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A Neural Network-Based Recruitment System for Optimizing Human Resources in Business Process Management Applications

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ABSTRACT:
Business processes have been formally studied from various perspectives since the onset of the industrial age. Despite this prolonged scrutiny, processes remain poorly understood, unmanaged, and ineffectively executed. Business school curricula are predominantly function-specific and limited, while IT programs concentrate on narrow technical competencies, neglecting the 'process view' and 'integration' aspects, which are often left to individual students or academics. This paper examines the deficiencies in current business and IS/IT education and reviews the historical context of business processes. It asserts the importance of business process management and underscores its potential to bridge gaps in business education. Additionally, it discusses the strategies adopted by business schools and the challenges faced in BPM education and research.

Keywords—Business Process Management (BPM), Business Process (BP), Data Reduction, Feature Extraction, Random Forest (RF).

I. INTRODUCTION

Globalisation and heightened market competitiveness jeopardise the survival of companies; yet, ERP installations are among the most prevalent strategies to address these challenges. ERP systems have become essential for firms to achieve competitive advantages, including cost

reduction, operational and departmental integration, enhancements in business processes, and increased effectiveness and competitiveness. It has been acknowledged that resource allocation is a significant concern when it comes to carrying out company processes. In practice, there are a number of factors that contribute to the requirement for resource allocation. Resources can be distributed in order to meet different and sometimes conflicting objectives. For example, resources can be allocated to maintain a high utilisation of available resource capacity, which may lead to bottlenecks, or to ensure smooth throughput of business process cases, which may lead to resource idleness and increased costs. As stated in [1], the right allocation of resources is a critical factor in ensuring that resources are used efficiently in the execution of business processes. It guarantees that each work item is completed by the appropriate resource at the appropriate time, in order to balance the demand for process execution facilities with the availability of these resources. It is not easy to select the "right" resources to complete job items in business process execution. In order to accomplish this, we suggest the use of intelligent strategies for learning, reasoning, and planning resource allocation based on experience [2]. This will allow for the production of rational decisions that will optimise resource allocation in a variety of process conditions. We expect that these methods will lead to better distribution of resources. This paradigm starts by examining the internal and external factors that drive change. It then uses benchmarking to assess the extent of the change, the magnitude of the change, and the radicalness of the change. The implementation phase has divided the tools and approaches into four categories: enabling, facilitating, integrating, and implementing. However, it has a significant shortcoming in assessing the outcome because it is not sufficiently addressed. The idea of this framework summarises the revolutionary scale of change that is based on breakthrough, one-time, or episodic techniques. In realm of process mining many strategies are utilised to extract essential information from event logs provided by various BP [3]. This information that is taken from event logs is useful for improving the behaviour of processes that are currently in progress. However, the excitement is growing in order to address continuing process instances by utilising process mining strategies. Predictive monitoring of BP is a subset of process mining that helps to offer timely information about ongoing processes in order to deal with future risks and improve performance. A number of runtime methods have been built with the goal of creating predictive models that may be used to forecast specific values by extracting meaningful data from event logs. In this situation, the event log gives the necessary properties of ongoing processes for the prediction. Predictive models generate output, which is the projected value of a specific type, by taking event logs as input. Predicted values can be of different sorts, including boolean, category, or numeric. It is both practically intriguing and problematic to predict such values using instances of ongoing processes. These projected values are used to evaluate the performance of running processes in terms of effectiveness and efficiency. Additionally, anticipated values can be utilised to reduce risks or to check for violations of process rules.

II. LITERATURE SURVEY

Business process re-engineering is a prominent change management strategy that aims to improve overall quality by promoting effective processes. However, it is estimated that over 80% of business process re-engineering efforts have failed because they did not have the appropriate framework or methodology. [4] framework is a comprehensive framework, as they describe it, for the implementation of business process re-engineering. There have been only a small number of attempts to forecast the future event. A multi-stage model is used to generate separate Markov models of different orders on the clusters that are obtained. The model begins by clustering event sequences using the k-mean approach, which is supplemented with sequential alignment [5]. Records of procedures received from a telecommunications firm were used to conduct experiments [6]. Another method involves the use of a sequential KNN classification and Markov models to forecast the next steps in a process by taking into account the temporal features [7]. The identical

