 2. Review product and services development efforts to ensure they align with customer requirements 3. Implementing suggestions for new products and improving existing products or services 5. Understand how the competitive landscape evolves 6. Gather business intelligence important to us 8. Improve coordination with customers, business partners and distributors 13. Identify, evaluate and import new information and knowledge 15. Assimilate new information and knowledge 24. Adjust business aligned to our business priorities 25. Revise business processes in support of new productive outputs
Medium	9. Ensure work outputs are synchronized across functional units and business partners 14. Transform existing information into new knowledge 16. Apply accumulated information and knowledge to assist decision-making 20. Streamline business processes with suppliers, distributors and customers 23. Optimize the onboarding and termination of business partners 26. Adapt internal resource and competence profiles 4. Ensure business continuity by developing greater reactive and proactive strength
Low	7. Improve coordination among different functional activities 10. Reduce overlapping and unnecessary activities performed by different operational units 11. Synchronize tasks and activities with functional units across different locations 12. Effective operations management in real time 17. Access data and other valuable resources from business partners in real time 18. Aggregate relevant information (e.g., operating information, business customer performance) from business partners, suppliers and customers. 19. Collaborate in demand forecasting and planning with business partners 20. Streamline business processes with suppliers, distributors and customers 21. Collecting and incorporating important key partner information

Table 4 shows that statements 1, 2, 3, 5, 6, 8, 13, 15, 24 and 25 are designated as high priority. Statements 9,14, 16, 20, 23 and 26 are designated as medium priority, and statements 4, 7, 10, 11, 12, 17, 18, 19, 21 and 22 are designated as low priority.

By considering these priorities, organisations are able to create a prioritized organisational transformation path pertaining to key Industry 4.0 organisational capabilities. Furthermore, organisations can ensure that Industry 4.0 organisational capabilities are incorporated into their Industry 4.0 vision and goals in a prioritized way, informing their strategy, business model, processes, products, services and culture alignment.

5. Discussion

A prototype checklist for organisations was developed using MS Excel to operationalize the study's findings. This operationalized checklist could empower organisations to measure how well they are performing regarding the action captured in each statement. In addition, whenever an organisation flounders when applying the checklist, the statements guide organisations on improvement actions.

In considering the prioritisation of the statement actions, an overall contribution of weight was associated with each of the priority areas, namely an overall weight of 50 for high priority, 30 for medium priority and 20 for low priority statement actions, totalling 100. The weight allocated to a particular priority was assigned equally across the

number of statements within the priority (statement action weight for high-priority statements 50/10 = 5). As the maximum rating per statement action can be 3, the individual weighted contribution of a statement action in the high-priority statement actions is 1.67 (5/3 = 1.6666). A weight can now be associated with each statement action, taking cognisance of the priority of the statement. To create a mastery profile for an organisation, it follows that such an organisation would score 3 for each statement action. Hence, the rating assigned to each statement action on the checklist can be multiplied by a specific factor or weight to either increase or decrease the contribution accompanying the specific statement action into the final score of the organisation. Table 5 shows the checklist containing the statement action, the maximum rating (3), the weight assigned to each statement action, and the weighted total to which each statement action would contribute.

Table 5. Checklist showing the maximum rating, statement action weight and weighted total for each statement.

Priority	Statement	Max. Rating	Statement Weight	Weighted Total
High	1. Scanning the environment and identifying new business opportunities	3	1.67	5.01
	2. Review product and services development efforts to ensure they align with customer requirements	3	1.67	5.01
	3. Implementing suggestions for new products and improving existing products or services	3	1.67	5.01
	5. Understand how the competitive landscape evolves	3	1.67	5.01
	6. Gather business intelligence important to us	3	1.67	5.01
	8. Improve coordination with customers, business partners and distributors	3	1.67	5.01
	13. Identify, evaluate and import new information and knowledge	3	1.67	5.01
	15. Assimilate new information and knowledge	3	1.67	5.01
	24. Adjust business aligned to our business priorities	3	1.67	5.01
	25. Revise business processes in support of new productive outputs	3	1.67	5.01
Medium	9. Ensure work outputs are synchronized across functional units and business partners	3	1.66	4.98
	14. Transform existing information into new knowledge	3	1.66	4.98
	16. Apply accumulated information and knowledge to assist decision-making	3	1.66	4.98
	20. Streamline business processes with suppliers, distributors and customers	3	1.66	4.98
	23. Optimize the onboarding and termination of business partners	3	1.66	4.98
	26. Adapt internal resource and competence profiles	3	1.66	4.98
Low	4. Ensure business continuity by developing greater reactive and proactive strength	3	0.67	2.01
	7. Improve coordination among different functional activities	3	0.67	2.01
	10. Reduce overlapping and unnecessary activities performed by different operational units	3	0.67	2.01
	11. Synchronize tasks and activities with functional units across different locations	3	0.67	2.01
	12. Effective operations management in real time	3	0.67	2.01
	17. Access data and other valuable resources from business partners in real time	3	0.67	2.01
	18. Aggregate relevant information (e.g., operating information, business customer performance) from business partners, suppliers and customers.	3	0.67	2.01
	19. Collaborate in demand forecasting and planning with business partners	3	0.67	2.01
	20. Streamline business processes with suppliers, distributors and customers	3	0.67	2.01
	21. Collecting and incorporating important key partner information	3	0.67	2.01
	Totals	78		100

