SUCCESSION PLANNING TECHNOLOGY TRENDS AND THE INFLUENCING FACTORS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Growth in Organization can trigger a change in the organizational structure that could happen suddenly, by design, or as predictable. Such as promotion, resignation, or any other process that could cause the organization's leadership emptiness. Seeing this as an essential thing, the organization must have succession planning. Succession planning can prepare successors systematically and continuously. Conventional succession planning has been implemented in many organizations but without involving technology in all the processes. Machine Learning techniques can be used to improve succession planning. To see what's the trends of succession planning articles and to know what factors influenced succession planning specifically in the candidate selection process, this paper used a Systematic Literature Review from Kitchenham as the research method. The database of this study gathers information from the early Covid19 pandemic era to see how succession planning was before the impact of the Covid19 pandemic. This paper found three trends in succession planning focus areas: concept, research, and thesis or dissertation product. Besides that, there are 23 factors extracted from the papers that influenced succession planning. The implementation of methodology such as machine learning is also discussed in the result papers to improve the process and implementation of Succession Planning in the organization.

Keywords: *Succession Planning, Machine Learning, Human Resources, Education, Systematic Literature Review*

1. INTRODUCTION

Information and communication technology (ICT) development causes positive impacts on an organization's growth. Five technologies transform the foundations of global business and the organizations that drive it: cloud and mobile computing, big data and machine learning, sensors and intelligent manufacturing, advanced robotics and drones, and clean-energy technologies [1]. The impact caused by ICT in the organization could be a change in business processes, procedures, and organizational structure. One of the most critical areas is the human resources department inside the organization. There are many processes in the human resources department, but one that is at the center of this research is the succession planning process. This is important because only a few organizations can sustain themselves without succession planning [2]. Succession Planning is a continuous and systematic process of developing individuals inside the organizations to save the critical position in the future [3]. Organizations need to prepare successors for their key roles, but it's not just about replacing; it needs to develop candidates to be the best successors. Historically, succession planning has only replaced positions and has not focused on talent potential [4]. Therefore, succession planning must be a whole process from candidate search and preparation to evaluation. Many technologies are used in the succession planning process, one of which uses machine learning techniques [5]. Machine learning is a set of processes that allow computers to develop and program models that work on data by finding meaningful systematic models using statistics from available data [6]. Concerning this technique and to solve the problems that rose along with the organization's growth such as the sudden change in the organization structure and the leadership vacuum, this study seeks to answer the

research question: what's the current trend in succession planning technology. Furthermore, the purpose of this study is to find out the algorithms or machine learning techniques that have been used for succession planning in the organization that can enrich the knowledge for the future succession planning implementation in organization.

2. METHODOLOGY

The methodology used to carry out this research is the Study Literature Review (SLR) of [7], which includes several phases: determination of the source of information, determination of search keywords, criteria to initiate inclusion and exclusion, data extraction, and analysis to define the research question

2.1 Information Source

The literature sources used in this research are AIS (aisle.aisnet.org), ACM Digital Library (dl.acm.org), IEEExplore Digital Library (http://ieeexplore.ieee.org), Science Direct (www.ScienceDirect.com), Emerald Insight (www.emeraldinsight.com). A keyword pattern that is used to answer a research question formed with the Boolean operators "OR" and "AND", a combination of keywords to the right of ("machine learning" AND "succession planning") OR ("Algorithm" AND "Succession Planning") OR (" Machine Learning "AND" Human Capital "). The criteria to validate the sources are the following: Article published between January 1, 2010, and April 10, 2020. The article has a complete structure consisting of a journal/conference, the identity of the author, and other information. Duplicate posts are removed from the source list.

2.2 Data Extraction

This research analyzes 3397 articles as found papers from various sources. The number of 251 articles is selected after an analysis based on the title and abstract. These papers are the candidate papers, some of which will be selected later as main papers for discussion. The process continues to delve into the content of any paper that could answer the research question. The result of this process is 34 papers selected, as shown in Table 1 below.

