

White Paper

Process Maturity

and BPMN

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Every company provides services for somebody, meaning that a set of activities must be performed by either employees or “machines”. This is in line with the definition of a business process, which can be defined as “a set of business activities that represent the steps required to achieve a business objective /.../” [1]. So, processes are performed in every company. This also means that it is not reasonable to divide companies into those who perform processes and those who do not. Instead, it is more reasonable to classify companies according to if, and how, they manage processes.

This paper discusses the importance of business processes and their management for the success of a company. A generic process maturity model is presented consisting of six process maturity stages. In line with the stages, the importance and role of BPMN models and supporting tools is discussed.

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Business Processes Need Management

In order to operate, each company has to perform a diversity of processes, which can be divided into the following groups:

- **Operational processes.** This group consists of processes that constitute the core business and create the primary value stream of a company (purchasing, manufacturing, sales, delivery, etc.).
- **Management processes.** This group consists of processes that govern the operation of a company or system (corporate governance, strategic management, quality management, etc.).
- **Supporting processes.** This group consists of processes that support the core and management processes (accounting, recruitment, technical support, finances, etc.).

How well a company's processes perform has a critical impact on the company's success. Therefore the mastering of processes, their adaptation for end-users and their successful management, have become the key elements for the competitiveness of a modern company [2].

These are just some of the many reasons why Business Process Management (BPM) is becoming so important. BPM represents a disciplined approach to identifying, designing, executing, documenting, monitoring, controlling, and measuring automated and non-automated business processes, in order to achieve consistent and targeted results that are aligned with an organization's strategic goals [3]. By using these properties, the BPM approach allows organizations to become more efficient, more effective, and more capable of change when compared to the traditional functionally-focused and hierarchical management approaches [4][5].

Process Maturity

A company's maturity is commonly evaluated according to its business processes maturity. Several process maturity models exist; however, the most commonly used process maturity model is based on the maturity model that the Software Engineering Institute (SEI) [6] defined for the maturity of software development capability. This approach is used in COBIT 4.1 [7], a framework for defining control objectives for common IT processes. The generic maturity scale for processes is presented in the following table.

Level	Title	Description
0	Non-existent	Complete lack of any recognisable processes. The enterprise has not even recognised that there is an issue to be addressed.
1	Initial/Ad Hoc	There is evidence that the enterprise has recognized that the issues exist and need to be addressed. There are, however, no standardized processes; instead, there are ad hoc approaches that tend to be applied on an individual or case-by-case basis. The overall approach to management is disorganized.
2	Repeatable but Intuitive	Processes have developed to the stage where similar procedures are followed by different people undertaking the same task. There is no formal training or communication of standard procedures, and responsibility is left to the individual. There is a high degree of reliance on the knowledge of individuals and, therefore, errors are likely to occur.
3	Defined Process	Procedures have been standardized and documented, and communicated through training. It is mandated that these processes should be followed; however, it is unlikely that deviations will be detected. The procedures themselves are not sophisticated but are the formalization of existing practices.
4	Managed and Measurable	Management monitors and measures compliance with procedures and takes action where processes appear not to be working effectively. Processes are under constant improvement and provide good practice. Automation and tools are used in a limited or fragmented way.
5	Optimized	Processes have been refined to a level of good practice, based on the results of continuous improvement and maturity modeling with other enterprises. IT is used in an integrated way to automate the workflow, providing tools to improve quality and effectiveness, making the enterprise quick to adapt.

Table 1: Generic process maturity model [7]