The next step comprised evaluating the prototype checklist for organisations. The evaluation was achieved through a two-step process. First, the digital profile of the organisations that would evaluate the checklist had to be understood. As this study pertained to Industry 4.0 transformation, the JISC digital capability framework applied in Clarke-

Darrington et al. [61] and Morze et al. [62] was used to guide the digital capability domain descriptions shown in the first column of Table 6.

Table 6. The six digital capability domains (Adapted from Clarke-Darrington et al. [61] and Morze et al. [62] for organization number (#) 1 and organization number (#) 2.

Digital Capability Domain	#1	#2
Digital Literacy: Enhance employees' proficiency in using digital tools, applications and services.	0	1.0
Information Literacy: Develop skills for finding, evaluating, managing and using digital information, including data management.	0.5	1.0
Digital Media Literacy: Improve the ability to critically interpret and produce various digital media formats.	0	1.0
Data Literacy: Foster skills in collecting, managing and interpreting data, adhering to legal and ethical guidelines.	1.0	1.0
Digital Creativity: Cultivate the capacity to design and create digital content and applications, including coding.	0	1.0
Digital Communication Competence: Enhance employees' ability to communicate effectively in diverse digital media and forums, respecting privacy and cultural norms.	0	0.5
TOTAL	1.5	5.5

The study approached two organisations in order to create their profiles based on the digital capability domains. Organisation #1 is in the education sector and Organisation #2 is in the finance sector. Organisations #1 and #2 proceeded to evaluate themselves against the digital capability domains. A scale of 0 to 1 was used, with 0 implying no compliance in the specified domain, 0.5 some compliance and one 1 full compliance in the digital capability domain. Table 6 lists the six digital capability domains and the self-evaluation of the two organisations.

It can be observed from the organisations' self-evaluation depicted in Table 6 that Organisation #2 is a highly capable digital organisation with a rating of 5.5 out of a maximum of 6 in comparison to Organisation #1's rating of 1.5. Organisation #1 excels in the area of data literacy, which is crucial for an organisation in the education sector.

The second step of the two-step process could be executed with the acquisition of two digital capability domain profiles. Each organisation was asked to rate their organisation on the checklist prototype shown in Table 5 using a pre-defined scale. The pre-defined scale applied a measurement scale of 0 to 3, where 0 indicates that the organisation does not focus on a particular statement action at all, and 3 indicates that the organisation is aware of and continuously focuses on the statement action, showing mastery of that particular statement action. A score of 1 indicates that the organisation is aware of a statement action although no planning or monitoring of a statement action has yet been developed. A score of 2 indicates that the organisation is aware of a statement action, has put a plan into motion and is continuously working on it but has not yet reached mastery. The evaluation of Organisations #1 and #2 against the prototype checklist and by applying the pre-defined scale was then visualized with a radar chart for high-, medium- and low-priority statement actions, as shown in Figure 3.

By observing the profiles based on the checklist evaluation by the organisations, Organisation #1, as the less digitally capable organisation, has a radar diagram much closer to the centre of the visualization, indicating low scores. However, in some areas, Organisation #1 has progressed on its digital journey, as reflected in the high scores for Statements 13 and 15, which is related to the organisation's ability to identify and assimilate new knowledge, a capability vital to an educational organization. Furthermore, Organisation #1 has better overall scores for the high- and medium-priority statement actions, showing that this organisation is focusing on the important statements first. Organisation #2, on the other hand, has high ratings in all three priority domains, with the high- and medium-priority domains having nearly maximum ratings. This reflects the organisation's high level of digi-

tal capability, as well as its prioritisation of high- and medium-priority statement actions. For Organisation #2, no statement was rated nil, indicating that this organisation is aware of the importance of these statement actions and is actively working in all three domains of importance. By focusing on the statement actions in which organisations scored low, such organisations can now use the statement actions to plan and execute corrective action.