Table 1: Data Extraction with Inclusion Criteria

Source	Founded	Candidate	Selected
AIS	1347	119	20
IEEE	259	25	3
ACM	1218	65	3
EmeraldInsight	573	42	8
TOTAL	3397	251	34

The 34 papers that were selected will be analyzed besides to see the trends of publication and also to see which paper discussed technology implementation in Succession Planning and which discussed succession planning factors.

3. RESULT AND DISCUSSION

This research aims to identify the trend in succession planning research or the concept that is using or implementing technology and or machine learning to improve the succession planning process. This study will provide demographic and characteristics data of the selected article, including the sources and year of publication, the country of production and the institution, the discipline of the researcher, the research sector, and the trend of succession planning. Limited to submitted pages, this document excluded and simplified some tables.

3.1 Demographic and Trend Characteristics
3.1.1 Publishing Outlet

Research has found many articles related to succession planning, some of which are published in the international journal (J) (18 papers) or from international conference proceedings (C) (9 papers). The papers can also be found in the form of a dissertation(T) or online resource (O) of the respective publisher, as seen in Table 2. This shows us that research on succession planning published in journals and conferences is still being conducted by researchers or is becoming an online resource for learning material. The range of research years in Table 2 also defines that succession planning is still being investigated until now. Even if the number of publications fluctuates from 2010 to 2020, as can be seen, there is only 1 paper on succession planning technology that appeared in 2012. In 2017 the number of papers was 8, then in 2019, the number was 13. In 2020 the number of papers was only 1. Since the final search ranges were in April 2020, there are more months until the end of 2020.

Table 2: Publication Year

No	Paper	J/C/T/O	Year
1	Exploring …[8]	C	2017
2	HR Metrics …[9]	J	2017
3	The …[10]	T	2015
4	Succession …[11]	T	2020
5	Leadership …[12]	T	2017
6	Intelligent …[13]	J	2019
7	Random …[14]	J	2019

No	Paper	J/C/T /O	Year
8	Relation …[15]	T	2019
9	"Where's …[16]	J	2019
10	Can …[17]	J	2017
11	What …[18]	J	2019
12	Big-Data …[19]	T	2019
13	What …[20]	J	2015
14	Sieving …[21]	J	2015
15	Key …[22]	T	2017
16	How …[23]	J	2019
17	Factors …[24]	C	2019
18	Re-examining …[25]	T	2016
19	Employee …[26]	J	2018
20	Organizational …[27]	C	2012
21	Automated …[28]	C	2018
22	A Service-Oriented …[29]	C	2019
23	A Data-driven …[30]	C	2019
24	Modeling …[31]	C	2017
25	Automated …[32]	C	2018
26	Predicting …[33]	C	2014
27	The …[34]	J	2017
28	The …[35]	J	2018
29	AI: …[36]	J	2019
30	Making …[37]	J	2019
31	From …[38]	J	2017
32	People …[39]	J	2019
33	Applying …[40]	J	2018
34	Implicit …[41]	J	2016

The source of the papers is mainly the journal, following Table 3 lists most of the journals or conference proceedings that published the papers. About fourteen percent is the Cornell University ILR School and the Strategic HR Review-Journal which produce 5 papers each. Followed by the Americas Conference on Information Systems (AMCIS), which produces 2 papers, and Walden Dissertations and Doctoral Studies, which produces 2, the remainder of the journal produces 1 paper each, or about 2.94% of the total 34 papers selected. These two Journals are the top two journals that publish

papers about succession planning technology in the period of data.

