Decision tree learning for detecting turning points in business process orientation: a case of Croatian companies

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Abstract. Companies worldwide are embracing Business Process Orientation (BPO) in order to improve their overall performance. This paper presents research results on key turning points in BPO maturity implementation efforts. A key turning point is defined as a component of business process maturity that leads to the establishment and expansion of other factors that move the organization to the next maturity level. Over the past few years, different methodologies for analyzing maturity state of BPO have been developed. The purpose of this paper is to investigate the possibility of using data mining methods in detecting key turning points in BPO. Based on survey results obtained in 2013, the selected data mining technique of classification and regression trees (C&RT) was used to detect key turning points in Croatian companies. These findings present invaluable guidelines for any business that strives to achieve more efficient business processes.

Key words: business process orientation maturity, key turning points, data mining, decision trees, Croatia

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1. Introduction

Competition in many industries has been based mainly on strategic assets and the ability to deploy these assets. Competition in today's global economy is now based upon capabilities, or "complex bundles of skills and accumulated knowledge, exercised through organizational processes" [10]. Owing to this new business approach, many organizations are now viewing processes as strategic assets. This perspective has meant that organizations are no longer viewed as a collection of functional areas, but as a combination of highly integrated processes [10]. Additionally, processes are now viewed as assets requiring investment and development as they mature. Thus, the concept of BPO is becoming increasingly important. A review of literature has revealed several

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general definitions of BPO, but the most extended version has been given by McCormack [9]: "The BPO of an organization is the level at which an organization pays attention to its relevant (core) processes (end-to-end view across the borders of departments, organizations, countries, etc.)". BPO can slim down operational costs, promote customer relations by satisfying customer needs better and increasing employee satisfaction through harnessing the benefits of organizational knowledge. As this is a complex process done over a long period of time, companies can attain various degrees of BPO acceptance through adjustments of their business processes.

Since the 1980s, a plethora of maturity models have emerged that claim to guide an organization through the process of building levels of maturity that lead to a competitive advantage [1, 4, 5, 9, 13, 19]. Road maps and step-by-step recipes are being offered that claim to describe the order that maturity components must be implemented to achieve success. To date, there has been a lack of quantitative studies documenting these road maps. One of the quantitative methods that can be used for detecting these road maps is a data mining method known as decision tree learning. Subsequently, this paper will present results of data mining research into the conditions, so-called turning point conditions, that are crucial for a company to transit from a lower stage of maturity to the next stage. Only once before has similar research been conducted [17, 18]. Research was conducted into Croatian and Slovenian companies indicating that the decision tree model can be used to generate rules that automate processes within a company. The research has detected only few key turning points for advancing BPO maturity: top management involvement in process renovation initiatives, defining and documenting processes, process measurement and management, appointing process owners and process-oriented organization culture. Therefore, understanding that the decision tree learning method provides valuable guidelines to organizations adopting BPO, and in order to extend this research and detect additional key turning points, for the purpose of this research the previously used research instrument (questionnaire) was expanded with the questions and components slightly modified. This paper aims to investigate BPO maturity levels in Croatian companies and to report on exploratory research results of the precedence of BPO maturity factors in implementation efforts using a "key turning point" concept and the decision tree learning method. The paper provides a scientific contribution in that it provides quantitative evidence of the critical maturity components associated at each maturity level and detects more key turning points than detected in previous research. These new findings expand current knowledge on BPO.

This paper is organized in the following way: first, an explanation is given of the background and purpose of the conducted research; second, the BPO model, components and key turning points are described; third, the methodology and the data source are presented; fourth, research results of the survey

conducted in Croatian companies are given; fifth, discussions are presented; and finally, the conclusion and future research are explained.

