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Text Mining Based Process Identification and Business Process Mapping from Job Description Documents

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Abstract
Business Process mapping (BP mapping) is important for a company to identify their activities. Previous research suggests several approaches for process identification and BP mapping, which would be easier if the company had already implemented a computer-based information system. The research presented in this paper has the purpose of providing an alternative method for BP mapping especially for the company that does not implement the computer-based information system. A proposed method is using job description documents that the company had to identify elements needed to perform BP mapping which are actor, process, document, and flow of documents. A Natural Language Process (NLP) which is text mining method is used for mining job documents to identify those elements that exist in each job position. To illustrate the applicability of the proposed method, samples of job descriptions of 15 companies are taken. It shows that the proposed method can be applied.

Keywords
Process Identification; Business Process mapping; Job Description Document; NLP; Text Mining.

Introduction

The business environment is rapidly changing right now (Adesola and Baines, 2005). As a result, every company must adapt to these changes (Seethamraju and Marjanovic, 2009; Zellner, 2011). Companies must anticipate these developments by evaluating business processes (BP). Companies must also analyze and increase their Business Process (BP) if management is dissatisfied with current conditions (Ingvaldsen et al., 2005; Weiss et al., 2016; Natarajan, 2005). Business Process Management (BPM) has a life cycle that includes process identification, analysis, redesign, implementation, monitoring, and control (Dumas et al., 2013). Typically, businesses conduct business process analysis as a foundation for process improvement (Pustulka and Hanne, 2021).

The relationship between processes is visually depicted in BPM as business process (BP) mapping (Siha and Saad, 2008). As a result, before conducting BP mapping and further business process analysis, the company must first identify the existing processes. A process, according to Soare (2012), is an activity that contributes to the conversion of inputs into outputs. Furthermore, the process can be interpreted as an activity that must be explained because it adds value to both the company and its consumers (Trkman, 2010).

One of the stages of the Business Process Improvement (BPI) methodology is BP mapping. BP mapping is included in the initialization stage, according to Gilberto (1995); Fisher (1996); Motwani et al. (1998); and Lee & Chuah (2001). Process identification, according to Gilberto, (1995); Fisher, (1996), can be accomplished by 1) observing the running process in real-time; 2) monitoring current processes and documenting them; or 3) conducting interviews with process owners and management (Gilberto, 1995; Islam and Ahmed, 2012). Furthermore, Van der Aalst and Weijters (2004) identified processes using a process mining approach, especially for companies that have implemented computer-based information systems. In this case, event logs are used to identify processes. However, according to Pustulka and Hanne (2021), such businesses frequently fail to document their processes

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and do not keep such logs. As a result, process documentation is done by hand. Another way to perform BP mapping was used by Ingvaldsen et al. (2005), who integrated formal documents in the company as a basis for BP mapping. However, the type of document used was not specified in this detail.

A job description document is an example of a formal document in a company. A job description is especially needed for a formal organization that is divided into several divisions according to their own set of duties and responsibilities that all employees in that division must fulfill. Workers will struggle to perform various tasks and responsibilities if they are only verbally communicated. To address this, a written document is required that details all tasks and responsibilities that employees must complete for each division. This written document is referred to as a job description document. To the best of the author's knowledge, in the previous research, there was no research dealing with the use of job descriptions for BP mapping. Therefore, this job description document is thoroughly examined in the research presented in this paper.

BP mapping requires several pieces of information, including: 1) actors carrying out the process; 2) processes carried out; 3) documents being worked on; and 4) document flow. Some of this information can be found in the job description document. However, if this information is retrieved manually, it takes a long time. In the research presented in this paper, a text mining method is proposed to assist with these activities.

The right sentence structure is required to facilitate BP mapping so that the word mining process using the text mining method is easier to do and the results are easier to map. However, no research on the improvement and design of job description documents that can be used to support the text mining process has been discovered so far.

The research presented in this paper aims to fill a research gap in the BP mapping area by providing an alternative method for process identification and BP mapping for the company that had not implemented yet the computer-based information system. The use of job description documents and text mining in process identification is used in the proposed method. In the proposed method, the redesigning job description documents that can aid in process identification at BPI (Business Process Improvement) and support BP mapping is also proposed. This research is important, especially in situations where the company does not keep process logs.