Table 3: Source of Paper

No	Journal	#	%
1	Cornell University ILR School		14,71%
2	Strategic HR Review	5	14,71%
3	Americas Conference on Information Systems	2	5,88%
4	Walden Dissertations and Doctoral Studies	2	5,88%
5	Annual IEEE International Systems Conference (SysCon)	1	2,94%
6	Business Educator Scholarship	1	2,94%
7	Doctor of Nursing Practice (DNP) Projects	1	2,94%
8	Engineering Management, Information, and Systems Research Theses and Dissertations	1	2,94%
9	European Journal of Training and Development	1	2,94%
10	Grand Valley State University Senior Projects.	1	2,94%
11	IEEE International Conference on Systems, Man and Cybernetics (SMC)	1	2,94%
12	IEEE International Systems Conference (SysCon)	1	2,94%
13	International Conference on Information Technology: IoT and Smart City	1	2,94%
14	International conference on Knowledge discovery and data mining	1	2,94%
15	International Conference on Machine Learning and Computing	1	2,94%
16	Journal of International Technology and Information Management	1	2,94%
17	Journal of Engineering, Design and Technology	1	2,94%
18	Journal of Organizational Effectiveness: People and Performance	1	2,94%
19	Master's Thesis, University of Tennessee	1	2,94%
21	Personnel Assessment and Decisions	1	2,94%
22	Practical Assessment, Research, and Evaluation	1	2,94%
23	SMU Data Science Review	1	2,94%
24	The Oxford Handbook of Talent Management	1	2,94%
25	Theses and Dissertations. Pepperdine Digital Commons	1	2,94%
	Total	34	100%

In terms of the research sector, the author found that some sectors become the focus of succession planning research. Those sectors then clustered into business, government, and education. As can be seen in Table 4, the number of papers focused on business is 31 articles, which is approximately 91.18%, while

only two articles focus on education, and one focuses on government. This shows that only a few researchers have done research on succession planning in education and the government sector, so there is still room for improvement in these areas.

Table 4: Research Sector

Group Sector	#	%
Business	31	91.18%
Education	2	5.88%
Government	1	2.94%
Total	34	100%

3.1.2 Most Prolific Authors

The study about the paper's author at the time of data collection shows that only three authors published 2 articles, while others only published 1 article. The three authors are Ratnik Gandhi, Raxit Goswami, and Sanjay Chaudhary; all come from the same article titled: "Automated Human Capital Management System" in 2018 and "A Platform of Recommendations for Service-Oriented Human Capital Management". While the rest of the authors only produced one article on succession planning technology. So, this field of study still has many opportunities to become a research topic. Seeing the table below, the authors' discipline backgrounds are various, including Management (37.33%), then followed by Computer Science (32.14%), and Information Systems (15.48%). They are the top three background areas of the authors. Based on Table 5 below, the topics of succession planning remain the focus of authors from the management discipline area. But in the future, collaboration between different disciplines is needed to enhance succession planning.

Table 5: Authors Discipline

Discipline	#	%
Management	28	33.33%
Computer Science	27	32.14%
Information Systems	13	15.48%
Statistics	5	5.61%
Education	4	4.76%
Psychology	4	4.76%
Total	84	100%

3.1.3 Most Productive Institution

Of the 34 papers found, there are 39 author's institutions, around 84% are universities, 12.82% are industries, and 2.56% are research institutes. There is the Ahmedabad University of India, with 11 researchers publishing articles on succession planning. Followed by 7 or about 8.05% of Cornell University researchers and 6 National Defense Technology University researchers as the top three most productive institutions. So, most of the research about Succession Planning Technology is still being done by researchers at the University.

