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Implementing Industry 4.0 in Aerospace and Defense: A Systematic Literature Review

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Abstract: In recent years, technologies have made considerable progress due to increased availability of larger data sets, more powerful computing performance, and greater budget allocations. However, many implications and concerns related to successful global implementation of A&D Industry 4.0 solutions remain. This study provides a systematic review of published material on Industry 4.0 in A&D to understand critical components needed for successful implementation of smart technologies. The review also included investigating Industry 4.0 definitions, technologies, implementation factors, and empirical studies on the usage of Industry 4.0 solutions in A&D. Records from 2015 to 2022 were found using multiple databases and showed ample research in organizations working toward digital transformation and model-based engineering, specifically in areas related to manufacturing, research and development, logistics, surveillance, reconnaissance, intelligence, and command and control. The results also emphasize the need for empirical evidence related to the implementation of Industry 4.0 and the lack of papers studying Industry 4.0 in A&D settings. The literature review includes a bibliometric analysis to assess the maturity of the topic and papers, and a TA to investigate the CSFs identified in the literature.

Keywords: framework; success factors; defense industries; Industry 4.0.

1 Introduction

1.1 Industry 4.0 in Aerospace & Defense (A&D)

This Systematic Literature Review (SLR) thoroughly investigates the existing literature related to the successful implementation of Industry 4.0 technologies in A&D settings. The review also focused on understanding current and future usage of these smart solutions in defense or military environments. The Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA) protocol was used for this systematic review; the PRISMA guidelines include 27 items that aim to reliably examine and detail applicable scientific evidence (Moher et al., 2009).

Following identification and review of the available literature, a bibliometric analysis was conducted to further investigate this area of research in terms of maturity and development. Through evaluating the current status of factors and implementation, a more strategic framework can be developed to improve the possibility of successful incorporation. This approach allows for a qualitative and quantitative investigation of the current state of this topic as well as provides a core set of publications that can be used for future research.

1.2 Research Questions

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The present literature review evaluates current applicable research on Industry 4.0 technologies within A&D organizations. The following RQs were formulated for this review:

RQ 1: What are the goals of Industry 4.0 implementation in A&D?
RQ 2: What are the challenges of implementing Industry 4.0 in A&D?

1.3 PRISMA Protocol

The present study focuses on Industry 4.0 in A&D environments. The main objective of this article is to discuss the current applications as well as known issues and challenges of successful implementation. The PRISMA protocol was used for this systematic review; the PRISMA guidelines include 27 items which aim to reliably examine and detail applicable scientific evidence. This paper is organized as follows: the methodology section explains the research questions and search strategy, the results discussion provides details on the chosen material, and the discussion and follow-up sections answer each defined Research Question (RQ) while elaborating on limitations and future research.

1.4 Methodology

The SLR approach minimizes research bias by ensuring a comprehensive and organized review of current literature related to Industry 4.0 and potential implementation success factors. The six-step process is shown in Figure 1 (Tranfield et al., 2003).

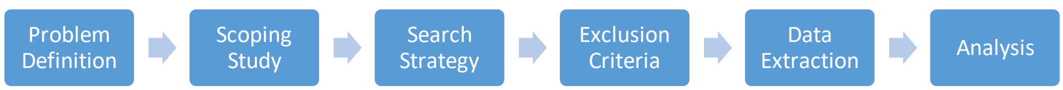

Fig. 1: Overview of the SLR Process

Alongside following PRISMA guidelines and the above six-step process, the main objective of this section is to discuss efforts related to the incorporation of Industry 4.0 solutions in A&D as well as known issues and challenges for successful implementation. This SLR is organized as follows: the next section explains the search terms and strategy, followed by lists of the exclusion criteria, a description of the results, and follow-on analyses of the chosen material.

1.5 Search Terms and Strategy

Because developing a search strategy is an iterative process, the use of a scoping study aids in refinement of the scope through identification of terminology applicable to the chosen research area. Therefore, during this exploration stage, various sets of keywords were used to discover relevant articles within multiple academic databases, including Compendex, ProQuest, Web of Science, and EBSCOhost. Because the research topic is multi-faceted, using appropriate keywords is crucial to identify applicable articles. Therefore, the capture rate for each potential search string of keywords or concepts was evaluated during this scoping study phase.

This preliminary review of the available literature reiterated the minimal research of Industry 4.0 in A&D environments and the need for more thorough investigations on the implementation of such technologies. The final search terms are shown in Table 1. Although other terms were considered and tested, these terms were found to not be applicable to the topic and were not considered for inclusion in this study. For example, words such as “incorporate” and “apply” were tested in place of “implementation” but did not yield results related to the scope of the study.

Table 1: Search Terms.

