id	Phase/categories		identifier	CSF's/challenges (literature)	Description	sources	Input (Requirements)	Output	Possible AI-tools
1	Define research question		1.1	Availability of contextual information	Access to contextual information such as process models, business rules, policy documents, legal and regulatory requirements that can aid process mining **(Mans et al., Mamudu and Bandara)**.	Mans et al., Mamudu and Bandara	Process models, business rules, policy documents, legal and regulatory requirements, possible projectteam-members	selected business process, composed project team, project goals, defined questions	manual task. But "random" Proess Analyses, like with the Proactive Insights Engine **(Veit et al.)**, may result in (new) research questions.
			1.2	Planning (Process selection)	Identifying questions or project goal(s), selecting business processes to be mined and composing the project team to execute process mining initiatives **(Mamudu ad Bandara)**. It is unclear what process properties are important **(Grisold et al.)**	Mamudu and Bandara, Grisold et al.			
			1.3	Team configuration	The composition of teams and expert groups involved in process mining projects. Two main configurations namely: Established units: An internal team dedicated to ex-ecuting process mining initiatives. E.g., a Centre of Excellence (CoE). Ad-hoc units: A group of experts assembled from dif-ferent departments within the organisation to execute process mining projects as and when required **(Mamudu and Bandara)**. Lack of interdisciplinary and cross-functional teams: PM suffers from a lack of interdisciplinary and cross-functional teams covering sponsors, IT, and data specialists as well as business users and project managers **(Martin et al.)**	Mamudu and Bandara, Martin et al.			
2	Data collection		2.1	Event data availability	The extent to which historical event data is available for process mining analysis **(Mamudu and Bandara)**. Constraining data access barriers: Limited data access across departmental and organizational boundaries restricts PM **(Martin et al.)** The availability of event data needed for PM is limited **(Martin et al.)** Restricting data privacy regulations: Compliance with data privacy and security regulations limits the detail of what can be discovered and analyzed through PM **(Martin et al.)** Difficult handling of unstructured data: PM provides limited support for exploiting unstructured data that is not available in activity-based semantics or even format **(Martin et al.)**. There is an asymetry in terms of the permission to access and use of relevant data **(Grisold et al.)**. Delays can occur due to data access, which is often tied to organizational barriers **(Grisold et al.)**.	Mamudu and Bandara, Martin et al., Grisold et al.	process description, located systems & databases, database documentation, which historical event data are available	access to the databases, data privacy regulations clarified, raw data exported, conceptual data model	Database crawler to find the belonging databases-, tables and entries, Apache OpenNLP, Web Scraping Applications,
			2.2	Data extraction expertise	The required data analytics expertise for the extraction and integration of event data for process mining **(Mamudu and Bandara)**. Teams who are responsible for data integration often have difficulties to obtain the data since they are not involved in the decision-making **(Grisold et al.)**.	Mamudu and Bandara, Grisold et al.			
			2.3	Extraction	Determining the data extraction scope, extracting event data, and transferring process knowledge be-tween business experts and process analysts **(Mamudu and Bandara)**.	Mamudu and Bandara			
3	Data pre-processing		3.1	Data preprocessing	Provisions for the extraction and preparation of event data from single or multiple sources for process min-ing based on lessons learnt **(Mamudu and Bandara)**. Complex data preparation: Substantial effort is required for data extraction and pre-processing **(Martin et al.)** There are data fractions when process run on different systems **(Grisold et al.)**	Mamudu and Bandara, Martin et al.	exported raw data	filtered event-log based on the research questions	Automated Event-log creation **(López de Murillas et al.)**, PM4KNIME **(Kourani et al.)**
			3.2	Event-log quality considerations	The data quality considerations and minimum requirements to be met by event logs for process mining **(Mans et al., Mamudu and Bandara)**. Source or event data are often in accurate, noisy, and/or incomplete **(Martin et al.)**	Mans et al., Mamudu and Bandara, Martin et al.			
4	Mining & analysis	General	4.1	Mining and Analysis	Applying process mining techniques to answer ques-tions and gain insights **(Mans et al.)**. Insufficient technical skills: The lack of sufficient training in technical skills required to implement PM is detrimental to setting up and conducting PM **(Martin et al.)** Process managers miss information about how certain variables can inform decision-making **(Grisold et al.)**.	Mans et al., Martin et al., Grisold et al.	Event-Log, Process model, research questions	required insights with different views, based on the research questions also a optimized process model	Proactive Insights Engine: From Process Discovery to Process Intelligence **(Veit et al.)** Nirdizati: an Advanced Predictive Process Monitoring Toolkit **(Rizzi et al.)**
			4.2	**Tool capabilities:** Integration capabilities	Integration of process mining capabilities with other data analytics capabilities **(Mamudu and Bandara)**. Challenging (real-time) system integration: Insufficient real-time system connectivity or integration into existing IT infrastructure negatively impacts deriving insights through PM **(Martin et al.)**	Mamudu and Bandara, Martin et al.			
			4.3	**Tool capabilities:** Analytical Scalability	The tool's ability to analyse data for insights into sin-gle, multiple and e2e processes **(Mamudu and Bandara)**. Fragmented solutions: There is a lack of comprehensive PM solutions supporting a wide range of conceivable use cases **(Martin et al.)**.	Mamudu and Bandara, Martin et al.			
			4.4	Incomprehensible outcomes	Non-standard visualization techniques used in PM may lead to overcomplicated and hardly understandable business process models **(Martin et al.)**.	Martin et al.			
			4.5	Lack of advanced features	PM lacks advanced features such as automation, simulation, and data anonymization **(Martin et al.)**.	Martin et al.			
		Discovery	4.6	**Tool capabilities:** Process discovery	Automated process model discovery and process vis-ualisation from event data **(Mamudu and Bandara)**. Difficult analysis of process exceptions: PM lacks support for deriving insights from process exceptions **(Martin et al.)**.	Mamudu and Bandara, Martin et al.			
			4.7	Data processing	Using process mining tools to create views, aggregate events, enrich or filter logs to generate the required insights from event logs **(Mamudu and Bandara)**.	Mamudu and Bandara			
		Conformance	4.8	**Tool capabilities:** Conformance checking/Compliance	Detection of deviations from process norms using event data **(Mamudu and Bandara)**.	Mamudu and Bandara			
		Performance	4.9	**Tool capabilities:** Process Benchmarking	Using event data for comparison of process behav-iours and process performance **(Mamudu and Bandara)**. Insufficient prescriptive capabilities: PM tools are limited regarding their prescriptive capabilities **(Martin et al.)**.	Mamudu and Bandara, Martin et al.			
		Social network analysis	4.10	/	No challenges found	/			
		Comparitive analysis	4.11	/	No challenges found	/			
5	Results	Stakeholder evaluation	5.1	Evaluation Missing involvement from process experts	Relating analysis results to improvement ideas to achieve project goals **(Mamudu and Bandara)**. One of the challenges in process mining projects is often that the process analysts are not domain experts for the process they are analysing **(Bozkaya et al., Suriadi et al.)**, which means that they may have difficulties determining the causes of unexpected analysis results.	Mamudu and Bandara, Bozkaya et al., Suriadi et al.	Insights with different views, prepared in an understandable way for the stakeholders (presentation, etc.), direct suggestions for improvement which should be made	Enthusiastic stakeholders who will continue to support PM in the future.	Artificial Intelligence Enabled Project Management **(Taboada et al.)**, PM4KNIME **(Kourani et al.)**
		Implementation	5.2	Process improvement and support	Using gained insights to modify the actual process execution **(Mamudu and Bandara)**.	Mamudu and Bandara			