3.1.4 Trends

Table 6 shows the trends of succession planning (SP) and or Machine Learning (ML) in different areas, grouped by concept, research, or thesis purpose

Table 6: Trends

No	Type of Papers	SP / ML	#
1	Concept	SP	6
2	Concept	SP ML	3
3	Research	SP	14
4	Research	SP ML	10
5	Thesis	SP	1

The concept means that succession planning technology has been discussed as a concept or theory in study material or articles. Research means that succession planning technology has been in a research focus or allows a beneficial implementation in succession planning. The thesis means that the purpose of the paper is for the compliance study of the researcher. The result of most of the trends of the article published on succession planning is for research, it is about 55.88% and the second place is for the concept of succession planning technology which is about 23.53% and it is the last one only for the purpose of the final thesis.
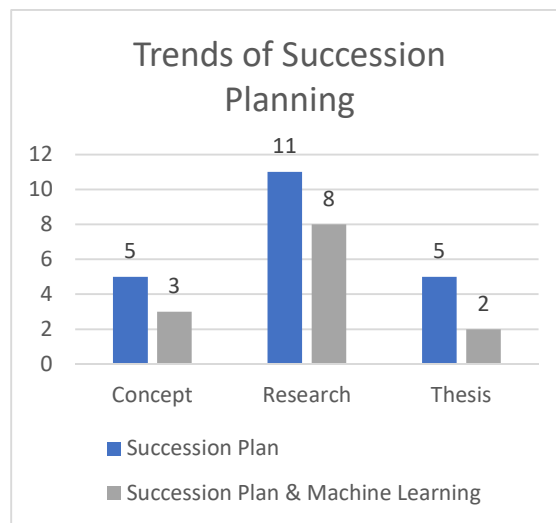

Figure 1: Trends of Succession Planning

Figure 1 shows the publication on succession learning for research, with 19 papers being the most trending one, 8 out of 19 discussed machine learning used in succession planning. In comparison, 11 papers covered succession planning technology in general. Followed by 8 concept papers on succession planning, where 5 papers dealt with succession planning in general and three papers dealt with machine learning in succession planning. The Thesis type of publication consists of 5 papers that discuss succession planning in general, and 2 out of 7 papers discuss machine learning in succession planning. This shows us that succession planning is important, and the use of technology to improve the process remains a focus of research. For example, research in Human Resource Analytics by [8], which has used exploratory case and qualitative research, suggests that business analytics needs more research for decision-making and provides an application for succession planning. Another researcher [9] also provides succession planning factors for talent analysis, such as Business meeting imperative, competitive advantage, internal potential talent, and data infrastructure. [10] in his research, which focuses on the business sector, he identifies some factors that affect working time, such as Individual characteristics like race, age, and marital status.

3.2 Factors of Succession Planning

Based on the 34 papers found, some papers deeply discussed important factors in the succession planning process, especially that related to successor candidates. There are 23 Factors extracted from 8 papers that can be seen in Table 7 below:

Table 7: Succession Planning Factors

Paper	Factors
Exploring Functional Affordances and Sensemaking in Human Resource Analytics [8]	1. Knowledge of the successor's candidate 2. Experience 3. Competencies 4. Psychometrics assessment
The Effects of Individual and Employer Characteristics on Hourly Employee Retention: An Empirical Study [14]	5. Helpfulness 6. Enthusiasm 7. Work Drive 8. General Reasoning 9. Ethical Behaviour 10. Service Urgency 11. Comfort with Procedures
Automated human capital management system [24]	12. Qualification 13. Locations

Paper	Factors
A Service-Oriented Human Capital Management Recommendation Platform [19]	14. Career Expectation
A Data-driven Analysis of Employee Promotion: The Role of the Position of Organization [20]	15. Geographic and Structural Position
Automated CV Analysing and Ranking Tool to Select Candidates for Job Positions [22]	16. Educational Background
Applying HR analytics to talent management [25]	17. Business and Professional Literacy 18. Personal Ability 19. Networking
Implicit assumptions in high potentials recruitment [26]	20. Work Delegation Ability 21. Adaptation Ability 22. Developing Mind Set 23. Value Integrity

These factors also need to be concerned regarding finding the best successor. In the papers found, the authors used different methods and techniques to find the relationship between the succession planning factors and the Human Capital process in general. Based on the 23 factors found, this research categorized all the factors into three types: Profile, Competencies, and Nature, which can be seen in Table 8. The profile category contains factors that explain the background and successor candidate's preference, while competencies explain the ability that own by the successor candidate. The last, Nature is the category that explains the character of the successor candidate. These factors found are based on the selected papers in this research and are still possible to grow and evolve in terms of number and type. These factors found are from many sectors of industry where succession planning becomes a focus in the research paper. So the definition and meaning of each factor are close to the specified sector but if it going to be implemented or used in another sector, there is still a possibility to combine the factors with more specific successor factors in that different sector.