A&D	Industry 4.0	Factor	Implement
Defense Industr*	Industry 4.0	Obstacle	Deploy*
Aerospace Industr*	Quality 4.0	Framework	Adopt*
Aerospace and Defense	Smart Manufacturing	Challenge	Implement*
Department of Defense	Smart Industr*	Factor*	
Defense Contractor	Digital Transformation	Barrier	

Table 1 displays four main concepts, one in each column, each with multiple related terms shown in the respective rows. The use of Boolean operators, such as AND and OR, were utilized to search for publications using the Compendex, ProQuest, Web of Science, and EBSCOhost platforms. The databases were chosen to increase the reach and potential of finding more applicable literature; EBSCOhost and ProQuest were chosen due to the broad platforms and inclusion of industry sources while Compendex and Web of Science were selected due to the inclusion of engineering-related research.

Within each concept (column), all search terms were combined using the OR operator; the AND operator was then used between each concept (column). This allowed for all search terms and concepts to be included within the Boolean phrase. The search scope was limited to “everywhere except full text” and papers written in English. This assisted in noise reduction and removal of captures that did not include these terms in the abstract or title. The results from executing the search are shown in Figure 2.

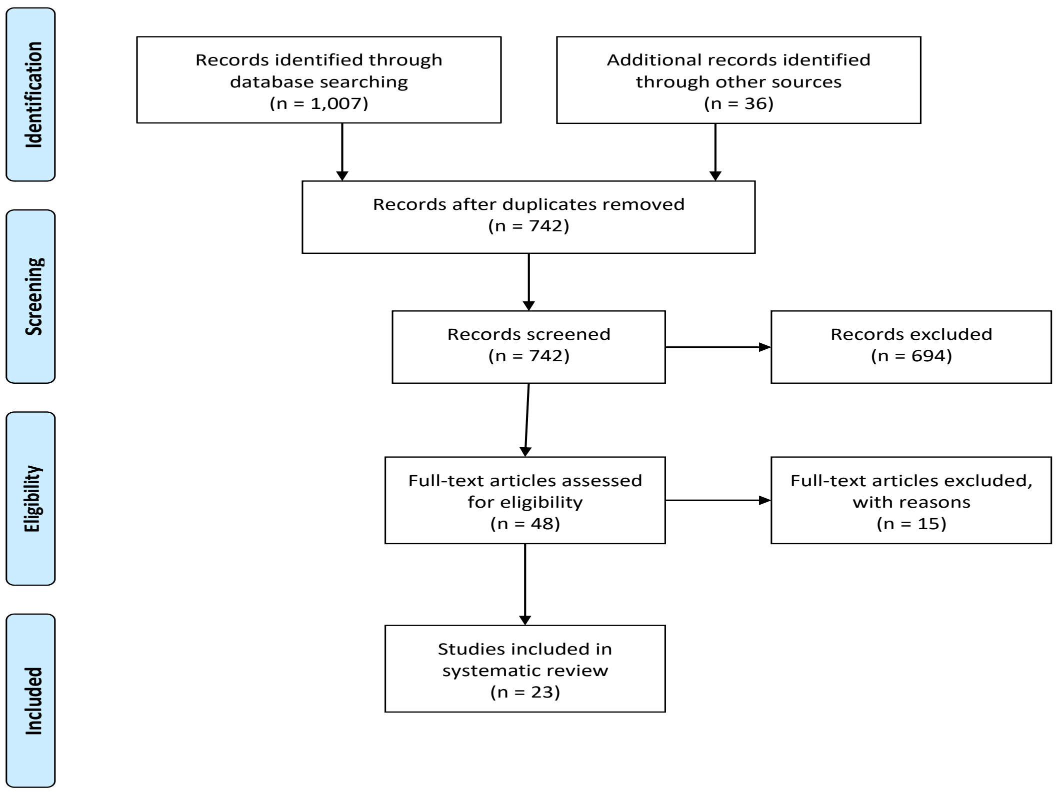

Fig. 2: PRISMA Literature Flow.

1.6 Data Extraction and Results

The initial search resulted in 1,007 publications being identified from the above academic databases. An additional 36 records, such as published theses and DOD technical reports, were also identified through the Defense Technical Information Center (DTIC). All of these sources provided ample information regarding Industry 4.0 or advances in A&D. Duplicate records were removed, which resulted in 742 titles remaining. A formal screening process was then used to narrow down the literature with the goal of identifying information relevant to the defined RQs. This screening process included applying the following criteria:

The exclusion criteria were as follows:

- Papers, upon review, were found to not be related to the RQ(s)
- Letters, posters, newspaper articles
- Papers written in other languages
- Papers which were classified or For Official Use Only (FOUO)

The inclusion criteria were as follows:

- Papers written in English
- Papers related to the RQ(s)
- Papers published from 2015 to 2022
- Papers identifying or describing Industry 4.0 in A&D
- Papers which were open access, unclassified, and not FOUO

The above criterion was then applied and the abstracts for the remaining papers were read for applicability. After removing irrelevant titles, 48 were analyzed by reading the entire text. Irrelevance includes if the paper explored the design or use of Industry 4.0 but did not focus on the implementation portion or applicable factors. A total of 23 records met all eligibility requirements and the inclusion criteria. These records, which were chosen for the review, were published between 2015 and 2022.

