Appendix for

Development and Evaluation of a Blockchain Concept for Production Planning and Control in the Semiconductor Industry

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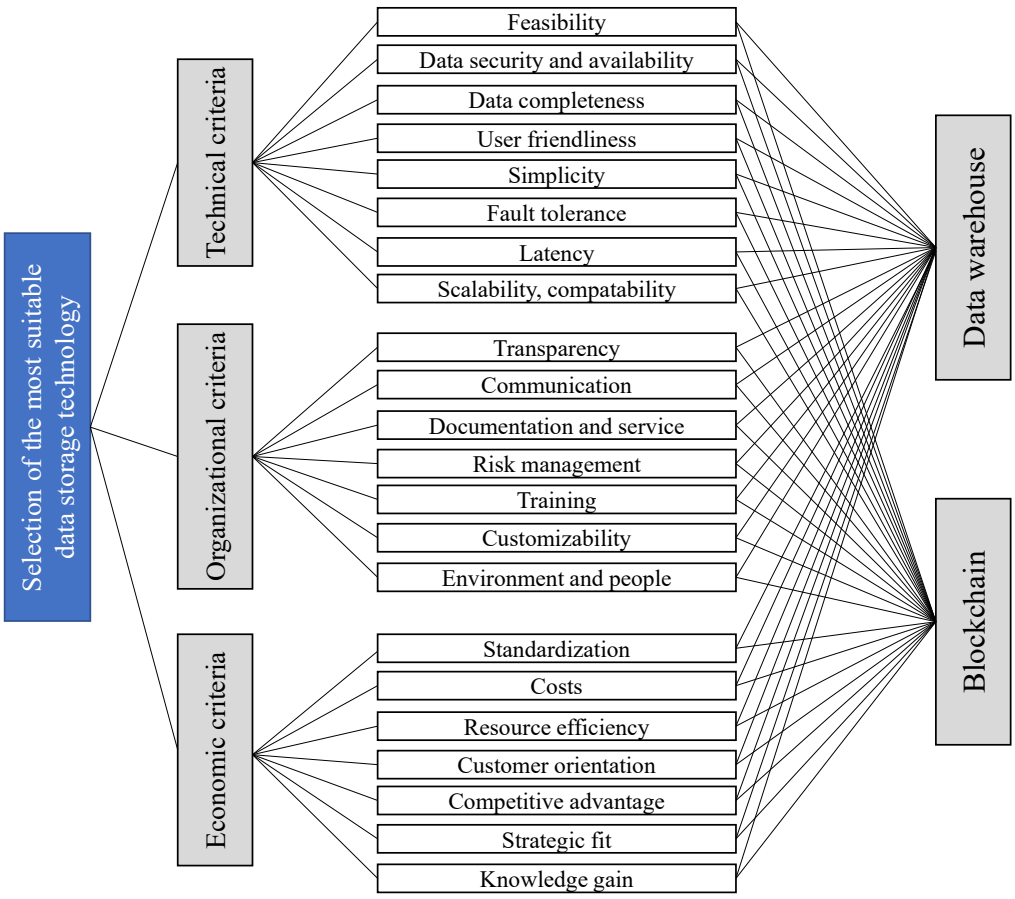

Figure 1. Structure of the AHP decision model to select the suitable data storage technology

Table 1. Literature analysis on the criteria to assess innovative digital technologies in the context of Industry 4.0

Literature source	Sevinç, Gür, and Eren 2018	Chansa-Ngavej and Srijuntub 2010	Subramanian and Ramanathan 2012	Erkan and Calkin 2019	Uslu et al. 2019	Lněnička 2015	Boutkhoum et al. 2016	Grafe 2015	Salenko 2013	Heber et al. 2018	Rahn 2018	Davis and Williams 1994
Technical criteria												
Feasibility		x	x		x						x	
Data security and availability		x		x	x	x	x	x	x	x		
Data completeness										x		
Fault tolerance				x	x	x						
Scalability, compatibility		x				x		x				
Latency						x				x		
User friendliness	x	x				x	x		x	x	x	x
Simplicity		x				x						x
Organizational criteria												
Communication	x		x		x		x	x	x	x	x	
Environment and people	x		x		x	x		x	x			
Risk management		x						x				
Customizability			x	x		x		x	x	x		x