Literature review

This section discusses prior research in the areas of Business Process Management (BPM), Business Process Improvement (BPI) and Process Identification (PI) in Business Process (BP) mapping, text mining, and job description.

Business Process Management (BPM), Business Process Improvement (BPI), and Process Identification (PI)

In today's environment, each business must consider how it can outperform its competitors in terms of business processes. As a result, the concept of continuous improvement is relevant to the business challenges confronting today's organizations. Business Process Management (BPM) is a continuous improvement methodology that combines business process redesign and information technology.

BPM also requires management commitments (Delgado et al., 2014; Jacklic et al., 2006; Gilbert, 2010; Gonçalves, 2010; Draghici et al., 2012; de Morais et al., 2014). BPM is structured around a cycle that includes the following steps: 1) process discovery; 2) process analysis; 3) process redesign; 4) process implementation; and 5) process monitoring and control (Dumas et al., 2013). Process discovery is used to identify existing processes and comprehend their interactions (de Morais et al., 2014). A process is related to an activity that benefits both consumers and companies (Soare, 2012; Trkman, 2010). Process mining can be used to identify processes (Van der Aalst & Weijters, 2004). If the business already has a computerized information system in place, they can document the process. The identification of processes within business processes is one of the steps that a company can take to increase its efficiency.

Process identification can be performed by interviewing the workers. Usually it is conducted to search for social networks (Chopra and Golab, 2018), to know the perception of each volunteer interviewed (Jacobson et al., 2012); to find out the respondent's interpretation of the job description (Buwembo et al., 2014); to know satisfaction with the job description (Kang et al., 2016); to conduct a job analysis (Lee et al., 2014); to know the role of each worker (Lewis et al., 2015); to determine interest (Kim and Talbott, 2017); and to know the actual situation (Qutab & Shafique, 2011). The interview results will then be analyzed to perform BP mapping. Additionally, process identification can be accomplished through the distribution of questionnaires, which employ the Likert scale to as-

certain the subject's characteristics (Park et al., 2016; Ramhit, 2019), and the priority scale for each job in a job description (Mouza and Taousanis, 2017). Process identification in business processes can also be accomplished through the observation of significant data collected for analysis purposes (Butler, 2008; Carliner et al., 2015; Krumer-Nevo et al., 2011; Stybel, 2010). Additionally, a systematic mapping study approach can be used to identify processes (Arias et al., 2018). Recent research on BPM was conducted by Song et al. (2022); Seiger et al. (2022); and Iman et al. (2024) that explored the Internet of Things (IoT) on process mining to support process identification (PI).

The first stage of the BPM lifecycle, which is process identification, is critical, as it serves as the foundation for subsequent stages, including process improvement. Siha and Saad (2008) distinguished two types of process improvement approaches: statistically oriented and non-statistically oriented. Six Sigma is a statistically oriented PI method. While benchmarking, business process reengineering (BPR), and process mapping are non-statistically oriented PI methods.

Lee & Chuah (2001) propose five super-methods for process improvement, including the following: 1) select the process; 2) comprehend the process; 3) conduct process measurement; 4) carry out process improvement; and 5) review the improved process. Adesola & Baines (2005) propose the following seven stages for MIPI (model-based and integrated process improvement): 1) comprehend business requirements; 2) comprehend processes; 3) model and analyze processes; 4) redesign processes; 5) implement new processes; 6) evaluate new processes and technology; and 7) review processes. Coskun et al. (2008) pioneered the Weak Point Analysis and Business Process Improvement (WABPI) model. Holtzman (2011) established the methodology for Business Process Improvement (BPI). According to Holtzman (2011), the BPI methodology consists of five stages: 1) establish business objectives; 2) identify processes that can be improved; 3) analyze the current process; 4) raise awareness of information technology; and 5) implement the improved process. From this explanation, it shows that process identification (PI) is important for the company as a basis for doing process improvement.

In the area BPM beside research on process identification (PI), there exists research that proposed modeling business processes using governing documents Ingvaldsen et al., (2005). However, it did not specify the type of governing document used. In addition, there exist researchers that use BPMN (Business Process Model Notation) to do BP mapping by visualizing the business process Weske (2012). There is some overlap between the BPI methodologies discussed above. For instance, it begins with an understanding of the process. There are numerous approaches to comprehending the process. One method is BP mapping. BP mapping is used to visualize processes and their interactions. According to Siha & Saad (2008), BP mapping is a visual representation of processes and their interactions. Ingvaldsen et al. (2005) integrate formal documents in the company as a basis for BP mapping. However, the type of document used was not specified in this detail.