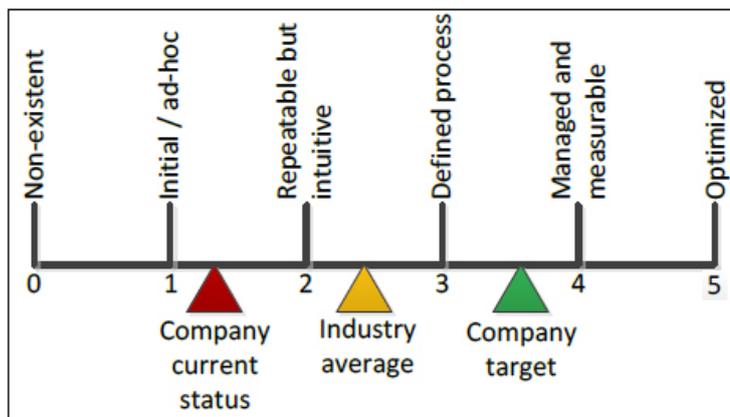


Figure 1: Graphical representation of companies (processes) maturity

Based on the generic process maturity model levels, a company can evaluate the maturity of its processes and also the company's overall maturity. However, it is important to highlight that parts (e.g. sub-processes) of a single process can be on different maturity levels. For example, some parts of the process can be well-defined or even automated, where other parts might not be defined at all.

Based on the average maturity level of individual processes the average processes' maturity (company's maturity) can be evaluated and visually illustrated as presented on the next figure.

As presented on the figure above, by using the process maturity model, a company's management can identify:

- the actual performance of a company ('as-is');
- the current status of the company's domain maturity;
- the company's target for improvement ('to-be');
- the required growth path between 'as-is' and 'to-be'.

The Role of BPMN in Process Maturity

The success of Business Process Management (BPM) depends on transparent and constantly improving business processes, which mostly result from business process-modeling (BPMo) techniques, approaches, and tools [8][9]. BPMo is concerned with the representation of organizational processes, so that current processes may be analyzed and improved in the future. In addition, BPMo is not only a requirement for many ISO 9000 quality programs, but also plays an important role in the implementation of work-flow management and enterprise resource planning (ERP) systems [8].

In order to be understood and interoperable, BPMo has to be based on standardized notations that are usually symbol-based or graphical. Currently, there are two standardized graphical notations for business process modeling: (1) Unified Modeling Language (UML) and (2) Business Process Model and Notation (BPMN) [1]. The focal difference between the two is that UML is object-oriented, whilst BPMN takes a process-oriented approach, more suitable within a business process domain [1]. Thus, BPMN is becoming the leader and de-facto standard in BPMo [10].

Nevertheless, the selection of BPMN is an insufficient condition for successful BPMo [11] and BPM. In addition, it requires the selection of appropriate methods and tools for building understandable BPMN models in an efficient way [12].

According to the generic process maturity model (Table 1), the following sub-chapters will present the role of BPMN models and supporting tools in different process maturity levels.

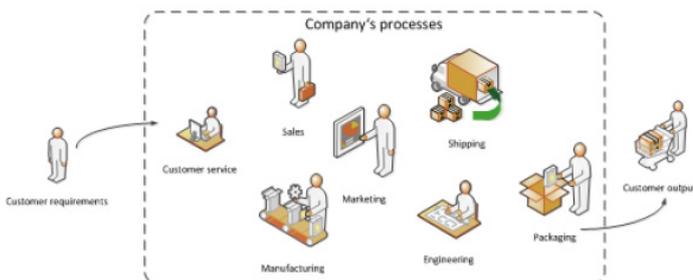


Figure 2: Processes are performed in each company

0. Non-existent level

The focal characteristic of the “non-existent” level is complete lack of any recognizable processes. This means that a company is not aware of its processes. At this level, there is no need for BPMN models. However, while this does not mean that processes are non-existent, there might be some IT tools which support individual process activities.



Figure 3: Process landscape

1. Ad-Hoc level

At the “ad-hoc” level, a company might be aware of (some) processes; however these processes are not clearly recognized or standardized. Instead, a company performs ad-hoc approaches for finishing stated tasks that

tend to be applied on an individual or case-by-case basis. A company does not recognize a need for BPMN processes at this level. However, while a company is already aware of its processes, they could already be modeled on a top-level (e.g. as a process landscape).

Figure 3: presents a common representation of a process landscape, which divides processes according to three categories: management, core and supporting. The sequence of processes can also have a meaning; it can represent a logical sequence of between-process collaborations or a value chain (see the sequence of core processes on Figure 3:). It is important to notice that the process landscape as presented on Figure 3: is not a part of BPMN, and that BPMN does not directly offer support for modeling process landscapes [13].