process log data as in [8] was used to demonstrate that their models were better than Markov and Hidden Markov Models (HMM). The MSA technique described in [9] treats each trace prefix as a state in a state-transition matrix. A state transition matrix is constructed using the prefixes that were observed and the events that followed them [10]. When a case that is currently being processed reaches a state that is not included in the state-transition matrix, the similarity between the case and the observed traces is calculated using string edit distance [11]. The prediction is based on the instance that is most similar to the one that was observed. [12] reports that the accuracy of their predictions for the next occurrence is as high as 30% and 60% when they evaluate the approach on two datasets from a telecoms provider. RegPFA [13] employs a probabilistic finite automaton (PFA) instead of a hidden Markov model (HMM). This allows the future hidden state to be a function of both the prior hidden state and the previous observed event, which is itself a probabilistic consequence of the previous hidden state. RegPFA uses an EM technique for calculating the model values of the PFA [14]. The evaluation incorporates data from the 2016 and 201 8BPI Challenges [15]. One-hot encoding can be used instead of word embeddings [16]. The authors also used the LSTM technique, but they only took into account the sequence of activities and their timestamps. They then turned the input activities into feature vectors by utilising one-hot encoding [17]. Both research used the same method to investigate the prediction of process activity duration. In addition, the second study [18] also performed experiments using a different Helpdesk dataset that was publically available from an Italian software business.

III. METHODOLOGY

In large-scale, organization-wide, dynamic environments, traditional methods of controlling business processes are frequently insufficient. However, as Internet and Intranet technologies have become more common, more and more corporate processes are showing these characteristics. As a result, a different method is required. To do this, we provide an explanation of the rationale, conceptualisation, design, and implementation of a new agent-based business process management system. The main improvement of our system is that it assigns the responsibility of carrying out different parts of the business process to a group of independent agents that are capable of solving problems. In order to fulfil their responsibilities, these agents usually communicate and negotiate with other agents so that they can work together and purchase the services that they need.

A. **BPM**

BPM is a systematic methodology for analysing and perpetually enhancing core activities, including manufacturing, marketing, communications, and other critical components of a company's operations. BPM primarily focusses on the critical elements of business operations that possess significant leverage and contribute a substantial amount of added value [19]. BPM must adhere to the following regulations:

- Major operations must be accurately delineated and recorded. BPM emphasises client orientation by establishing horizontal connections among essential tasks.
- BPM depends on systems and defined protocols to guarantee discipline, consistency, and reproducibility in quality performance.
- BPM depends on measurement activities to evaluate the performance of each process, establish targets, and provide output levels that align with business objectives. BPM must be founded on a constant optimisation strategy through problem-solving and extracting additional advantages.
- BPM must be guided by best practices to ensure the attainment of exceptional competitiveness.

  BPM is a methodology for cultural transformation and cannot be achieved alone through effective systems and appropriate structures.

B. Improvement through BPM

The interviews confirmed an organizational commitment to continuous process improvement, as evidenced by the preceding discussions on culture. Specific approaches included benchmarking to identify and establish best practices, the creation of compendiums and databases of best practices, and the correlation of improvements with evaluations based on the EFQM, Baldrige, and other quality models. Although BPR was evidently implemented in certain organizations, notably Texas Instruments and Rank Xerox, it was predominantly discussed in relation to process simplification or process improvement within the spectrum of BPR definitions.

C. Reduction of data and Construction of Features

The significance of representation has been acknowledged as a critical concern in AI and ML. Within the framework of example-based learning and attribute-value representation of input data, the initial representation consists of a vector of attributes (features, variables) that delineate examples (instances, objects). The transformation of input attributes for feature construction can be articulated as follows: given the original feature vector and the training set, create a derived representation that improves upon certain criteria (e.g., predictive accuracy, representation size). The newly changed properties either supplant the old attributes or can be appended to the examples' descriptions. Instances of attribute transformations include counting, grouping, interval construction/discretization, scaling, flattening, normalisation (of numerical values), clustering, and principal component analysis, among others. This thesis transforms the input attributes for two purposes: (i) to operationalise a certain construct and (ii) to diminish data dimensionality for enhancing the predictive accuracy of a model. Prominent approaches for dimensionality reduction include PCA and FA.