It is important to mention the risk of bias in the selection of relevant papers. In this review, bias could occur through the application of the exclusion and inclusion criteria, or when determining applicability to the systematic review. To address the potential bias, clear and objective RQs were considered throughout the selection process.

2 Bibliometric Analysis

Bibliometrics uses both qualitative and quantitative techniques to assess the content and maturity of available literature (McBurney & Novak, 2002). Using the core set of publications identified through the SLR, the 23 papers were evaluated based on specific standards (Tranfield et al., 2003). The chosen criteria help to provide valuable insights about the development of Industry 4.0 in A&D. The information collected include characteristics of publication, the author(s), and the research design used; this section addresses RQ3.

2.1 Characteristics of the Publication

To understand the trends in the paper set, the number of studies per year was identified. The SLR searched for papers published between 2015 and 2022, with the final set including studies from 2017 to 2021, as shown in Figure 3.

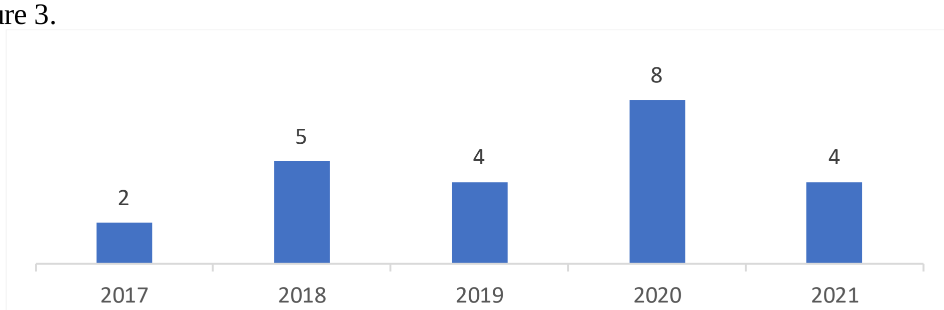

Fig. 3: Publications Per Year.

The earlier studies used descriptive methods based on literature reviews to provide insight into elements needed for success. These papers focused on providing theoretical frameworks and qualitative assessments regarding implementation challenges. More recent studies, including those from 2020 and 2021, use case studies and structured questionnaires to gain more insight into implementation in the field. This evolution reflects the modernization of techniques to synthesize evidence and the need to understand Industry 4.0 in practice. The results also provide more confidence in the recent studies to help understand the current state of Industry 4.0 implementation challenges and impacts. In addition, although not consistent, the increase in research since 2017 is shown with the most papers being published in the 2020 timeframe. This reiterates the research area of Industry 4.0 is growing as more organizations are attempting to utilize the advancing systems.

Within the paper set, there were two types of studies – journal articles and conference proceedings. Figure 4 visually summarized these findings and showed the majority of the studies were journal articles.

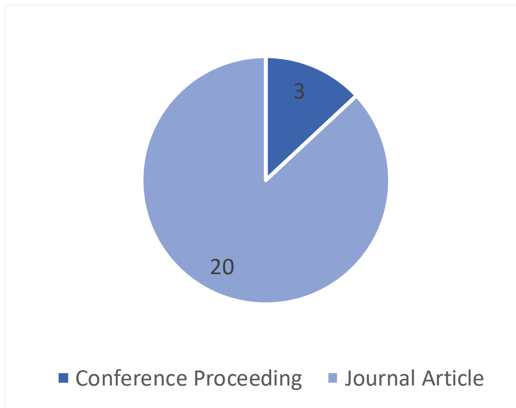

Fig. 4: Study Types.

This result emphasizes the emergent nature of the Industry 4.0 research area in A&D as most studies are categorized as academic, descriptive, or exploratory investigations. In addition, there are very few examples from conferences or books which focus on industry best practices or lessons learned.

2.2 Characteristics of the Author(s)

To further understand the publications, the characteristics of the authors were investigated to highlight the perspectives contributing to the research topic. This also includes understanding the disciplines of the contributors and the location of the research being performed. Using the 75 total authors included in the 23 papers, Figure 5 depicts whether the author represents academia or industry.

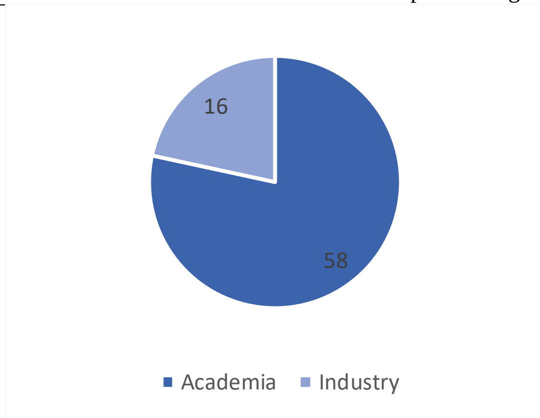

Fig. 5: Author Representation.

It can be suggested there are few experts within the field of A&D Industry 4.0 as no two others have more than one study included in this data set. However, there is collaboration amongst authors as there was an average of 3.26 authors per study. This result emphasizes the need for more practical and empirical studies investigating the integration of Industry 4.0 within the field. Expanding on this, Figure 6 summarizes the academic or professional associations of the authors.