Literature source	Sevinç et al., 2018	Chansa-ngavej & Srijuntub, 2010	Subramanian & Ramanathan, 2012	Erkan & Calkin, 2019	Uslu et al., 2019	Lněnička, 2015	Boutkhoum et al., 2016	Grafe, 2015	Salenko, 2013	Heber et al., 2018	Rahn, 2018	Davis & Williams, 1994
Training	x				x							x
Documentation and service	x					x	x		x			x
Transparency								x		x		
Economic criteria												
Competitive advantage	x	x	x		x							
Standardization	x		x		x		x	x	x	x	x	
Strategic fit	x		x		x		x	x	x	x	x	
Costs	x	x	x	x		x	x		x			x
Resource efficiency		x	x							x		
Knowledge gain			x									
Customer orientation			x	x	x			x				

Table 2. Scale of similarity / superiority levels in AHP (based on Saaty 1994)

Similarity/ Superiority level	**Description**
1	A and B are equally important or make an equivalent contribution to the achievement of the overall objective
3	A is somewhat more important or somewhat more pronounced than B
5	A is more important or more pronounced than B
7	A is much more important or much more pronounced than B
9	A is extremely dominant over B
2, 4, 6 and 8	These levels are used for a finer gradation of the importance or the degree of expression

Table 3. Description of the technical criteria

Technical criteria	**Description**
Feasibility	Feasibility in the sense of applicability of the concept in daily business
Data security and availability	Concepts for ensuring data security, such as encryption
Data completeness	Ensuring a comprehensive data history
Fault tolerance	Tolerance of the system, e.g. against system failure
Scalability, compatibility	Scalability options for each concept
Latency	Delay time to complete requests vs. real-time capability
User friendliness	Ease of use, availability of interfaces
Simplicity	Simplicity and comprehensibility of the technology

Table 4. Description of the organizational criteria

Organizational criteria	**Description**
Communication	Simplicity of communication between departments
Environment and people	User acceptance, ease of implementation in the operational environment
Risk management	Type and extent of risk management with regard to data security and availability
Customizability	Individual design of visualization and analysis tools for the technology
Training	Experience and level of training of employees
Documentation and service	Scope of documentation for the technology and service offer for maintenance
Transparency	Completeness and integrity of data and transparency for users

Table 5. Description of the economic criteria

Economic criteria	**Description**
Competitive advantage	Competitive advantage that can be achieved by applying the technology
Standardization	Standardization of data processing and the use of databases
Strategic fit	Strategic fit to further ongoing innovation and standardization projects of the company
Costs	Costs for setting up and maintaining the databases
Resource efficiency	Resource consumption for setting up and operating the database, e.g. personnel and energy consumption
Knowledge gain	Knowledge gain through the application of the technology
Customer orientation	Alignment of the databases to the customer and usability for external communication purposes

Survey details

Part I:

Please evaluate the following criteria according to the scale given in Table 2.

Table 6. Evaluation table for the main criteria

Main criteria	Technical criteria	Organizational criteria	Economic criteria
Technical criteria			
Organizational criteria			
Economic criteria			

Table 7. Evaluation table for the technical criteria

Technical criteria	Feasibility	Data security and availability	Data completeness	Fault tolerance	Scalability, compatibility	Latency	User friendliness	Simplicity
Feasibility								
Data security and availability								
Data completeness								
Fault tolerance								
Scalability, compatibility								
Latency								
User friendliness								
Simplicity								

Table 8. Evaluation table for the organizational criteria

Organizational criteria	Communication	Environment and people	Risk management	Customizability	Training	Documentation and service	Transparency
Communication							
Environment and people							
Risk management							
Customizability							
Training							
Documentation and service							
Transparency							

Table 9. Evaluation table for the economic criteria

Economic criteria	Competitive advantage	Standardization	Strategic fit	Costs	Resource efficiency	Knowledge gain	Customer orientation
Competitive advantage							
Standardization							
Strategic fit							
Costs							
Resource efficiency							
Knowledge gain							
Customer orientation							

Part II:

Please evaluate the two technical solutions according to the scale given in Table 2.