D. Traning in the Model:

1) SVM:

The SVM technique establishes decision boundaries through kernels to efficiently manage high-dimensional data, rendering it favoured for IDS applications. It demonstrates superior generalisation and identifies a worldwide minimum-risk solution [20]. The independence of SVM from empirical risk indicators allows for the selection of optimal parameters, providing computational efficiency essential for real-time intrusion detection. SVMs can adaptively revise the training of EDM patterns with the introduction of a novel pattern during the classification procedure.

2) DT

The DT is a hierarchical model used to classify inputs through a series of decision-making processes based on the input data. The decision tree is a composite structure including two main components: decision points and terminal points, referred to as leaves. A key advantage of employing decision trees in intrusion detection systems is their capacity to execute classification tasks with minimum processing demands. Furthermore, DT has the capacity to recognise and categorise critical network characteristics that can proficiently differentiate fraudulent operations. As a result, decision trees have been utilised as BPM within the Internet of Vehicles (IoV) framework.

3) KNN:

The KNN has demonstrated efficacy in tasks related to fault detection, localisation, and classification. The KNN algorithm is one of the most straightforward machine learning

approaches. The class predominantly selected by an object's k nearest neighbours is ascertained through a majority vote among those neighbors. K is a positive, frequently minuscule integer. The item is assigned the class of its nearest neighbor when k = 1. Selecting k as an odd number in double-class classification problems is beneficial, as it mitigates the risk of tied votes. A system employing redundant statistical features derived from wavelet packet transform, utilizing an advanced KNN-based fault detection method.

4) **ANN**:

ANN are interconnected systems inspired by the biological structure of neurones found in animal brains. The most common structure of an artificial neural network consists of three layers: input, hidden, and output. An ANN can be represented as a set of connections between the input layer and the hidden layer, characterised by several weights and associated biases [21]. Artificial neurones, which are interconnected nodes in artificial neural networks, emulate the neurones present in the biological brain. Analogous to the manner in which synapses in biological neurones transmit impulses, the interconnected nodes perform a similar function.

IV. Results and Discussion

The capacity to proactively oversee business operations is a primary competitive differentiation for companies. Execution logs produced by PAIS provide process-specific predictions to enhance proactive situational awareness. The objective of the suggested methodology is to forecast the subsequent process event from the finalised activities of the active process instance, utilising execution log data from previously concluded process instances. By forecasting process events, organisations can implement prompt interventions to rectify undesirable departures from the intended workflow.