2. Theoretical background on the Business Process Orientation maturity model and turning points

The broad adoption of BPO within an organization is derived from the understanding that processes have life cycles or developmental stages that can be clearly defined, managed, measured and controlled within a timeframe. Higher maturity levels in any business process result in: better control of results; improved forecasting of goals, costs, and performance; greater effectiveness in reaching defined goals; and improving the ability of management to propose new and higher targets for performance [9]. As organizations increase, their process maturity and institutionalization take place via policies, standards, and organizational structures [7]. Building an infrastructure and a culture that supports process-oriented or horizontal methods, practices and procedures enable process maturity to survive and endure long after those who have created them. Continuous process improvement is based on many small evolutionary rather than revolutionary steps. Continuous process improvement provides the energy that maintains and advances process maturity to new maturity levels [9]. As processes mature, they move from an internally focused perspective to an externally focused, system perspective. A maturity level represents a threshold, that when reached, will institutionalize a total system view necessary for achieving a set of process goals [9]. Achieving each maturity level establishes an organization's higher process capability level. In the current business environment, there is no scarcity of process maturity models [12]. For the purpose of this research, McCormack's BPO maturity model and assessment instruments [9] were used as a starting point and adapted to the needs of each individual research objective. The McCormack construct describes a four-step pathway for systematically advancing business processes along the maturity continuum (Ad hoc, Defined, Linked and Integrated level). Each step builds on the work of the previous steps in applying improvement strategies corresponding to the current maturity level. The following definitions for the stages an organization goes through when becoming BPO are provided [9, 10]:

(1) Ad hoc. The processes are unstructured and ill defined. Process measures are not in place. The jobs and organizational structures are based on traditional functions, not horizontal processes.

(2) Defined. The basic processes are defined, documented and available in flowcharts. Changes to these processes must now go through a formal procedure. Jobs and organizational structures include a process aspect, but basically remain functional. Representatives from functional areas (sales, manufacturing, etc.)

meet regularly to coordinate with each other, but only as representatives of their traditional functions.
(3) Linked. The breakthrough level. Managers employ process management with strategic intent and results. Broad process jobs and structures are put in place outside of traditional functions.
(4) Integrated. The company, its vendors and suppliers, take cooperation to the process level. Organizational structures and jobs are based on processes, and traditional functions begin to be equal or are sometimes subordinate to process. Process measures and management systems are deeply imbedded in the organization.

Based on our extensive literature review we synthesize different viewpoints of BPO into a comprehensive BPO model that takes into account the majority of components, frequently mentioned in literature. In order to analyze and improve BPO, companies need to take the following components (domains) into account:
A1. Strategic view
A2. Process identification and documentation
A3. Process measurement and management
A4. Process-oriented organizational structure
A5. Human resources management
A6. Process-oriented organizational culture
A7. Market orientation
A8. Supplier perspective
A9. Process-oriented information technology

A1. Strategic view
Two dominant aspects of strategic view seem to be critical [15]:
(1) The alignment of business processes with an organization's strategy can be achieved by linking process goals to the organization goals. A well-developed strategy provides an optimal definition, enables planning and execution of business processes that are strategic;
(2) Active support and involvement of top management in implementing BPO principles for the functioning of the organization. It has been shown that, compared to projects where top management had not participated, active involvement of top management has led to higher success rates.

A2. Process identification and documentation
Excellent knowledge and understanding of internal processes is a prerequisite of BPO. Organizations need to understand how processes work, where they are being executed and how they interconnect. The following aspects of process definition and documentation that an organization must ensure are [11]:
(1) Existence of a complete and uniform enterprise,
(2) The process model,

(3) Documentation of processes,
(4) Use and update of process documentation,
(5) Definition of inputs and outputs for each process,
(6) Definition of suppliers and customers for each process,
(7) Existence of process cascades,
(8) Segmentation of business processes if they face heterogeneous requirements.

Additionally, process documentation enables and catalyzes process improvements, helps employees in understanding how end-to-end processes really work and what their role in the process is.