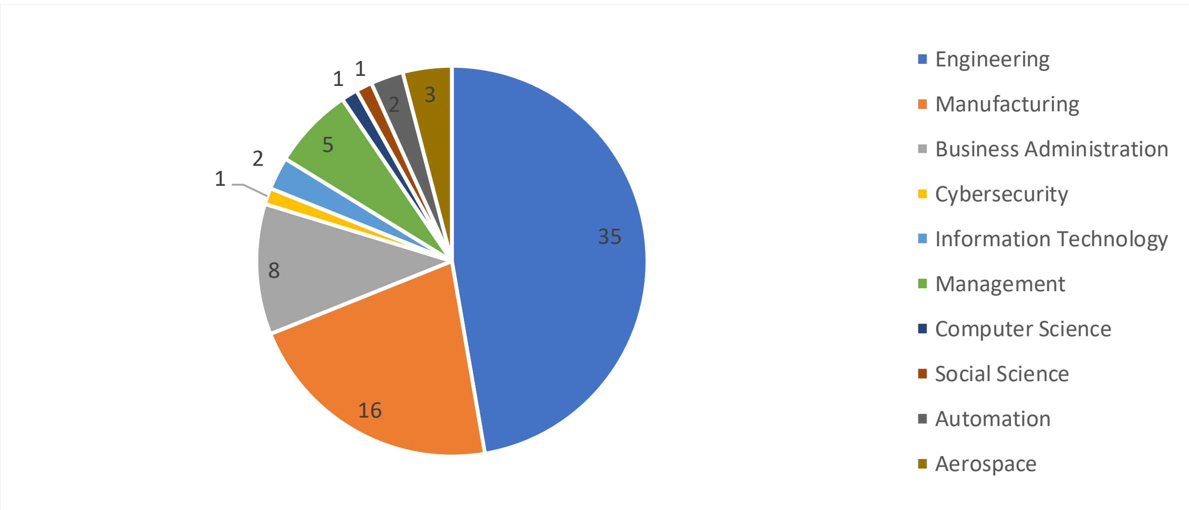

Fig. 6: Author's Discipline.

The above analysis shows most of the research is being conducted from an engineering perspective, followed by manufacturing and business approaches. The multitude of disciplines found in the set of publications echoes the multifaceted topic of Industry 4.0 and the interdisciplinary nature required for successful implementation. Moreover, the international interest and preliminary collaboration efforts in this area are evident with 19 countries being represented in the papers.

2.3 Characteristics of the Research Design

The classification of methodologies in terms of data collection and the data analysis approach was also investigated. The results, summarized in Figure 7, show over 56% of the studies used the traditional literature review method and 26% used the SLR approach to collect information. This indicates there is ample data from the conceptual or theoretical standpoint related to industry 4.0. On the other hand, three studies used case studies to collect data while one paper utilized a survey. This reiterates the lack of practical research related to Industry 4.0 implementation, particularly in the A&D domain, and the developing or emergent theories during this time.

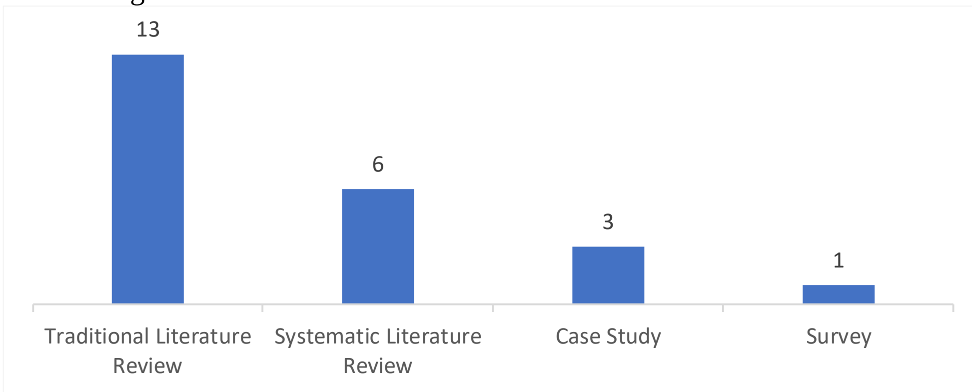

Fig. 7: Data Collection Method.

To further understand the maturity, development, and rigor of the research related to Industry 4.0 in A&D, the methodologies used in the selected set of papers were also examined; these results are shown in Figure 8.