Text mining for BP Mapping

According to Weiss et al. (2016), text mining is the process of transforming data into text. Text mining can be used to uncover unstructured text's hidden patterns (Natarajan, 2005). Prior to inferring and mapping text data, several stages in text mining must be completed, including text preprocessing, text transformation, and feature and attribute selection, as well as text mining methods, interpretation, and evaluation (Patel and Sony, 2012). Text preprocessing is a multi-step process (Srivihya and Anitha, 2010; Lourdusammy and Abraham, 2019). They are as follows: 1) Tokenization is step one. This procedure is designed to unearth significant elements within the text; 2) Eliminate all stop words. This procedure is used to eliminate words such as "this", and "and" so forth; 3) Embedding. This procedure is designed to locate the root word; 4) Elimination of punctuation.

Text mining is used in a variety of fields, including medicine (Silahtarolu and Ylmaztür, 2019), finance (Bach et al., 2019), human resource management (Piazza and Strohmeier, 2011), and customer satisfaction (Lucini et al., 2020). (Ingvaldsen et al. (2005) discuss the use of text mining to integrate governing documents into the business process model. Text mining is used to discover meaningful patterns in unstructured data, which is ambiguous and difficult to process in comparison to data types stored in databases (Kobayashi et al., 2017; Kumar and Bhatia, 2013). Text mining can be used to process data such as process descriptions, related document processes, and communication logs. These types of data are frequently used to determine an organization's level of strategic alignment (Kobayashi et al., 2018). Text mining is typically used to make it easier to process extremely large amounts of data, which would take an inordinate amount of time if done manually. If observed, text mining is nearly identical to data mining in terms of performance, as both are capable of mining structured data; however, text mining can perform data mining on unstructured and semi-structured data (Kumar & Bhatia, 2013; Kobayashi et al., 2018). To the best

of the author's knowledge, there exists no research focus on using text mining for process identification in job descriptions documents.

Job description document

A job description is a formal document created by an employer that details the nature of an employee's job, the tasks he or she is expected to perform, and his or her position within an organizational hierarchy (Krumer-Nevo et al., 2011). Additionally, the job description serves as a unit for the internal talent management process, which includes recruitment, succession planning, coaching, training, and compensation (Stybel, 2010). Additionally, Pennell (2010) evaluates work and develops a performance plan (Carliner et al., 2015). According to another interpretation, the job description refers to "a unit responsible for the internal talent management process, which includes recruitment, succession planning, coaching, training, and compensation" (Pavur, 2010; Stybel, 2010). Several perspectives on the job description led to the conclusion that it is a pillar of human resource management.

Job descriptions assist businesses in managing performance, identifying processes and opportunities for training and development, planning, and measuring rewards, among other human resource management functions (Baker, 2016). Having a job description enables businesses to place employees in the optimal location, at the optimal time, with the optimal quality, in the optimal situation, and at the optimal cost based on the optimal company information (Pató, 2017). Additionally, the existence of a job description within an organization or company is critical, especially if the document details each task and responsibility associated with each position within the organization or company, ensuring that employees perform at their best (Lee et al., 2014; Carliner et al., 2015; Lewis et al., 2015; Park et al., 2016) and more favorable employee relations (Kieserman, 2007). When creating a job description document, several critical components must be included (Verbouncu and Zeininger, 2015). They are "job title", "department/section", "hierarchical levels", and "employee names". In addition, "interactions (internal and external)", "responsibilities and duties based on available resources", "required abilities for the job holder", "level of education/training/authorizations/certifications", "foreign language qualifications and abilities", and "criteria for evaluation are also included in the job description document". Meanwhile, O'Rouke (2015) asserts that every job description document contains at least six components, namely: "position,", "summary of duties", "job requirements", "job duties or tasks", and "relationship at work".