A3. Process measurement and management

Management and measurement are closely tied. What is not measured cannot be managed. Appropriate performance indicators encourage employees to act in line with the strategic goals. Two of the most frequently cited aspects of measurement and management elements are [2]:

(1) Implementation of a process measurement system through the definition of process goals (that need to be aligned with an organization's goals), key performance indicators for these goals, setting of performance targets and continuously monitoring the efficiency and effectiveness of processes;
(2) Formalization of process improvement practices and use of established methodologies and techniques that enable more successful implementation of new and/or changed processes.

A4. Process-oriented organizational structure

An organizational structure describes the predominating configuration of activities and tasks in an organization. Some of the most cited aspects of process organizational structure are [15]:

(1) Organizing work around core processes,
(2) Flatter organizational structure (fewer levels of hierarchy),
(3) Teamwork,
(4) Employee empowerment,
(5) Jobs that involve heterogeneous tasks and activities, not just simple work,
(6) Process ownership.

BPO does not require a complete process organizational structure as it has some disadvantages as well. The final goal should not be to replace vertical structures with horizontal ones, but to find a way to intertwine the advantages of both specialization and expertise of functional structures with responsiveness and adaptability of process structures.

A5. Human resources management

Human resources management is a wide management discipline that deals with many aspects of managing people. In terms of BPO, the most important aspect

of people management is strategic people management that focuses on the practices involved in training and educating employees for the sake of aligning employee skills and knowledge with business strategy. The most cited elements of people management closely tied with the structural elements of BPO are as follows [14]:

(1) Enabling employees to work in multifunctional teams;
(2) Providing employees with training and education to acquire new skills and knowledge that can be used on newly defined multidimensional jobs , not just simple tasks;
(3) Including and involving employees in improvement programs, as they have the domain knowledge and will need to buy into the new processes;
(4) Educating employees on techniques and methods of process improvement and redesign;
(5) Communicating the changes of processes to all employees that are affected by the changes.

A6. Process-oriented organizational culture

Changing an organization to being process oriented represents a vast change in the way business is conducted. To that end, organizational culture plays an important role in an organization's ability to change. Key values and aspects of organizational culture that are most often cited in literature in terms of implementing BPO are [5]:

(1) Shared vision and purpose,
(2) Openness and cooperation,
(3) Creativity and positive attitude of employees,
(4) Usage of appropriate process terminology (input, output, process owner, etc.),
(5) Employee empowerment and inclusion in decision making,
(6) Flexibility,
(7) Goal orientation,
(8) Getting employees to understand that they work for end customers.

A7. Market orientation

The basic goal of any process is creating value for (external or internal) customers. In that regard, understanding customer needs and whishes is inextricably linked to BPO. Organizations need to understand customer preferences in order to design appropriate processes to supply the output satisfying these preferences. Organizations must know that their customers come first. Customers can be internal or external. Organizational goals must focus on external customers and that is why identifying them is important. Customers can be a valuable source of information in process improvement efforts [17]. Knowing and understanding customers is only a part of market orientation. Organizations also need to know and understand their competition. Appropriate

strategies and the underlying processes that execute them can only be established if the organization combines knowledge on its customers and competitors.

A8. Supplier perspective
Process optimization cannot be optimal if supplier processes are disregarded. Clearly, an organization does not have an impact on supplier processes if the cooperation is transaction based. On the other hand, forming long-term relationships with supplier offers more opportunities for a joint and coordinated redesign of processes that span several organizations [19].

A9. Process-oriented information technology
The role of information technology (IT) in process redesign has long been stressed as one of the more important aspects of redesign efforts. A combination of process redesign and utilization of appropriate IT support can drastically improve business processes. Even though many authors stress the importance of IT in redesign efforts, its role can be very different at different stages of the redesign [6].

At each maturity level, certain components of BPM become evident and others are barely registered. The question of which components must be established and stable before others are brought into focus is an important one that justifies investment in a detailed quantitative study. A key turning point can be defined as a component of BPO that stabilizes within an organization and leads to the establishment and expansion of other factors that move the organization to the next maturity level. The aim of this paper is to identify the most important turning points that enable companies to advance to higher levels of BPO maturity by using data mining methodology.