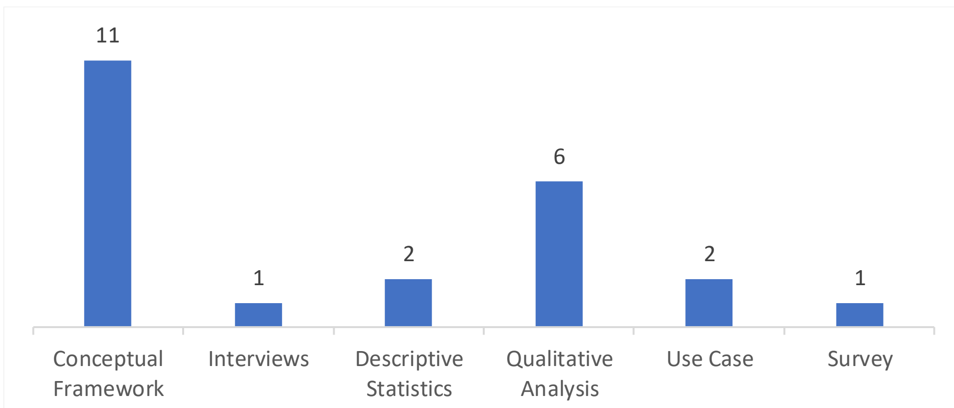

Fig. 8: Data Analysis Method.

The most common approach for data analysis was to provide a conceptual framework followed by the use of qualitative analysis. These methods highlight the exploratory nature of this research topic and the need to further explore implementation models. Other utilized methods include generating descriptive statistics following case studies, conducting an interview to understand the challenges of Industry 4.0 implementation in manufacturing environments, using a survey to investigate the applicable factors for using augmented reality, and evaluating digital twin environments via the use case method.

These data collection and analysis methods were mainly exploratory in nature and showed the need to further develop empirical research in this domain.

2.4 Content Characteristics

The content, in terms of identified keywords and the specific Industry 4.0 technology mentioned, was explored. The exploration began with compiling the keywords provided by the authors to understand the most frequently used and to also identify the variations in terminology amongst the papers. A total of 109 keywords were gathered with each paper using approximately four keywords per article. Figure 9 displays the most frequent keywords found in the SLR.

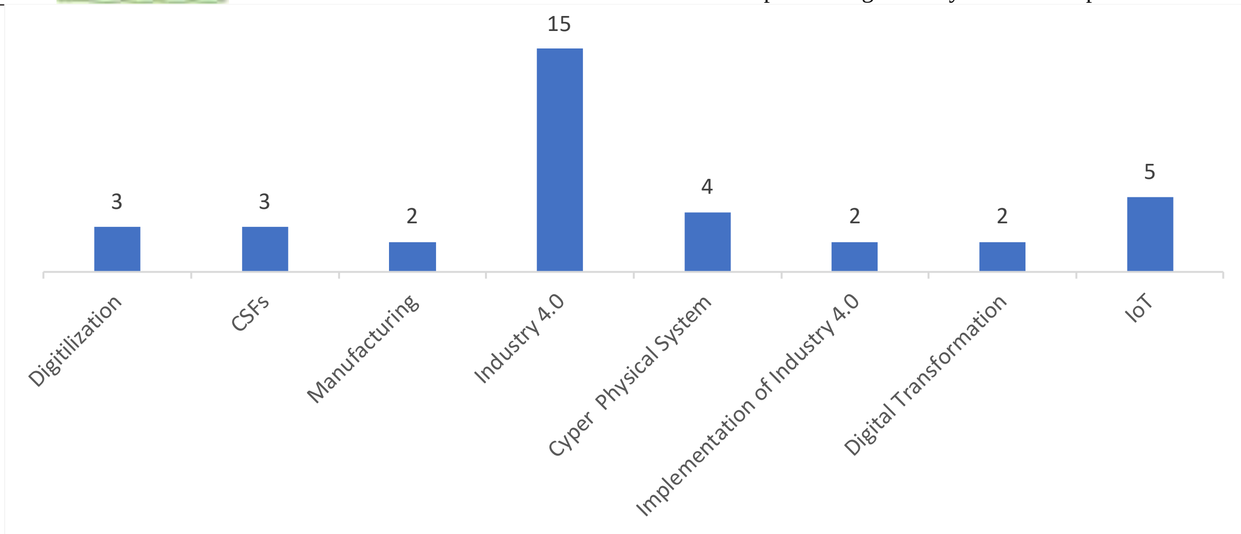

Fig. 9: Most Frequent Keywords.

This analysis helps provide insight to the topic of the study, aids in learning variations in terminology within the research field and assists in expressing significant constructs. The most common keyword used in the set of papers was Industry 4.0, with a significant number of occurrences compared to the remaining set of words. In addition to this list, more than 15 other keywords were mentioned once in the data set. This emphasizes the variations amongst the terminologies in this research domain. For example, terms such as “smart factory” and “smart manufacturing” were mentioned in different articles. Further, the “workforce” and “management” keywords also had dissimilarities but indicate these are important categories of factors to consider during Industry 4.0 implementation.

The specific types of Industry 4.0 technologies mentioned within the papers were also studied. The results can be seen in Figure 10.