Initially, job description documents focused exclusively on the tasks and activities performed by an employee (Baker, 2016). The next generation's job description, namely the second generation, places a high value on work competence (Baker, 2016). The job description document is then developed for the third generation. In this generation of job descriptions, the emphasis is on non-work roles, which play a critical role in organizational and employee performance (Baker, 2016). Job description documents must be updated on a continuous basis to reflect changes in the work environment and technology (Raju and Banerjee, 2017) and to avoid becoming obsolete (EL-Hajji, 2011). The following criteria must be included in any job description document that refers to human capital: the right employee, the right competencies, the right conditions, the right location, the right time, the right cost, and the right employer, with the appropriate fragmentation of content and structure" (Pató, 2017). To the best of author's knowledge there exist no research trying to utilize job description documents in process identification (PI) and BP mapping.

Materials & Methods

Research Methodology

The research presented in this article aims to fill the gap in research related to process identification (PI) and BP mapping by proposing a text mining-based method that can be used to identify processes using job description documents. This method is hoped to become an alternative method for companies that have not implemented a computer-based information system but have a job description document can identify the process more efficiently. The stages in the research methodology can be seen in Figure 1.

Based on Figure 1 the research methodology started by getting samples from job descriptions documents from several companies either manufacturing or service companies. There are no specific criteria for companies selected as respondents if the company already has a job description document.

After obtaining the job description document, analysis is then carried out using text mining to see whether the existing job description document meets the BP elements. To be able to perform BP mapping there are 4 elements to be identified. They are: 1) actors who perform activities; 2) activities performed; 3) documents performed; 4) flow of document. If the results of text mining method do not include all four elements above, then sentences in the description of the role of position of employee in the job description document need to

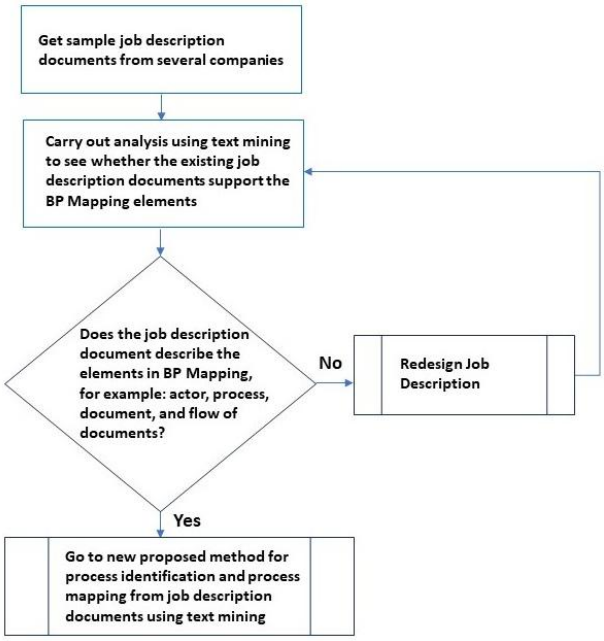

Fig. 1. Research Methodology

be revised. Therefore, the research described in this article proposes a sentence format for the job description document so that the elements in BP mapping can be identified.

To facilitate the text mining-based process identification, it is suggested that the sentence within the job description is following this pattern:

$$\text{S} + \text{V} + \text{O} + \text{TO} + \text{PURPOSE}$$

In which, S (subject) reflects to the actor; V (verb) reflects the verb that represents the activity or process; O (object) reflects to document; TO reflect to the flow; PURPOSE reflects to destination.

As an example, in the following sentence in a job description "PPIC sends production plan document to Production", the actor is "PPIC", the activity is "send", the document is "production plan document", and the destination is "Production".

In addition, for every document used in the company it is suggested that it is written in the job description document with the structure as "name of document + report(s)" or "name of document + document(s)" or "name of document + form(s)", for example: "weekly sales report", "monthly production plan document", and "daily performance form". Therefore, during the analysis of the text mining method, documents can be easily identified.

The next step is carrying out the proposed method for process identification based on the job description document as can be seen in Figure 2.

Proposed method for process identification (PI)

Based on Figure 2, the first step begins with the creation of a database of actors, processes, and documents. Document databases are created by collecting all the company's documents. The actor database is created by examining all people performing specific activities. Process database, on the other hand, refers to the basic verb. It is determined by the job description documents' language. All documents are stored in Microsoft Excel (.xlsx) file.

Step 2 of the proposed method presented in this paper is preparing the job description to have the format that can be processed using text mining. For performing this step, the description of the role of that position of employee in the job description document is copied and is pasted in the Microsoft Excel (.xlsx) file. Therefore, there is a Microsoft Excel (.xlsx) file to store all descriptions of the role of position of employees in the job description document that is being examined.