3. Methodology and data source

Data mining is an approach to data analysis that is based on the nontrivial extraction of implicit, previously unknown and potentially useful information from large data sets through identification of patterns within underlying data [18]. There are a number of techniques used for pattern recognition and adopted from statistics, mathematics and artificial intelligence. Methods such as clustering, association rules and decision trees can be used to investigate turning points in maturity models.

3.1. Methodology on decision trees

A decision tree is a common machine learning method used in data mining [10]. Decision tree is a versatile predictive model used for classification of problems and regression. A decision tree is used in expert systems and data mining projects in customer relationship management systems for customer profiling, financial services systems for fraud detection, for process control and reengineering, marketing systems for efficient targeting of marketing campaigns, etc. A tree can learn how to classify a given set of data (training set) by determining split criteria for each branch. Decision tree learning can provide useful insight into differences between organizations that are classified at neighboring levels of BPO maturity. These differences provide information on critical areas that cause transition between successive maturity levels. Such information can serve as a valuable guideline to organizations adopting BPO. The results of the decision tree model are used to generate rules employed to automate processes within a company or knowledge management system. These facts provide a reason for choosing the method for detecting key turning points in Croatian companies. Various decision tree algorithms such as CHAID, ID3, C4.5, C&RT, and others produce trees that differ from one another in the number of splits allowed at each level, the way these splits are chosen when the tree is built, and how tree growth is limited to prevent over fitting. However, the most important characteristic of the algorithms is the criteria for determining the split. The general C&RT algorithm uses statistical measurements of homogeneity of cases in a node (such as Gini index, Chi-square or Gsquare). ID3 algorithm and C4.5 algorithm uses an information-driven evaluation function based on entropy and information gain. All of the algorithms try to determine the predictor variable and split criterion that can generate the greatest improvement of the predictive accuracy. For the purpose of this research, the software program STATISTICA was used. STATISTICA provides the general C&RT algorithm for building binary decision trees that use any of the abovementioned criteria for evaluating the appropriate predictor variable for split. Depending on the data type of the dependent variable, there are classification trees and regression trees. Classification trees are used to predict membership of cases or objects in classes of categorical dependent variables based on measurements of one or more predictor variables. Regression trees are used to predict the value of the continuous dependent variable based on one or more continuous or categorical predictor variables. Since the dependent variable that describes the current maturity level of a company in this research is categorical, we will for the purpose of this paper use a classification tree as it is more appropriate [18].

The process of computing classification and regression trees in STATISTICA involves 4 basic steps [3]:

(1) Specifying the criteria for predictive accuracy. Here the criterion is to minimize the proportion of misclassified cases where the misclassification cost is taken to be equal for every class.
(2) Selecting splits. Splits are made using the variable value based on an impurity measure that optimally improves the predictive accuracy. The Gini measure is a measure of the impurity of a node and is commonly used when the dependent variable is a categorical variable, defined as:

$$g(t) = \sum_{j \neq i} p(j/t)p(i/t)$$

where the sum extends over all k categories. The variable p(j/t) is the probability of category j at the node t and C(i/j) is the probability of misclassifying a category j of a case as category i.
(3) Determining when to stop splitting. When the criteria for splitting is reached, splitting stops.
(4) Selecting the 'right-sized' tree. Based on the misclassification costs, the final tree is selected.

3.2. Description on survey and data

In 2013, empirical research was carried out with the main goal of assessing assess the current state of BPO maturity of Croatian companies. The questionnaire had 60 questions on BPO characteristics, divided into 9 domain as follows: strategic view (5 questions), process identification and documentation (6 questions), process measurement and management (10 questions), process-oriented organizational structure (7 questions), human resources management (5 questions), process-oriented organizational culture (6 questions), market orientation (7 questions), supplier perspective (3 questions), and process-oriented information technology (11 questions). Each question describes a particular BPO component within each domain. The degree of presence of these characteristics in the firm's organization was measured on a 7-point Likert scale (1=strongly disagree, 2=disagree, 3=more disagree than agree, 4=neither agree or disagree, 5=more agree than disagree, 6=agree, 7 =strongly agree).