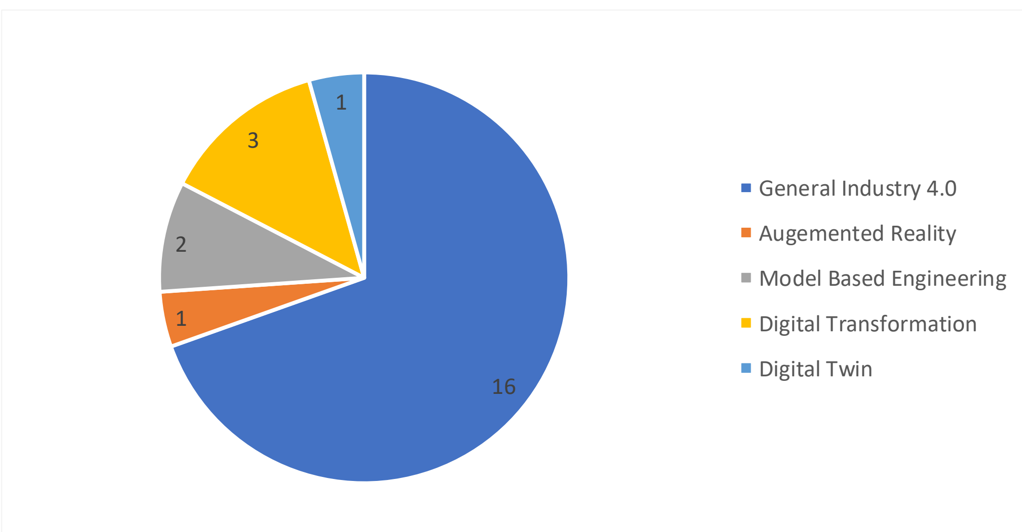

Fig.10: Industry 4.0 Technologies.

The majority of the papers did not specify the type of Industry 4.0 solution which the study was focused on. These papers did provide a high-level summary of increasingly popular smart technologies but used a more system level approach to discuss the overall challenges, benefits, and key factors for use. Three of the papers focused on digital transformation techniques, which is another variation in effort and terminology to the digital twin concept studied in another article; augmented reality and using model-based approaches were less popular topics of the studies. This result proves that increasing research related to the general concept of Industry 4.0

solutions is needed prior to elaborating on each specific smart technology. This initial background can be applied to future efforts, including those involved with improving the methods for implementation.

Table 2: expands on the technologies mentioned in the paper and provides a list of the cited technology as well it's application or definition.

Table 2: Industry 4.0 Technologies from SLR.

Source	Technology	Application or Definition
Havle & Ucler, 2018	Advanced/Smart Robots	Autonomous robots with integrated sensors and standard interfaces
Havle & Ucler, 2018	Additive Manufacturing	For manufacturing prototypes and spare parts
Masood & Egger, 2019	Augmented Reality	Digital enhancements with display devices; positioned between physical and virtual reality with broad applications such as training or assembly operations
Havle & Ucler, 2018	Simulation	Represents optimization using real time data
Havle & Ucler, 2018	Horizontal and Vertical System Integration	Integrated value chain from supplier to customer
Havle & Ucler, 2018	IoT	Networked machines, products, and communication
Havle & Ucler, 2018	Cloud Computing	Real time communication for production using large amounts of data
Havle & Ucler, 2018	Cybersecurity	Intelligent machines managing security risks for systems and products
Havle & Ucler, 2018	Big Data Analytics	Analyzing data from various digital measures
Bécue et al., 2020	Digital Twin	Aids in monitoring and controlling through replication physical assets
Abollado et al., 2017	Digital Workflows	Management tool to improve, automate, improve organizational performance, and streamline processes
Da Silva et al., 2019	CPS	Unification of digital environment with the real world through multidisciplinary engineering systems
Papke et al., 2020	MBSE	Project captures and maintains system design information in a system modeling toolset and data repository
Bibby & Dehe, 2018	e-Value Chains	Connect the entire supply network from suppliers to distributers to end customers

Source	Technology	Application or Definition
Bajic et al., 2020	Fog and Edge Computing	Decentralized service for storage and processes; can act as the interface between end users and cloud data centers
Bajic et al., 2021	Semantic Web Technologies	Allow humans and computers to work collaboratively

Lastly, NVivo 12 Pro was used to perform an assessment on the most frequent words within the paper set to provide insight into the key concepts associated with the research topic. Figure 11 depicts the 30 most frequent words used in the articles but excludes words with less than four letters to reduce nuisances in verbiage or common acronyms.

Fig. 11: Most Common Words from SLR

The results show words such as management, performance, support, information, and improvement are all components of Industry 4.0 and should be studied as potentially influential constructs. Other attributes include challenges, engineering, digital, and integration.

3 Review of the Literature

3.1 Defining Industry 4.0

The included literature reaffirmed the lack of a uniformly accepted definition of Industry 4.0. Furthermore, although there is agreement that the revolution started in Germany, there are variations in the attributes which comprise this approach. Havle and Ucler (2018) stated Industry 4.0 is a transformation of technologies and organizations which requires physical components to integrate and communicate with the digital environment. Becue et al. (2020) added that digitalization results in economical and societal changes as well. One study suggested there are six principles of Industry 4.0 related to virtual replicas of physical processes, interoperability, decentralization, real-time capacity, service orientation, and modularity (Da Silva et al., 2019). Another article added three more attributes to this list including cost reduction, mass personalization, and convergence (Pollak et al., 2020).