Table 8: Succession Factors Categories

Categories	Factors
Profile	1. Experience 2. Psychometrics assessment 3. Locations 4. Career Expectation 5. Geographic and Structural Position 6. Educational Background
Competencies	1. Knowledge of the successor's candidate 2. Competencies 3. General Reasoning 4. Qualification 5. Busines`s and Professional Literacy 6. Personal Ability 7. Networking 8. Work Delegation Ability 9. Adaptation Ability
Nature	1. Helpfulness 2. Enthusiasm 3. Work Drive 4. Ethical Behaviour 5. Service Urgency 6. Comfort with Procedures 7. Developing Mind Set 8. Value Integrity

3.3 Technology Perspectives

Thirteen Papers found deeply discussed machine learning implementation in Succession Planning; the papers are below:

1. Intelligent Software Tools for Recruiting [11] has three objectives of research first, elaborate on how recruitment and talent acquisition gained importance within the HRM field, and the second explain a brief introduction of the newest tools used by professionals in recruiting process and last, describe AI-based tools that have important roles in the HRM field. In their research, the software application used by recruiters and talent acquisition professionals can be categorized into three types: Job aggregator software, which can scan jobs posted on various websites and bring them to one website. The second category is candidate assessment software; it helps to assess the candidates and choose the best one that matches the criteria. The third category is Applicant Tracking Software, which keeps track of the candidate process.

2. How is the Role of AI in Talent Acquisition Evolving? [12] found some AI tools that can be used to support Recruitment and Selection: Vacancy prediction software, Job description optimization Software, Targeted job advertising optimization, Multi-database candidate sourcing, CV Screening Software, AI-Powered psychometric testing, Video screening software, AI-Powered background checking, Employer Branding Monitoring, Candidate Engagement Chatbot/CRM, Automated Scheduling. Each of these AI Tools solved a specific problem related to Recruitment and Selection.

3. Factors Inhibiting the Adoption of Artificial Intelligence at the organizational level: A Preliminary Investigation by [13] focuses on closing the gap for the Australian industry to adopt AI. They found some barriers that are grouped into organizational, environmental, and technical barriers.

4. The Effects of Individual and Employer Characteristics on Hourly Employee Retention: An Empirical Study by [14] developed a model to predict how long the working period is based on pre-work application. This study found that personal characteristics such as race, age, and marital status significantly play important roles in the working period. The decisions that the organization has made after hiring employees are the most significant factor that influences the working period. These decisions include scheduling, job description, and staff's time to be promoted.

5. Random Forest as a Predictive Analytics Alternative to Regression in Institutional Research [15] argues that Random Forest is a valuable tool for institutional research predictive analytics tasks, it's because the random forest is easy to apply, flexible, and computationally inexpensive, and the decision-tree infrastructure provides an interpretable competitor to classic regression methods.

6. "Where's the I-O?" Artificial Intelligence and Machine Learning in Talent Management Systems by [16] focuses on the current state of AI/ML in talent assessment as well as its benefits and potential pitfalls. The potential benefit of AI/ML are reduced cost (time, effort, money, and human resources); increased power to handle large quantities of data; greater accessibility to previously burdensome forms of data; potential for increased predictive accuracy for individual

and organizational outcomes of interest. While the potential limitation of AI/ ML is that: Quality of prediction is bound by the quality of the data obtained and the appropriateness of the algorithm used; algorithms are, to some extent, a "black box" such that it is often unclear how or why AI/ML arrived at a given prediction; potential for future legal issues around data privacy and automated handling of personal data; unfavorable reactions towards AI/ML from job applicants, media and the general public.