The questionnaires were sent to CEOs or senior managers in 1200 companies. In all, 127 Croatian managers responded, so the final response rate was 10.58%.

Company size was determined by the number of employees. In the resulting data set, 40 companies had between 1 and 50 employees, 44 companies between 50 and 249 employees and 43 companies 250 or more employees.

The first step in the data mining task is data preparation. Based on the responses of companies, maturity levels for each company had to be assessed.

According to McCormack [9], each sample had a different maturity level mapping and had to be determined for each data set separately. In this research, the BPO maturity level was assessed using the average value of all 9 domains. Due to the difference on the Likert scale in the questionnaire and the number of maturity levels, values were mapped using cluster analysis in order to assess the maturity level for each data set record. Accordingly, the BPO maturity level mapping given in Table 1 was determined specifically for Croatian companies.

Likert scale values	BPO maturity level
1.0-3.9	AdHoc
4.0-4.8	Defined
4.9-5.6	Linked
5.7-7.0	Integrated

Table 1: *BPO maturity level mapping*

4. Results

A model was developed using the general C&RT algorithm. The maturity level assessment was used as a dependent variable, and the other variables obtained from the questionnaire were used as predictor variables. Validating the optimal tree model required the use of V-fold cross-validation to sample the data set and calculate classification error for each generated tree of the so-called CV score. Finally, tree number 1 was selected as the optimal model based on the lowest classification error (Figure 1).

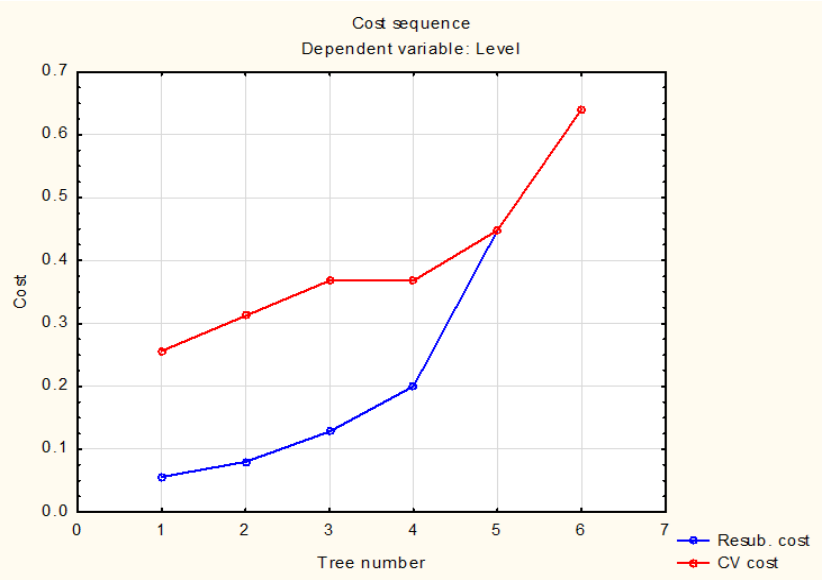

Figure 1: *A comparison of the decision tree model using CV score sequence*

The selected model successfully classifies 82.3% of presented data. It contains 15 terminal nodes and 14 intermediate nodes as shown in Figure 2.