Although this paper utilizes the definition of Industry 4.0 mentioned in Table 1, further definitions of Industry 4.0 mentioned in the paper set are included below, in Table 3.

Table 3: Definitions of Industry 4.0 from the SLR.

Definition	Source
"A new value chain organization and management throughout the products life cycle."	Kagermann & Helbig, 2013
"A collective term for technologies and concepts of value chain organization."	Hermann et al., 2016
"Fusion of technologies that is blurring the lines between the physical, digital and biological spheres."	Unido, 2017
"A complex communication network between various companies, factories, suppliers, logistics, resources and customers."	Qin et al., 2016
"The new technological developments that the Internet and support technologies form the backbone of integrating physical objects, human players, intelligent machines, production lines and processes across organizational boundaries."	Shaif et al., 2015
"Fostering strong customization of products under the conditions of highly flexible production, introduction of methods of self-optimization, self-configuration, self-diagnosis, cognition and intelligent support of workers in their increasingly complex work."	European Commission, 2017
"Designated the digital networking of people, products and machines, and moreover the closely related intelligent data processing, digital value-added services and business processes."	Sony & Naik, 2020
"An integrated digital approach that uses authoritative sources of systems' data and models as a continuum across disciplines to support lifecycle activities from concept through disposal."	Zimmerman et al., 2019
"Horizontal integration of networks to facilitate intercorporation collaboration, vertical integration of hierarchical systems inside a factory…and end-to-end engineering integration across the entire value chain."	Pollak et al., 2020

3.2 Challenges and Benefits of Implementation

This section is focused on discussing the challenges and benefits of implementing Industry 4.0 technologies mentioned in the SLR papers. Both these sections address RQ 1 and Sub RQ 2.

There are challenges associated with the prevention of large-scale implementation, which can be considered barriers or obstacles to Industry 4.0. The main barriers include the lack of government regulations, the need for high financial investments, the poor technological infrastructure, the complexity of the technologies, organizational issues, and lack of human capital (Da Silva et al., 2019).

There are also challenges associated with the process of Industry 4.0 integration. Managerial, security, technological, and financial are categorical groups that encompass multiple implementation concerns (Da Silva et al., 2019). For example, due to the resulting social changes (Rahanu et al., 2021) and modifications of the role of human workers (Becue, et al., 2020), there are many managerial issues dealing with the lack of human resources, such as various levels of skilled workers, a clear strategic vision, differing definitions, and financial resources. There is also the resistance to upgrade knowledge and the uncertainty involved with personnel data protection (Bajic et al., 2020) as there are new categories of risks and vulnerabilities increase in parallel with the amount of real-time data and connections to cyberspace (Tupa et al., 2017). Financial uncertainties such as the return on investments (ROI) and technological challenges including the integration of machines and newfound dependencies on automation (Da Silva, 2019) are additional challenges that need to be addressed to incorporate Industry 4.0 in A&D. There are also potential obstacles associated with the strategy of implementation; Sony & Naik (2020) stated an organization can lose its sense of purpose and generate chaos if the approach involves quick adaptation and integration without proper planning.

To resolve concerns, there needs to be ethical guidance for developers and users (Rahanu et al., 2021), assurance of integrity and positive human-machine interactions (Elkaseer et al., 2018), standardization of policies, data governance, an assessment of the transformation process, and knowledge of the technologies prior to incorporation. Adoption requires understanding the potential benefits of the technologies to help alleviate these barriers and challenges (Masood & Egger, 2019). Potential benefits are categorized as economic, environmental, social, technological, or a combination of these. Economic advantages include real-time decision making, improvements in quality, increased competition, reduction in processing times, and transparency between organizations. In terms of environmental impacts, Industry 4.0 can aid in failure prevention, reduction of waste, and increased energy savings. There are also social advantages, including more uniformed processes for workers and reduction of high-risk tasks performed by personnel, (Da Silva et al., 2019) as a result of overall advances in systems and advancements in systems due to using smart technologies. These technologies, if effectively integrated, can establish new types of services, products, or more value-added business models. In addition, mass customization of parts, automatic or flexible production chains, product optimization, enhanced communication channels, and increased human-machine interactions all result from using these approaches (Havle & Ulcer, 2018). The inclusion of complex machines can help to simplify processes while reducing costs, increasing the quality of the service or product, developing green solutions such as sustainable manufacturing, and enhancing competitiveness and innovation (Pozzi et al., 2021) within organizations.

3.3 A&D Adoption Models

Understanding the benefits and challenges of implementing Industry 4.0 in A&D is essential for successful execution. The DOD mandate of modernizing systems and capabilities to streamline processes and improve practices (Wang, 2020) is driven by the 2018 DOD Digital Engineering Strategy and Systems Engineering Transformation (SET) initiatives (Zimmerman, 2019). The transformation is needed to sustain complex systems in an environment with constantly changing threats and evolving mission requirements. To deliver agile capabilities and speediness in results, Wang (2020) emphasized that transformation involves more than tools or infrastructure but also encompasses changes in processes and people, where the latter is considered the hardest issue to tackle.