Step 3 is dealing with carrying out the identification using text mining, because performing it manually will take more time. To further expedite the process, text mining can be used (Chopra et al., 2018). At this stage, the description of the role performed in the job description is analyzed using text mining method using R software. R packages that are used to do text mining include the following packages: "writexl", "write_xlsx", "readxl", "read_xlsx", "text clean", "tm", "dplyr", "plyr", "tidyr", "tidytext", and "stringr". In the "n-gramming" step of the text mining method, it is used $n = 3$. Therefore, the result of this process is a sentence, with the structure of the sentences: Actor + Verb + Object.

After performing text mining method, the Step 4 discuss about how text mining results are analyzed for business process mapping.

An illustrative example to show the applicability of the proposed method for Process Identification (PI) dan Business Process (BP) Mapping

To illustrate the applicability of the proposed methods, job description documents from 15 different companies were collected. From Tab. 1 the 15 companies come from different types of industries such as garment manufacturer, machinery manufacturer, beverages manufacturer and so on. For each company, one job description document was selected arbitrarily. The details of the job description documents are presented in Tab. 1.

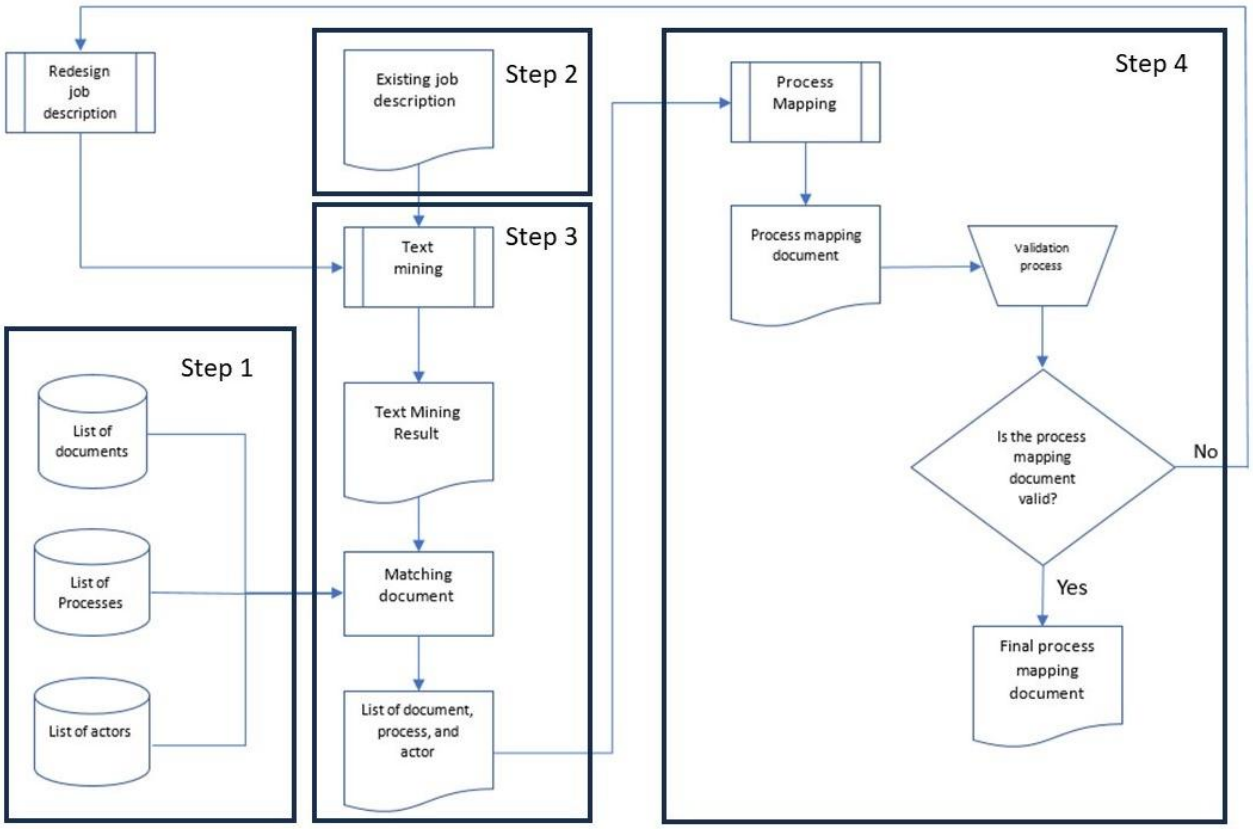

Fig. 2. Proposed method for Process Identification (PI) dan Business Process (BP) Mapping