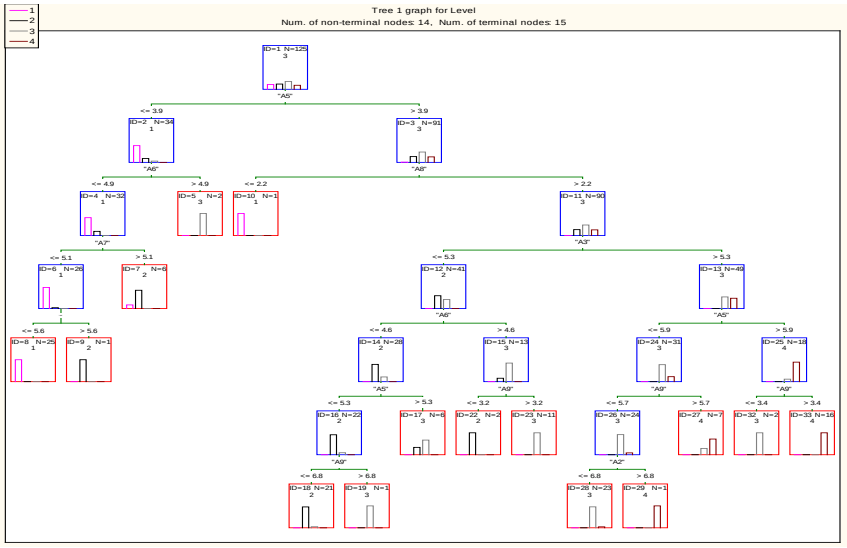

Figure 2: *Decision tree classification of maturity levels*

A classification rule can be derived from the tree for each terminal node by combining split criteria from the tree root to each terminal node into a classification precondition. If the case in data set coincides with the precondition, the rules classifies it to a given maturity level. Variables are marked as A1, A2, A3, A4, A5, A6, A7, A8, A9 and represent components of BPO as described in Chapter 2. A support indicator and misclassification error indicator are calculated for each rule in order to differentiate between significant and insignificant rules. A rule is supported by the ratio of the total number of cases classified using the respective rule and number of cases in the data set. Support of a rule supp(Rn) is defined as:

$$supp(R_n) = \frac{n_j}{\sum n}$$

where nj is the number of cases that are classified correctly by that rule and $\sum n$ is the total number of cases in the data set [3].

The misclassification error is the ratio of the number of cases misclassified by the given rule and total number of cases (both misclassified and correctly classified) that are classified by the rule. The misclassification error E(Rn) is defined as:

$$E(R_n) = \frac{n_e}{n_j + n_e}$$

where nj is the number of misclassified cases by the given rule and total number of cases (both misclassified and correctly classified) that are classified by this rule [3].

If a rule has low support it can be significant only if the number of misclassified cases is very low, preferably with no classification error at all. Table 2 shows all the rules derived from this research with their support indicators and misclassification errors.

Rule ID	Ad Hoc	Defined	Linked	Integrated	Total	Support Indicator	Misclassification error indicator
8	25	0	0	0	**25,0**	20%	0%
28	0	0	22	1	**23,0**	18%	4%
18	0	20	1	0	**21,0**	17%	5%
33	0	0	0	16	**16,0**	13%	0%
23	0	0	11	0	**11,0**	9%	0%
27	0	0	2	5	**7,0**	6%	29%
7	1	5	0	0	**6,0**	5%	17%
17	0	2	4	0	**6,0**	5%	33%
5	0	0	2	0	**2,0**	2%	0%
22	0	2	0	0	**2,0**	2%	0%
32	0	0	2	0	**2,0**	2%	0%
9	0	1	0	0	**1,0**	1%	0%
10	1	0	0	0	**1,0**	1%	0%
19	0	0	1	0	**1,0**	1%	0%
29	0	0	0	1	**1,0**	1%	0%

Table 2: *Rules with support indicators and misclassification errors*

Based on what has been said, the most important rules, those with highest support and lowest misclassification errors, are given in Table 3.