Supports

Supports

6	Stakeholder Support and Involvement		6.1	Management support	Top-Level Management/Senior Executives support **(Mans et al., Mamudu and Bandara)**. Initiating, funding, and conducting PM initiatives requires a strong management commitment **(Martin et al.)** Process managers need guidance to convince decision-makers **(Grisold et al.)**.	Mans et al., Mamudu and Bandara, Martin et al., Grisold et al.	Time, money, persuasion and training (workshops).	Informed and educated stakeholders with an understanding of the importance of PM to the business and the PM project being completed.	manual task, PM4KNIME **(Kourani et al.)**
			6.2	External stakeholder support	Engagement with external collaborators or industry partners (such as suppliers) who influence an organisation's business process and how they are executed **(Mamudu and Bandara)**. Transparency may lead to distrust and perceived surveillance **(Grisold et al.)**.	Mamudu and Bandara, Grisold et al.			
			6.3	Subject matter experts (SMEs)	SMEs of a particular business domain who contribute to process mining efforts **(Mamudu and Bandara)**.	Mamudu and Bandara			
			6.4	User groups	The contribution of ultimate users (such as first-line personnel) to process mining outcomes **(Mamudu and Bandara)**.	Mamudu and Bandara			
			6.5	Process mining expertise	The required know-how needed to execute process mining initiatives and interpret outcomes **(Mamudu and Bandara)**.	Mans et al., Mamudu and Bandara			
			6.6	Process analyst expertise	The required expertise for designing, streamlining, and re-engineering business processes **(Mans et al., Mamudu and Bandara)**. Insufficient analytical skills: The lack of fundamental analytical skills, including business process modelling and optimization, impedes deriving value from PM **(Martin et al.)** Insufficient domain expertise: The lack of comprehensive domain and business expertise inhibits the ability to customize PM as well as to adequately interpret the results **(Martin et al.)**	Mans et al., Mamudu and Bandara, Martin et al.			
			6.7	Training	The education and sensitisation of stakeholders on the appropriate execution of process mining initiatives for the intended results **(Mamudu and Bandara)**. Insufficient technical skills: The lack of sufficient training in technical skills required to implement PM is detrimental to setting up and conducting PM **(Martin et al.)**	Mamudu and Bandara, Martin et al.			
7	Organizational and strategic alignment		7.1	Change Management	The series of activities that ensure that the needed change emanating from process mining results is im-plemented in the organisation **(Mamudu and Bandara)**. Unclear organizational anchoring: It is unclear how PM expertise should be anchored within the organization **(Martin et al.)** It is important to cope with the increased transparency created through process mining **(Grisold et al.)**.	Mamudu and Bandara, Martin et al., Grisold et al.	These are general challenges and concerns belonging PM. Thats not a concrete phase in the PM-process. For this reason there are no direct Inputs or Outputs.	These are general challenges and concerns belonging PM. Thats not a concrete phase in the PM-process. For this reason there are no direct Inputs or Outputs.	Artificial Intelligence Enabled Project Management **(Taboada et al.)**
			7.2	Project Management	The management of activities and resources, such as time and cost throughout all phases of the process mining project to obtain the defined project outcomes **(Mans et al., Mamudu and Bandara)**.	Mans et al., Mamudu and Bandara			
			7.3	Unclear success factors	It is unknown which organizational setups and properties ensure an efficient and effective use of PM **(Martin et al.)**.	Martin et al.			
			7.4	Elusive business value	The business value of PM is difficult to determine with regard to the alignment of strategic and operational goals as well as the quantification of costs and benefits **(Martin et al.)**. Process managers do not know how to calculate the business value of PM activities **(Grisold et al.)**	Martin et al., Grisold et al.			
			7.5	Missing implementation guidance	There is a lack of comprehensive guidance on the implementation of PM for different organizations, domains, contexts, and strategic goals **(Martin et al.)**.	Martin et al.			