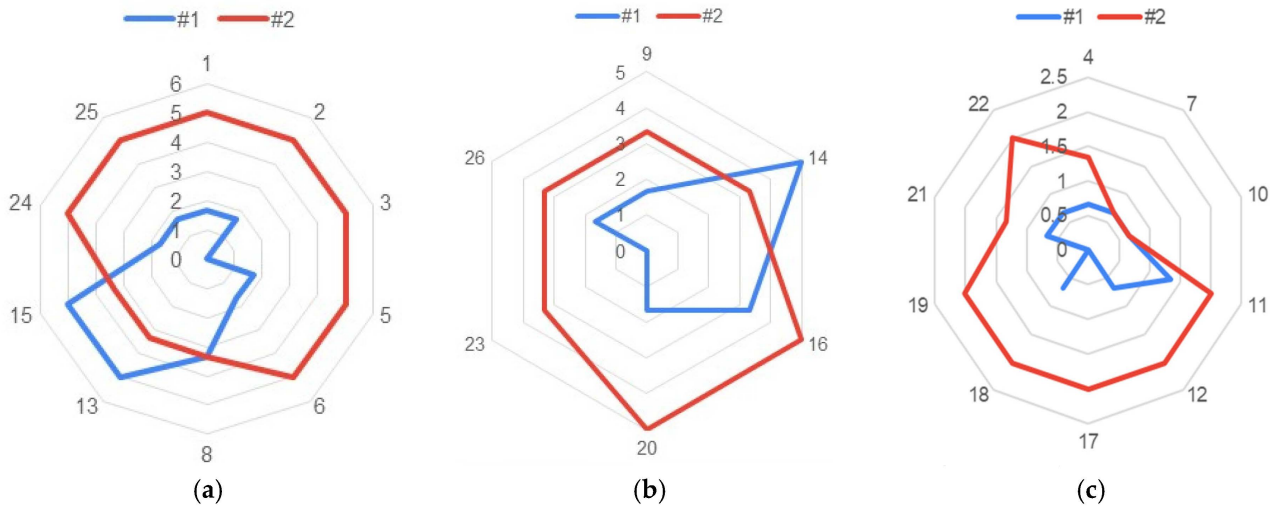

Figure 3. Prioritized Industry 4.0-related transformation actions for organizations applying the prototyped checklist for organization number (#) 1 in blue and organization number (#) 2 in red colour. (**a**) High-Priority Statement Actions; (**b**) Medium-Priority Statement Actions; and (**c**) Low-Priority Statement Actions.

6. Conclusions

This study aimed to understand how Industry 4.0 organisational capabilities can be prioritized for organisational transformation. Industry 4.0-related organisational capability prioritisation is required as organisational and technological changes, as well as associated capital investment and multiple organisational aspects (business value, strategy, process, operating model, etc.), must be managed efficiently and effectively, compelling organisations to prioritize their efforts. Therefore, the purpose of this study was to investigate how key Industry 4.0 organisational capabilities can be prioritized towards organisational digital transformation.

Accordingly, a data collection questionnaire using a five-point Likert scale rating scale was designed with questionnaire statements related to sensing, seizing, transforming and supporting organisational capabilities. Data from 49 participants were collected and analysed using descriptive statistics. By analysing the mean values of each questionnaire statement, a prioritisation of statement actions could be determined, allocating the questionnaire statements to high-, medium- and low-priority groupings. The high, medium and low delineated statement set was then operationalized by creating a checklist and developing a prototype to apply the checklist. The researchers invited two organisations to apply the checklist by understanding the organisation's digital profile and application of the checklist actions. The study presented different profiles with different implications for the prioritisation of Industry 4.0-related organisational transformation as relates to the two organisations. By understanding the prioritisation of Industry 4.0 capabilities, organisations can ensure that resources are allocated optimally for business value creation based on organisational capability prioritisation.

Managerial implications of this study are that organisations can more effectively plan and assign resources to focus on the more important organisational capabilities first. Organisations can effectively create a roadmap that will aid them in their digital transformation journey.

In terms of the study's limitations, we acknowledge that a very basic rating scale was used to illustrate and operationalize the checklist. Having confirmed the utility of the operationalized checklist, this assessment could be extended for future research by applying a more granular scale. In addition, the findings may be validated by practical application in diverse organisational contexts. Finally, we recognize that, due to time constraints, the number of participants included in this study was limited. Therefore, the study's outcomes should be interpreted within the context of its industry and geographical limitations. To generalize these fundings to all technology driven organisations, further research will be required. Future research can include sending a questionnaire to more organisations in different industrial sectors including global organisations, as well as gathering a bigger participant pool.

Author Contributions: Conceptualisation, S.S. and A.v.d.M.; methodology, S.S. and A.v.d.M.; software, S.S.; validation, S.S.; formal analysis, S.S.; investigation, S.S.; resources, S.S.; data curation, S.S.; writing, namely original draft preparation, S.S.; writing, namely review and editing, S.S. and A.v.d.M.; visualisation, S.S.; supervision, A.v.d.M.; project administration, S.S.; funding acquisition, S.S. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: The study was approved by the Ethics Committee of the Faculty of Engineering, Built Environment and Information Technology, University of Pretoria (protocol code EBIT/49/2020 and date of approval 3 September 2020).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: The data presented in this study are available on request from the corresponding author. The data are not publicly available because of the ethical clearance obtained.

Conflicts of Interest: The authors declare no conflicts of interest.

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