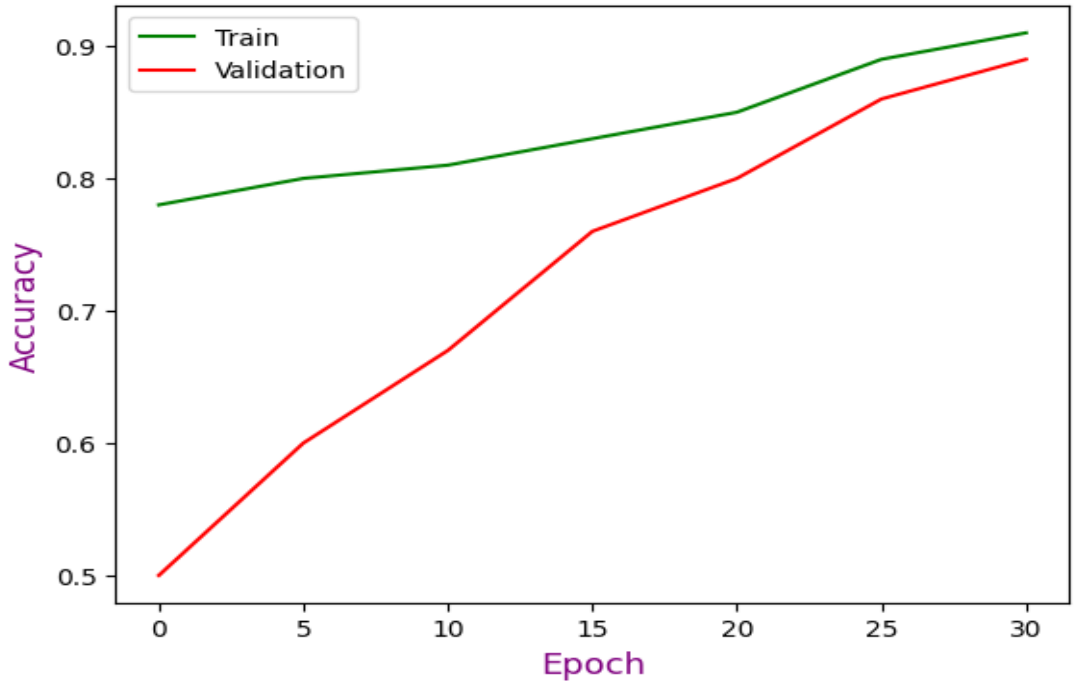

Fig. 1. Confusion Matrix for Proposed Model

Figure 1 illustrates the accuracy of the proposed model throughout the training and validation phases. This instance achieved a training accuracy of 91% and a validation accuracy of 89%.

TABLE I. PROPOSED MODEL TABLE

Models	Accuracy	Precision	Recall	F1-Score
SVM	92.07	87.22	86.54	88.45
DT	89.76	88.74	86.77	89.99
KNN	90.74	89.33	88.44	90.82
ANN	94.23	92.78	90.70	94.55

Table 1 provides a summary of the performance metrics for each of the four models. DT, KNN, ANN, SVM are all examples of these models. SVM outperforms its competitors in most measures, including accuracy, precision, recall, F1-score. The results demonstrate that SVM are quite effective for tasks that need accuracy and predictability.

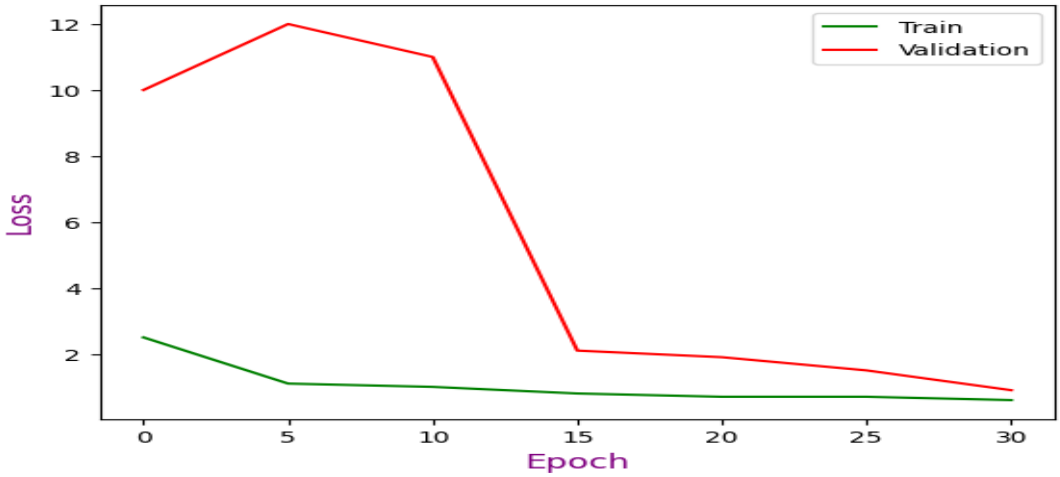

Fig. 2. Loss of the Proposed Model

Figure 3 shows the training and validation losses of the proposed model.