BC = Blockchain, DWH = Data Warehouse

Technical criteria	BC	DWH
Feasibility		
BC		
DWH		
Data security and availability		
BC		

DWH		
Data completeness		
BC		
DWH		
Fault tolerance		
BC		
DWH		
Scalability, compatibility		
BC		
DWH		
Latency		
BC		
DWH		
User friendliness		
BC		
DWH		
Simplicity		
BC		
DWH		

Organizational criteria	BC	DWH
Communication		
BC		
DWH		
Environment and people		
BC		
DWH		
Risk management		
BC		
DWH		
Customizability		
BC		
DWH		
Training		
BC		
DWH		
Documentation and service		
BC		
DWH		
Transparency		
BC		
DWH		

Economic criteria	BC	DWH
Competitive advantage		
BC		
DWH		
Standardization		
BC		
DWH		
Strategic fit		
BC		
DWH		
Costs		
BC		
DWH		
Resource efficiency		
BC		
DWH		
Knowledge gain		
BC		
DWH		
Customer orientation		
BC		
DWH		

Results of the Analytical Hierarchy Process

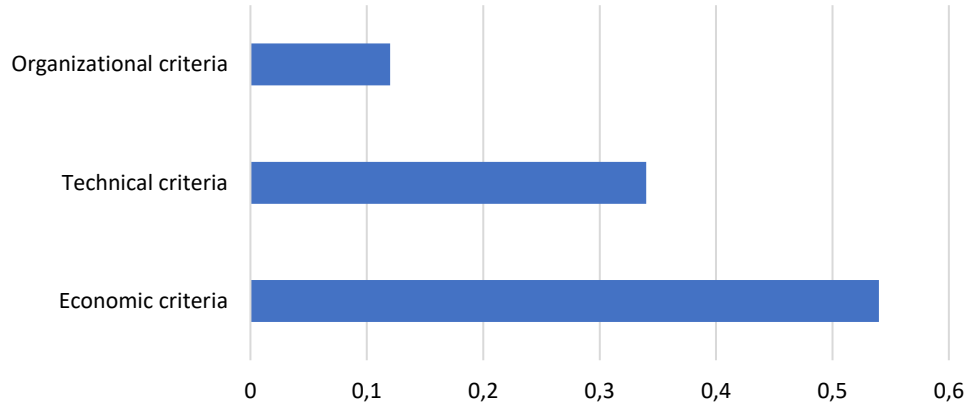

Figure 2. Weighting of the main criteria

Decision category	Weighting	Block-chain	Data ware-house
Technical Criteria	**0,34**	**0,49**	**0,51**
Feasibility	0,23	0,20	0,80
Data security, availability	0,32	0,75	0,25
Data completeness	0,14	0,80	0,20
User friendliness	0,11	0,25	0,75
Simplicity	0,08	0,11	0,89
Fault tolerance	0,06	0,75	0,25
Latency	0,04	0,25	0,75
Scalability, compatibility	0,03	0,17	0,83

Figure 3. Results of the assessment of the technical criteria

Decision category	Weighting	Block-chain	Data ware-house
Organizational Criteria	**0,12**	**0,65**	**0,35**
Transparency	0,31	0,83	0,17
Communication	0,24	0,87	0,13
Documentation & Service	0,17	0,17	0,83
Risk management	0,12	0,75	0,25
Training	0,08	0,17	0,83
Customizability	0,05	0,80	0,20
Environment & People	0,03	0,25	0,75

Figure 4. Results of the assessment of the organizational criteria

Decision category	Weighting	Block-chain	Data ware-house
Economic Criteria	**0,54**	**0,74**	**0,26**
Standardization	0,27	0,89	0,11
Costs	0,20	0,25	0,75
Resource efficiency	0,20	0,89	0,11
Customer orientation	0,12	0,75	0,25
Competitive advantage	0,11	0,87	0,13
Strategic fit	0,06	0,83	0,17
Knowledge gain	0,04	0,89	0,11

Figure 5. Results of the assessment of the economic criteria

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