In the case of using BPMN, a process landscape can be modeled by using a standard set of BPMN elements, as presented in Figure 4.

Figure 4 represents a BPMN-based process landscape, which consists of two regular BPMN elements: collapsed processes and groups. Another possibility for representing a process landscape is by using BPMN conversation models (Figure 5), which were introduced in BPMN 2.0. In order to regularly define conversation models, common communication paths between processes should also be identified. However, BPMN conversation models are not as common as BPMN process models.

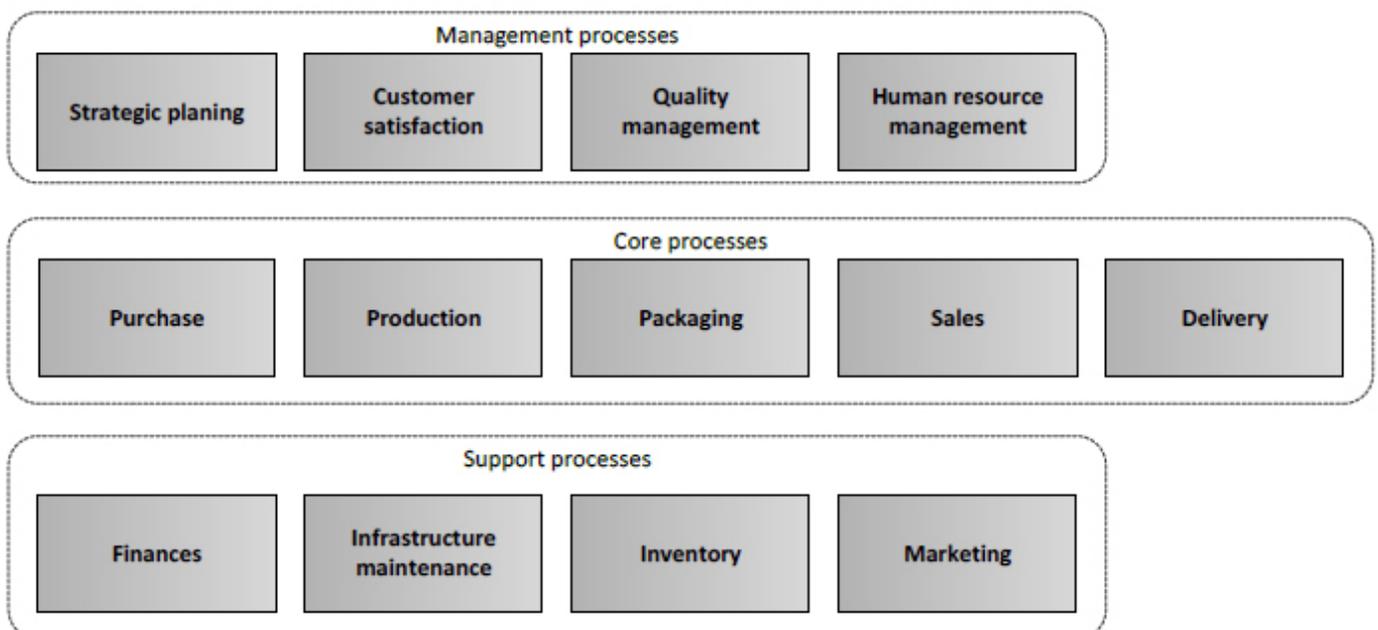


Figure 4: BPMN based “process landscape”