Following the proposed procedure, the first step is creating database actors, documents, and processes. A list of actors can be obtained in column "Position" in Tab. 1, which are production manager, production head, ..., refinery planning (RP) section head. This list is then stored in the database for actors. After that, a database of documents is created. An example of a list of documents in the company obtained from job s shown in Tab. 2, the results of text mining on 15 job description documents using n-gramming with $n = 3$ indicate that there are several job descriptions that do not mention the name of the document being worked on, the actors involved, or the document's flow. In addition, Tab. 2 shows that there is no naming of the type of document or that there are still documents that are mixed with verbs and conjunctions.

As suggested in the previous section, there are options for improving the presentation of the job description document by revising its sentences without diluting the original job description's intent. Revised sentences for the sample job descriptions are presented in Tab. 3. The revised sentences can be called '*complete*' since it facilitates automated business process mapping. Each sentence consists of four components: 1) actors who perform activities; 2) activities performed; 3) documents performed; 4) flow of document. It is noted that the flow of description documents presented in Tab. 1 are "isbn (International Standard Book Number)", "daily production output", "daily production schedules", "monthly reports", "production plan", "stock opname reports", "performance reports", "goods receipt report", "attendance reports", "recruitment instrument", "receiving incoming orders", "financial bookkeeping", "design drawings", "production schedule", "monthly plans", and "annual processing plans". This list then is stored in the database for documents. The database of process is conducted by identifying the verb that existed in the job description document. After all the databases are created, then Step 2 of the proposed method presented in Figure 2 is performed. In this step, the file of job description document is copied and pasted in Microsoft Excel file (.xlsx).

After that following Step 3, text mining process is conducted to the sentences in the job description documents, which consist of the step of import, preprocessing, and n-gramming. After doing n-gramming with $n = 3$, the result is analyzed, and the result is presented in Tab. 2.

Table 1
Job description documents being examined

No	Type of Industry	Position	Description
1	Printing company	Production manager	Receive isbn
2	Manufacturer of paper and paper products	Production head	Integrating all divisions into the production department in order to meet the annual objective for box and tube production.
3	Manufacturer of rubber and plastics products	Production manager	Creating and preparing daily production schedules that each division will subscribe to in accordance with a predetermined schedule
4	Manufacturer of beverages	Production manager and maintenance	Planning and managing the production plan to ensure there are no shortages or excesses of inventory
5	Manufacturer of garment	Production manager	Complete daily production output in the production book
6	Manufacturer of rubber and plastics products	Head of warehouse	Prepare monthly reports and stock opname reports for each internal order completed by the company.
7	Logistics company	Warehouse staff	Make a goods receipt report
8	Manufacturer of other non-metallic mineral products	Human resource staff	Creating recruitment instrument
9	Manufacturer of leather and related products	Accounting	Performs financial bookkeeping for the business and is accountable for its finances.
10	Manufacturer of basic metals	Supervisor	Create a production schedule to production department
11	Manufacturer of fabricated metal products	Supervisor	Make performance reports needed by managers
12	Manufacturer of rubber and plastics products	Section head human resource department	Make employee attendance reports
13	Printing company	Marketing division	Responsible for receiving incoming orders, including maintaining their documentation
14	Manufacturer of machinery	Designer	Making design drawings according to customer orders
15	Manufacturer of extraction of crude petroleum and natural gas	Refinery Planning (RP) Section Head	The section of refinery planning is led by a section head who is responsible for developing monthly and annual processing plans.

As shown in Tab. 2, the results of text mining on 15 job description documents using n-gramming with $n = 3$ indicate that there are several job descriptions that do not mention the name of the document being worked on, the actors involved, or the document's flow. In addition, Tab. 2 shows that there is no naming of the type of document or that there are still documents that are mixed with verbs and conjunctions.