Rule ID	Rule formulation
18	If A5>3,9 and A8>2,2 and A3<=5,3 and A6<=4,6 and A5<=5,3 and A9<=6,8 then "Defined"
23	If A5>3,9 and A8>2,2 and A3>5,3 and A5<=5,9 and A9<=5,7 and A2<=6,8 then "Linked"
28	If A5>3,9 and A8>2,2 and A3<=5,3 and A6>4,6 and A9>3,2 then "Linked"
33	If A5>3,9 and A8>2,2 and A3>5,3 and A5>5,9 and A9>3,4 then "Integrated"

Table 3: *The most important rules generated by the decision tree model*

Transforming the resulting values of the rules using key in Table 1 and by observing Figure 2 and Table 3, we can conclude: (1) rule 18 can be used to determine turning point conditions for the Defined BPO maturity level, (2) rules derived from nodes 23 and 28 can be used to determine the turning point conditions for linked processes, and (3) rules derived from node 33 can be used to determine turning points for integrated business processes. Consequently, the developed decision tree model detected 5 turning points for advancing BPO maturity to the Defined level (A3, A5, A6, A8, A9), 6 turning points for the Linked level (A2, A3, A5, A8, A6, A9) and 4 turning point for the Integrated maturity level (A3, A5, A8, A9) (Table 4).

Maturity levels:	Key turning points:
Ad hoc ⟶ Defined	Process measurement and management (A3) Human resources management (A5) Process oriented organizational culture (A6) Supplier perspective (A8) Process oriented information technology (A9)
Defined ⟶ Linked	Process identification and documentation (A2) Process measurement and management (A3) Human resources management (A5) Process oriented organizational culture (A6) Supplier perspective (A8) Process oriented information technology (A9)
Linked ⟶ Integrated	Process measurement and management (A3) Human resources management (A5) Supplier perspective (A8) Process oriented information technology (A9)

Table 4: *Detected key turning points*

5. Discussion

The key turning points for reaching the Defined level of BPO maturity are: process measurement and management, human resources management, process-oriented organizational culture, supplier perspective, and process-oriented information technology. The first turning point for advancing BPO maturity to the Defined level is process measurement and management. After a company has defined its performance measures, defined target values and started measuring them, feedback should be given to employees and they should be kept informed of the process efficiency and effectiveness. Only by having this information loop can employees readjust their work in accordance with targeted performance. Previous research has shown that performance measurement is a prerequisite for process redesign as it enables the alignment of an organization's

processes and strategy [6, 10]. This finding is confirmed in this research as it shows that process measurement and management is a turning point acting as a prerequisite for advancing to all higher levels of BPO maturity.

The second important turning point for advancing BPO maturity to the Defined level is human resource management. In other words, when establishing BPO it is very important to define clearly the roles and responsibilities of employees who execute the processes. Usually when adopting process principles, companies expand employee responsibilities, enabling the employees to perform more multidimensional tasks and make more decisions, possibly resulting in fewer handoffs and shorter process cycle. A clear definition of roles is the key to this process and successful completion of the task is just one (and not the only one) of the conditions for reaching higher maturity levels.

The next turning point for reaching the Defined level of BPO maturity is supplier perspective. It means that close cooperation with suppliers is a key BPO element, as an organization's processes may extend outside its borders and be closely connected to supplier processes [14].

Another key turning point for reaching the Defined maturity level is a process-oriented organizational culture. It is a turning point somewhat neglected in literature. An appropriate organizational culture is also important in adopting a process paradigm. Based on our fieldwork experience in process renovation projects, we have found, and this is confirmed by this analysis, that an appropriate organizational culture is of paramount importance. Employees must understand and see the functioning of a company as a set of processes. A traditional functional mind-set, where people see functional departments, organizational units and strong hierarchy, and where turf wars are frequent and ubiquitous, hinders the development of BPO.