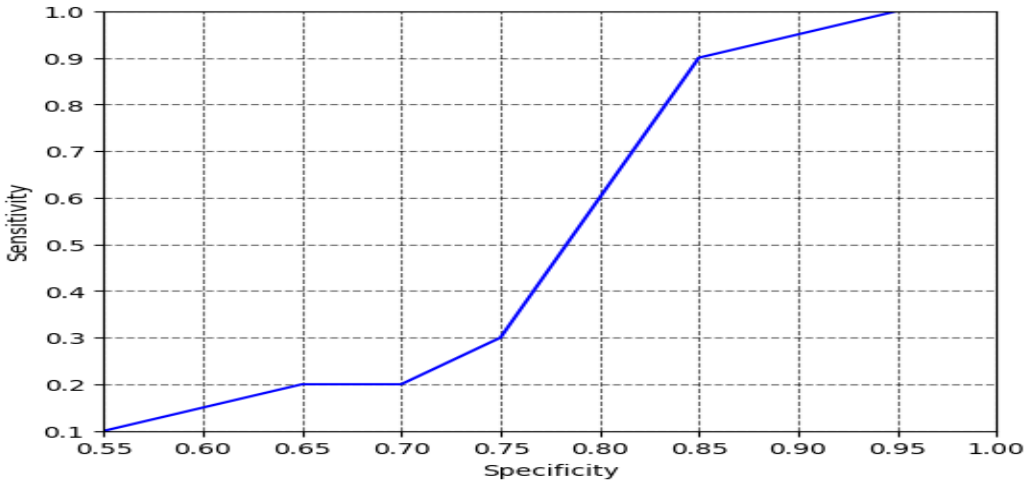

Fig. 3. Propsoed ROC Curve of the Model

The ROC curve in Figure 3 shows the trade-off between sensitivity and specificity for a number of different threshold values. The curves of optimal classifiers come together in the upper left corner, which is where specificity and sensitivity are at their maximum levels. The distance of a

model's curve from this point demonstrates the model's ability to discriminate.

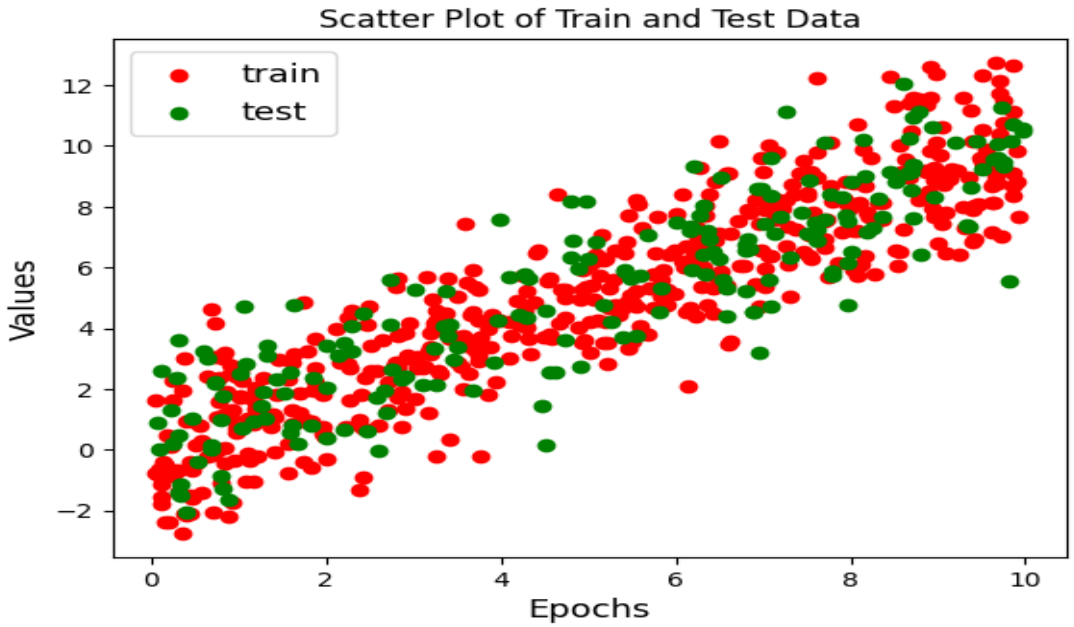

Fig. 4. Scatter Plot of the Model

The scatter plot in Figure 4 shows the observations relative to the predicted values. The correlation diagram shows a value of around positive 1. Even though the dataset is small and there are just a few depicted values, there is a positive connection between the two variables. The graphic demonstrates that the model is effective because the actual and anticipated values are nearly identical.

V. Conclusion and Future Directions

BPM is a concept that has been around for several decades. In general, it is part of a tradition that seeks to improve the way business people think about and run their enterprises. The specific ways in which it appears, whether referred to as Work Simplification may change over time, but the fundamental motivation to change the way that managers and employees think about how businesses are organised will continue to develop and thrive. This paper will give a very general overview of the BP movement. Anyone who attempts to promote a change in business processes within a genuine organisation will quickly discover that there are many different BP traditions and that people from these diverse traditions suggest different methods for changing business processes. BPM has evolved into a comprehensive management discipline due to over twenty years of interdisciplinary study and a wide range of BPM projects in companies of all sizes and industries. As a result, it is necessary to address a number of complementing factors in order to successfully and sustainably implement it. This chapter presents a consolidating framework that offers structure and breaks BPM down into six fundamental components. The six components listed below are the fundamental framework for this BPM Handbook.

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