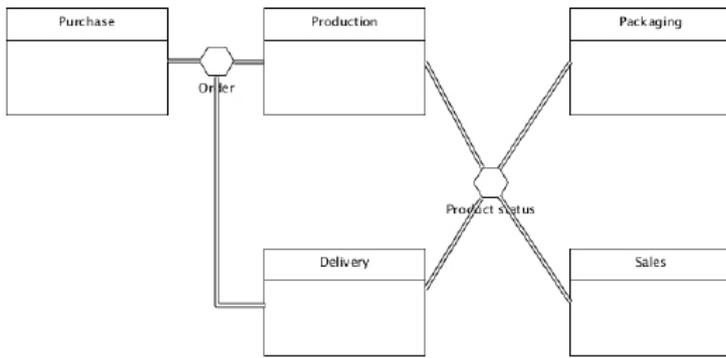


Figure 5: BPMN conversation model

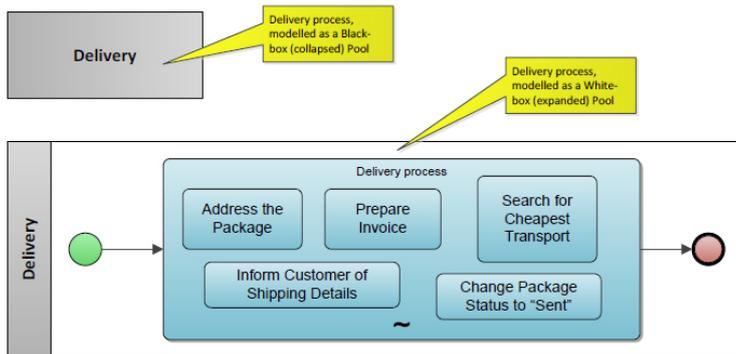


Figure 6: Delivery process modeled as "black-box" and "white-box" Pool

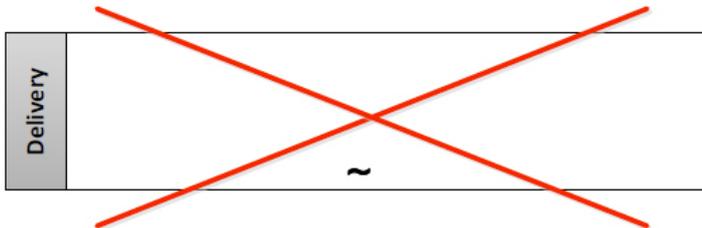


Figure 7: BPMN specification does NOT define an ad-hoc Pool

2. Repeatable level

At the "repeatable" level the process instances have the general capability to be performed similarly by different people who undertake the same task. This means that similar and common processes emerge, but are largely intuitive because of individual expertise. Some documentation and informal understanding of policy and procedures might exist. Transforming these characteristics into the BPMN domain means that processes might have some defined details and that process performers would be capable of defining processes if a process analyst were to obtain this information from them.

Figure 6 presents a BPMN based delivery process model, defined as "black-box" and "white-box". The "white-box" represents an "ad-hoc process situation", modeled with an expanded ad-hoc subprocess (annotated with a sign "~"). This means that a sub-process has not clearly defined the sequence of activities. This is the simplest form of an expanded Pool with ad-hoc activities, since a BPMN Pool does NOT have an "ad-hoc" attribute (Figure 7). Only sub-processes and tasks can be defined as ad-hoc. Note that such a modeling approach (Figure 6) is not very common and useful, since the work-flow is not clearly defined.