As suggested in the previous section, there are options for improving the presentation of the job description document by revising its sentences without diluting the original job description's intent. Revised sentences for the sample job descriptions are presented in Tab. 3. The revised sentences can be called '*complete*' since it facilitates automated BP mapping. Each sentence consists of four components: 1) actors who perform activities; 2) activities performed; 3) documents performed; 4) flow of document. It is noted that the flow of documents can be sent to other parties or stored in a data base. To demonstrate that the suggested job description document improvement aids in process, document, and document flow identification, the first job description with revised sentences "production manager receives "isbn" document". Production managers forward "isbn" document to the "gm planning" is taken as sample for further process. The result of text mining process for this sentence are presented in Tab. 3.

Table 2
Result of text mining method

Job Description No	Analysis Result		
	Actor	*Activity*	*Document Flow*
1	x	v	x
2	x	v	x
3	x	v	x
4	x	v	x
5	x	v	x
6	x	v	x
7	x	v	x
8	x	v	x
9	x	v	x
10	x	v	v
11	x	v	v
12	x	v	x
13	x	v	x
14	x	x	v
15	v	v	x

Table 3
Text mining result of the first job description

No	Paired word
1	**production manager** receives
2	manager receives isbn
3	Receive **isbn document**
4	isbn document production
5	document **production managers**
6	production manager forward
7	manager **forwards** isbn
8	forward isbn document
9	isbn document to
10	document to the
11	To the gm
12	**to gm planning**

According to Tab. 3, it can be identified elements that are needed to perform BP mapping which are: 1) actors (production manager; gm planning); 2) process (receives); 3) document (isbn document); and 4) flow of document (indicated by conjunction "to"). Because actor(s), process(es), document(s), and flow of document(s) can be determined based on the text therefore, the proposed sentences in the job description document to describe the role and responsibility of each employee facilitates BP mapping. When business processes are mapped, the outcomes are as indicated in Fig. 3.

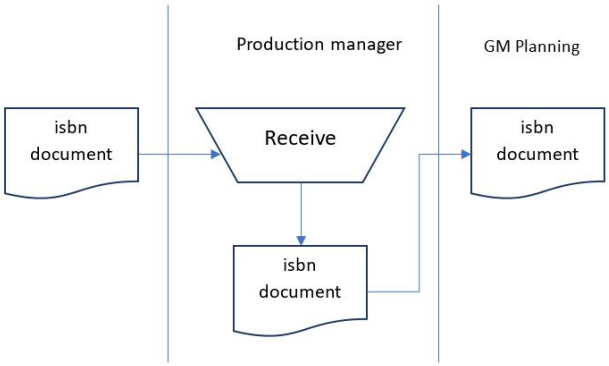

Fig. 3. Process mapping of the first job description

Similar steps are taken to examine all suggested sentences in the job description document as is shown in Tab. 4.

From Tab. 4 for example in the company 1, the previous sentence is "receive isbn". In the proposed method presented in this paper, the suggested sentences in the job description document so that it can support process identification (PI) and BP mapping using text mining is "production manager receives isbn document. Production managers forward isbn document to the gm planning".

Conclusions and Discussions

Based on sample of job description document from 15 companies as illustrative example to illustrate the applicability of the proposed alternative method for process identification (PI), BP mining, the proposed method can be an alternative to be used by company to perform process identification. Text mining is used in the proposed method to make the process identification can be performed faster compared to if it is performed manually.

The most significant finding from the research described in this paper is that identifying processes within a business can be accomplished using text mining on job descriptions. The job description document that contains a description of the roles and responsibilities of a position can be a source of data to identify existing processes in a company in addition to other

Table 4
Suggested job descriptionsentences that facilitate business process mapping