7. Big-Data Talent Analytics in the Public Sector: A Promotion and Firing Model of Employees at Federal Agencies [17] objective is to investigate data science techniques to predict top performers in the U.S public sector using the various definition of top performance. They found a new model of promoting and firing that can be used by the federal government to plan for a productive workforce and bridge the productivity gap. One factor that becomes a high predictor of a "shiny star" is whether or not the employee holds a bachelor's degree.

8. Automated CV Analysing and Ranking Tool to Select Candidates for Job Positions [18] extracts the information from the CV and ranks the CVs according to given criteria to screen them out from the vast number of received applications in an organization. They create four modules: Data Extracting Module, Candidate profile Module, Job Recommendation Module, Generating Templates, and CV Ranking Module.

9. A Service-Oriented Human Capital Management Recommendation Platform [19] presents a stateless, scalable, micro-service-based architecture to push toward automation through recommendations using Machine Learning and Statistical Methods.

10. A Data-driven Analysis of Employee Promotion: The Role of the Position of Organization [20] attempts to put forward ideas on a data-driven solution to the promotion issue in HRM, and focus on the influence of the position of the organization. They found that structural position plays a more critical role than geographic position.

11. Modelling Intelligent Human Resources Systems by [21] describes the novel model of Intelligent Human Resources Systems (IHRS) using Big Data to analyze and predict about the future status of the employees based on the Support Vector Machine (SVM).

12. Automated CV Analysing and Ranking Tool to Select Candidates for Job Positions[22] extracts the information from the CV and ranks the CVs according to given criteria to screen them out from the vast number of received applications in an organization

13. Predicting employee expertise for talent management in the enterprise [23] deploys an analytics-driven solution that infers employees' expertise through the mining of enterprise and social data that is not specifically generated and collected for expertise inference.

Based on the thirteen papers, we can conclude that using technology supported by machine learning techniques is important in the Human Resource area, especially in the succession planning process, which becomes the main discussion in this research. In finding the best suitable candidates for a position, some researchers developed tools involving artificial intelligence and Big Data technology. The source of the candidate could come from the external or internal of the organization. These technologies or tools can help categorize or suggest the best one from hundreds of candidates. Regarding the factors involved in succession planning, the authors have a different point of view; it is normal considering the research developed from different fields and focuses.

4. CONCLUSION AND IMPLICATIONS

The study of succession planning technology trends using SLR from 34 papers found that the research concept and thesis being produced also give some factors that can improve the succession planning process and the implementation of Machine Learning for succession planning. The authors also found similar SLR methods used in some of the papers. The differences between the previous papers are based on the literature sources and the focus of the research, such as factors of succession plan candidates that have never been discussed in more detail. The 23 Factors that are categorized into three groups: Profile, Competencies, and Nature.

This research has theoretical and practical implications on the usability of using Technology in the Succession Planning Process, specifically in any industry sector. As a practical impact, the result

shows that only a little research has been done on succession planning in the government and the education sector, whether it's because not many education institutions already have succession planning or this area of research still needs to be explored more. Then the Succession Planning Factors found specifically for successor candidates are important to be concerned with implementing succession planning. Then to the theoretical implication, this research can be used as a reference to improve Machine Learning implementation in Succession Planning processes in Education and Government Sectors. The three main categories of factors found can be used as a reference to select perfect candidates in the succession planning process in various industries.

5. LIMITATION & FUTURE RESEARCH

This research has limitations in the search sources and any other possible research area related to machine learning in the succession planning process. The database searched in 2020 during the Covid19 pandemic, and the database in the after-pandemic era could give different results in return. In the future, combining another term or keyword search is advised to achieve more results. Next, this research will continue to discuss each factor generated by the selected papers in more detail.

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