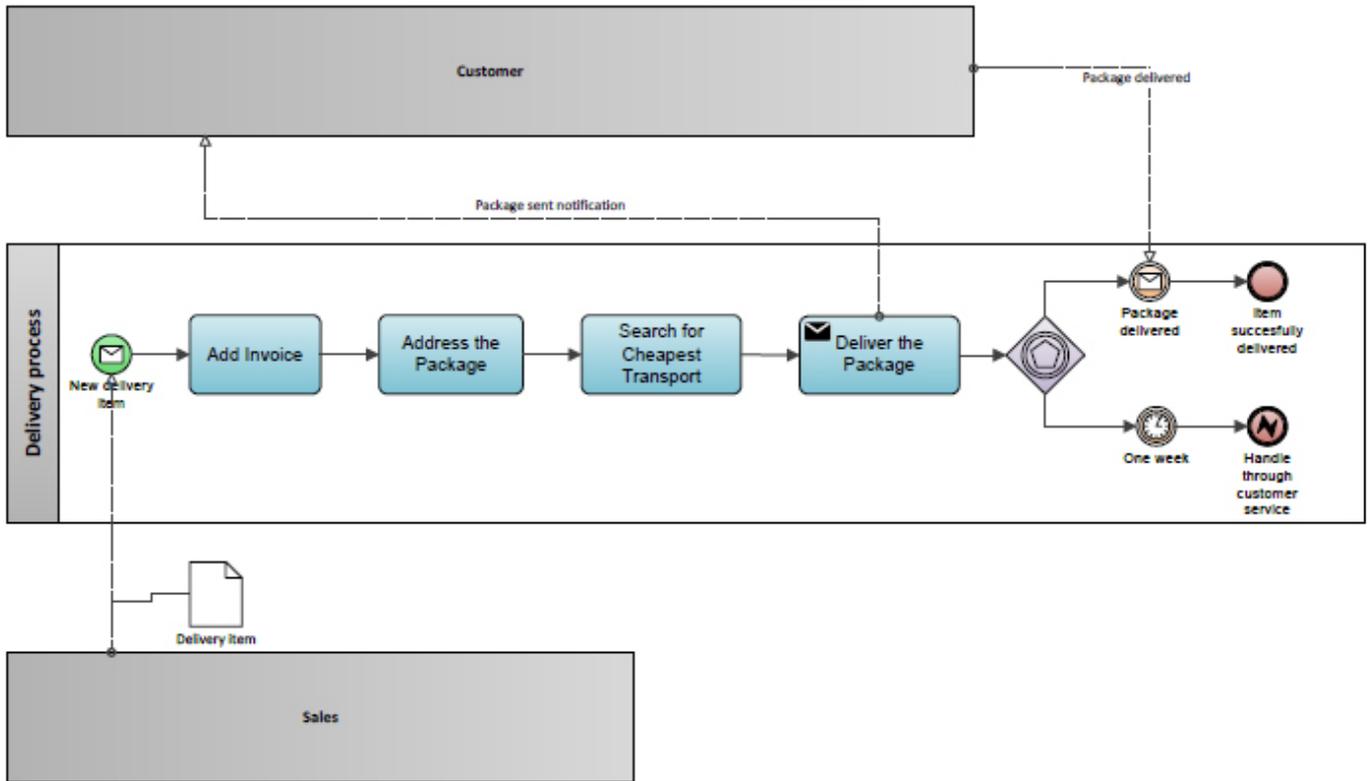


Figure 8: Delivery process defined as a BPMN collaboration model

3. Defined level

The “Defined” process maturity level denotes standardized and documented processes, where the documentation of a process is commonly based on a process diagram (visual process model). At this process maturity level it is reasonable to use BPMN, since it is well-defined, standardized and popular. BPMN offers support for several types of business process models:

- **Process models.** They represent a specific process in an organization as a graph of Flow elements. The most common Flow elements are tasks or activities.
- **Collaboration models.** They represent interactions between two or more processes, where each individual process represents a person, role or a system. Besides Flow elements, the most common elements are message flows between individual processes, which are used to exchange data and coordinate work.
- **Choreography models.** They are new in BPMN 2.0 and focus on between-process interactions and message flows.
- **Conversation models.** They are new in BPMN 2.0 and represents conversations between persons, roles or systems. They represent a top-level view of processes and their top-level interactions, and are therefore used for representing a process landscape.

Figure 8 represents the delivery process defined as a BPMN collaboration model. In this case, the diagram represents the details (work-flow) of the delivery process and its interactions (message flows) with two other Pools – Sales process and Customer. In the case of

Customer and Sales, collapsed Pools were used, since the details about how these processes are performed are not important in this case or view.

The “Defined” process maturity level requires also that BPMN models are presented to respective employees through communication and training. In most cases, the descriptive level of BPMN elements is sufficient at this process maturity stage.

4. Managed and Measurable level

In the case of the “Managed and measured” process maturity level, a company’s management monitors and measures compliance of performed work with the defined processes and takes actions where processes appear not to be working effectively or efficiently.

In this scenario, processes should be extended with activities, which enable monitoring of process efficiency and effectiveness. For example:

- **Process efficiency** could be measured with process lead time, which represents the time necessary to process a single item or a process instance.
- **Process effectiveness** could be measured with the ratio between successfully delivered packages and all packages that were sent to customers.