Furthermore, the key turning point for reaching the Defined level is process-oriented information technology. Even though many authors stress the importance of IT in redesign efforts, its role can be very different at different stages of the redesign. Kovačič and Bosilj-Vukšić [7] define three roles: 1) creating new needs and opportunities (new products and services); 2) process redesign support; and 3) process execution support. Tatticchi [16] defines six different roles of IT/IS: 1) constraint; 2) catalyst; 3) neutral; 4) driver; 5) enabler and 6) proactive. While the role of IT in implementing BPO is clearly diverse, there seems to be a consensus on one aspect. Specifically, only a carefully considered combination of process redesign efforts coupled with appropriate IT/IS support offers the most beneficial potential to organizations embarking on a transformation path. Kung and Hagen [8] have found that utilizing process-oriented information systems and the principles of process management in combination yields most noticeably increases the quality and success of individual processes.

Key turning points for reaching the Linked level of BPO maturity are: process identification and documentation, process measurement and management, human resources management, process-oriented organizational culture, supplier perspective and process oriented information technology.

All these key turning points were described in the previous sections as they represent key turning points for advancing to the Defined level, as well for advancing to the Linked level. The next turning point for advancing to the Linked level is called process identification and documentation. The reasoning behind this turning point is very straight forward; companies cannot improve their processes if they fail to identify which processes they own and how they operate. Hence, after ensuring support from management for BPO implementation, the first step is to thoroughly examine and document processes. However, in our research, this turning point was detected not as the key for the first step, as it should have been. The reason for this lies in the sample size of the conducted research and it is explained within the limitations of this study.

The key turning points for reaching the highest level, the Integrated level of BPO maturity are: process measurement and management, human resources management, supplier perspective and process-oriented information technology.

Needless to say the list of these turning points is not conclusive, nor the relationships among them. The list is valid only for Croatian companies. Previous research conducted in Croatian and Slovenian companies detected only a few key turning points for advancing BPO maturity: top management involvement in process renovation initiatives, defining and documenting processes, process measurement and management, appointing process owners and process-oriented organizational culture. Therefore, the conclusions are that the results presented in this paper support certain earlier findings on turning points, as well as revealing some new turning points.

6. Conclusion and future work

Previous research has shown a positive impact of BPO on organizational performance, as streamlines operational costs, promotes customer relations and consequently increases employee satisfaction. There is, however, a lack of research into what precisely companies need to do to advance their BPO maturity level. Therefore, the purpose of this paper was to address this issue and to identify key turning points for transitioning from one BPO maturity level to another. For this purpose, decision tree learning as a data mining method was used to analyze the maturity state of BPO in Croatian companies. In order to uncover this knowledge from the practice of Croatian companies, a classification tree model was developed. The developed model detected 4 turning points that are keys for reaching all of the higher BPO maturity levels (Defined,

Linked and Integrated): process measurement and management, human resources management, supplier perspective and process-oriented information technology. Moreover, the key turning point process-oriented organizational culture was detected which is crucial for reaching first Defined and subsequent Linked BPO maturity level. Finally, the decision tree learning method detected the key turning point process identification and documentation for advancing to the Linked maturity level.

Although, this research reveals new turning points that have not yet been discovered, it is worth mentioning that there are a few limitations to our research. First, we have approached our research question with a survey design. This means that the conclusions of our research are subject to the general weaknesses of correlational studies. Still, we have found correlations that are in line with our propositions. One of the limitations is also the sample size. The success of this method depends highly on the data set used for training the decision tree model. If the data set contains a small number of cases for a particular maturity level, the model will discard these cases as classification errors. Some rules will not be generated for these levels, so the insight into turning points between the subsequent or precedent level remains undetermined. A way to detect all key turning points for each maturity level and to improve the reliability of the results is to increase the sample size of a survey in future research. Discovering the required precedence and sequence of the steps, in addition to identification of more turning points, will be left for future research. Since this survey is limited to respondents from Croatian companies, future research can be done in a few other countries in order to develop a methodology that could be used to compare BPO maturity levels and to detect BPO key turning points in different countries.

In spite of the boundaries set by these limitations, we believe our findings offer important implications for research and practice. The knowledge discovered about turning points can be used as practical guidelines for any Croatian company that strives to achieve more efficient business processes and the results of the survey presented in this paper could provide a solid basis for further research in the field it addresses.

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