No	Original Job Description	Suggested Job Description
1	Receive isbn	Production manager receives isbn document. Production managers forward isbn document to the gm planning
2	Integrating all divisions into the production department in order to meet the annual objective for box and tube production.	Production head receives annual box report and tube production target report. Production head submit annual box report and tube production target report to the section and unit head.
3	Creating and preparing daily production schedules that each division will subscribe to in accordance with a predetermined schedule	Production manager creates daily production planning document. Production manager saves daily production planning document to the data base. Production manager create production planning report based on daily production planning document. Production manager distributes production planning report to the sub level.
4	Planning and managing the production plan to ensure there are no shortages or excesses of inventory	Production and maintenance manager creates a production schedule form for the general manager. general manager sign production schedule form.
5	Complete daily production output in the production book	Production manager creates production output report in the production book. Production manager submits production output report to head of warehouse.
6	Prepare monthly reports and stock opname reports for each internal order completed by the company.	Head of warehouse prepares monthly reports. Head of warehouse prepares stock operation reports to internal orders. Head of warehouse forwards monthly report to general manager. Head of warehouse forwards stock operation report to general manager.
7	Make a goods receipt report	Warehouse department prepares receipt of goods report. Warehouse department saves receipt of goods report to the data base. Warehouse department submits receipt of goods report to purchasing department.
8	Creating recruitment instrument	Human resource department prepares recruitment instrument. Human resource department saves recruitment instrument to the data base. Human resource department submit recruitment instrument to internal audit.
9	Performs financial bookkeeping for the business and is accountable for its finances.	Accounting creates financial statements report. Accounting report financial statements report to to the director.
10	Create a production schedule to production department	Ppic create a production schedule document. Ppic deliver a production schedule document to the manufacturing department
11	Make performance reports needed by managers	Supervisor creates performance reports.supervisor delivers performance report to managers.
12	Make employee attendance reports	Head of human resources and administration compiles a employee's attendance report. Head of human resources and administration saves employee's attendance report to the data base. Head of human resources and administration distribute employee's attendance report to the assistant manager of human resource department.
13	Responsible for receiving incoming orders, including maintaining their documentation	Marketing department receives the order form. marketing department saves order form to the database.
14	Making design drawings according to customer orders	Engineering staf creates design drawing document. engineering staf saves design drawing document. engineering staf submit design drawing document to ppic.

Table continued next page

Table 4 continued

No	Original Job Description	Suggested Job Description
15	The section of refinery planning is led by a section head who is responsible for developing monthly and annual processing plans.	Refinery planning (RP) section head creates monthly processing plan report. Refinery planning (RP) section head saves monthly processing plan report to the data base. Refinery planning (RP) section head deliver monthly processing plan report to maintenance and support manager. Refinery planning (RP) section head creates annual processing plan report. Refinery planning (RP) section head saves annual processing plan report to the data base. refinery planning (RP) section head deliver annual processing plan report to maintenance and support manager.

techniques, such as 1) interview (Chopra and Golab, 2018; Jacobson et al., 2012; Buwembo et al., 2014; Kang et al., 2016; Lee et al., 2014; Lewis et al., 2015; Kim & Talbott, 2017; Qutab & Shafique, 2011); 2) survey (Park et al., 2016; Ramhit, 2019, Mouza & Taousanis, 2017; Butler, 2008; Carliner et al., 2015; Krumer-Nevo et al., 2011; Stybel, 2010); 3) systematic mapping study (Arias et al., 2018) and 4) process logs and IoT (Van der Aalst & Weijters, 2004; Song et al., 2022; Seiger et al., 2022; and Iman et al., 2024)

Another finding is that from sample from 15 job descriptions document in, it shows that using the text mining method, the existing job description document can only extract information about processes and actors whereas to accomplish BP mapping, four elements are required: 1) actor; 2) process; 3) documents; and 4) document flow. As a result, in the research presented in this paper, restructuring the sentence in the job description is proposed on specific sentences, most notably the roles and responsibilities of positions. The basic grammatical structure is as follows: subject (to identify the actor) + verb (to identify the process) + object (to identify the document) + to (to identify the document's flow) + destination (to reflect the actor who received the document). To determine whether an object is a document, it is necessary to understand how documents are named. Documents are named using the following structure. 1) the title + document; 2) the title + form; or 3) the title + report. The newly constructed sentence structure was then analyzed using text mining with n-gramming= 3, with the result that the four elements required to perform BP mapping could be identified.

Based on the results obtained in this paper, it is suggested that the proposed procedure can be translated into an automated computer program. The input of this program is the job description documents, which are written using the proposed grammatical structure, while the output of this program is the complete process map. Using this automated computer program, BP mapping can be quickly accomplished, so that the improvement to the business process can also be immediately implemented.

The limitation of applying the proposed method is that the proposed method, namely text mining-based process identification in job descriptions, can run effectively if the sentence stating the role and responsibility of a position is in the format proposed in the research in this paper, namely: S + V + O + TO + PURPOSE, where, S (subject) reflects to the actor; V (verb) reflects the verb that represents the activity or process; O (object) reflects to document; TO reflect to the flow; and PURPOSE reflects to destination.

Further Research

Further research is needed regarding the existence of a framework that can be used to validate the results that have been obtained using the method proposed in this article.

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