Zimmerman et al. (2019) referenced recent and ongoing initiatives such as the Submarine Warfare Federal Tactical Systems, Naval Air Warfare Center (NAVAIR) SET, and Future Vertical Lift (FVL), to discuss the enablers and readiness of Industry 4.0 in A&D. Enablers include the strategies, policies, continuous improvement initiatives, workforce culture, and employee training. These constructs are needed to assess the readiness of integrating smart technologies in the defense sector with the goal to transform the design, development, delivery, and operations of complex A&D systems (Zimmerman et al., 2019).

Bibby & Dehe (2018) assessed Industry 4.0 readiness and maturity in the United Kingdom (UK) defense sector by performing an assessment using a focal firm and 14 experts. The results emphasized three key areas for assessment – factory of the future, people and culture, and strategy. Wang (2020) also summarized lessons learned from recent DOD efforts. These include the need for an overarching vision, development of priorities, using an incremental approach, adherence to the vision, and needing support from executive management.

Bibby & Dehe (2018) described two maturity models from two different consulting firms; the first gives feedback on the organizational opportunities and provides advice for improvement. The second model, by PwC, gives an assessment of the organization’s current Industry 4.0 status before giving advice on how to proceed. Pacchini et al. (2019) studied the readiness of a Brazilian diesel engine manufacturing company, where the results stressed the importance of understanding the current status of an organization prior to implementing

Industry 4.0. Fitsillis et al. (2018) identified the need to recognize personnel competencies to assess readiness as the skills required are numerous and diverse. This paper recommended learning the different work segments, product life cycles, and technologies within an organization to calculate the required skills and training needs for Industry 4.0 readiness.

There are multiple adoption models mentioned throughout the literature as well; Butt (2020) recommended using a modified Business Process Management (BPM) method to ensure that all applicable business processes are effective. On the other end, Masood & Egger (2019) acknowledges four models which are not ideal for the implementation of Industry 4.0. For example, the Diffusion of Theory (DOR) is not preferred as it does not incorporate the environmental aspect of Industry 4.0, which is a component that can be categorized as an essential barrier or driver. The Technology Adoption Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) focus on the individual user, which is not preferred due to the narrow scope and not focusing on the potential organizational changes with larger impacts. The suggested approach follows the TOE method (Technology, Organization, Environment) where each measure can either promote or impede implementation success (Masood & Egger, 2019). This method was used as a basis to further develop the constructs described in Chapter 5, as it can be used to assess the readiness of an organization to transform and incorporate Industry 4.0 solutions in A&D.

4 Conclusion

Using the PRISMA approach, 23 publications were selected to investigate CSFs for implementing Industry 4.0 in A&D. To assess the maturity of this literature, a bibliometric analysis was performed. The bibliometric analysis reviewed metrics that show the diversity of disciplines researching Industry 4.0. Although the authorship revealed a minimal number of industry experts empirically testing data, a multitude of countries and technologies were discussed. The number of studies and research growth per year were also evaluated, as well as the approaches for data collection and analysis.

Although A&D manufacturers are expected to lead the transition of smart factories and Industry 4.0 implementation (Minnick, 2017), the articles describe the challenges of acceptance and barriers to integrating these technologies. This includes variations in defining the associated terminologies and different assessment models being used to propose requirements for Industry 4.0 in the field. Due to the lack of empirical testing in the articles, as well as the factors and the approaches not being unified, a more detailed analysis of the existing evidence is needed to develop a comprehensive framework. The next chapter focuses on a thematic analysis to uncover common themes and identify CSFs within the publications, as the multitude of factors mentioned in the papers requires categorizing and prioritizing to improve chances of success.

5 Limitations of the SLR

Although beneficial, the SLR method also includes limitations and biases in the selection process. During the initial review phase, the researcher may lose some potential relevant work when searching with the “everything but full text” feature of the database. However, this approach was used to limit capturing papers that mentioned the search term once within the article. Further, if the article mentioned the term within the title, abstract, subject line(s), or in the keyword(s), the chance for relevance to the topic increased.

There are also limitations in terms of the variations of terminologies used across publications. This can cause inhibit inclusion of all related work. While the use of iterative searching can aid in this limitation, there is still the possibility of missing applicable research. Similar to search methods, there are limitations with the various platforms. Indexed publications are limited depending on the database. To address this, multiple platforms were used to increase the capture rate of the search. Other methods which were included involved strategic development of the inclusion and exclusion criteria to establish a specific scope and identify the range of terminology related to a single concept.

Future efforts can use more search iterations and multiple knowledgeable researchers to further refine and improve the overall research approach while minimizing limitations. The research can also be extended through further investigation of the interrelationships amongst the factors, more in-depth analysis of the identified factors within A&D, and operationalizing the factors to better comprehend the constructs. In addition, field studies can be performed to provide validation approaches for empirical testing.

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