According to the above defined process efficiency and process effectiveness metrics, process decisions or corrective actions can be defined. For example, the transport can be selected according to the average “transport time per mile” (see incoming information flow to the “Search for Appropriate Transport” activity in *Figure 9*).

In order to support the above activities, process models can be extended with additional elements, which support the monitoring and control of a process. *Figure 9* presents the extension of the delivery process (which was presented in *Figure 8*) with additional activities dedicated to process measurement (elements coloured in orange). At this level, the analytical set of BPMN elements (all graphical BPMN elements) should be used,

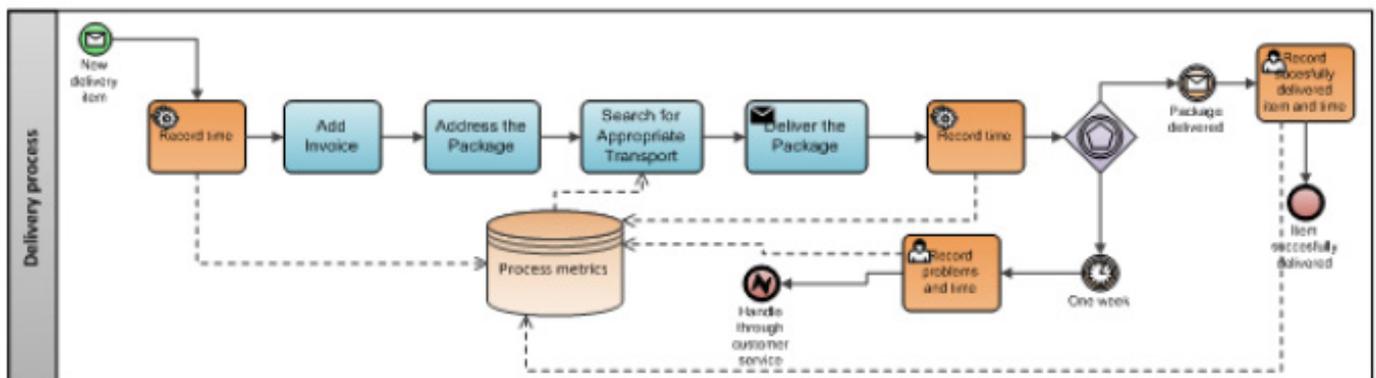


Figure 9: Process monitoring activities, defined in a BPMN process model

since it offers the full set of visual BPMN elements and enables, for example, exception flows.

Another and more sophisticated approach is to implement the defined process models (*Figure 8*) in a Business Process Management System - BPMS. In this case it is not necessary to explicitly define the measurement activities (see *Figure 9*), since the underlying BPMS takes care of them.

5. Optimised level

At the “optimized” process maturity level, processes have been refined to a level of good practice, based on the results of continuous improvement, maturity modeling with other enterprises, process related frameworks and best practices. This means that process definitions (process models) are implemented in a way which enables quick model changes and quick process model implementations in process instances (actual work). Translated into BPMN this means the following:

- Process models should be defined in an environment which enables (a modeler to make) quick changes to process models (e.g. access to BPMN models over a repository or cloud-based solution).
- Process model changes need to be quickly and easily implemented in the actual work environment. This requires effective communication with process participants and adaptable and integrated process IT support. The most reasonable way to support a process at this level is by using a Business Process Management System - BPMS. BPMN-based BPMSs enable easy or even direct execution of BPMN models. However, in this case BPMN models should be defined at the appropriate level of detail - common executable level of BPMN modeling.

The common executable level of BPMN modeling does not differ visually from the analytical level.

However, it defines additional BPMN element attributes, which enable their execution on a BPMN process engine. Table 2 represents the attribute differences between the analytical (visual) level of BPMN elements and common executable level of BPMN elements of the BPMN model, presented in *Figure 8*.

BPMN Element	Graphical Representation	Analytical Level Attributes	Common Executable Level Attributes
Participant (pool)		id, name, processRef	-
Sequence Flow (unconditional)		id, name, sourceRef, targetRef	id, (name), sourceRefa, targetRefb
Message Flow		id, name, sourceRef, targetRef	-
Task (None)		id, name	-
User Task		id, name	id, name, renderings, implementation, resources, ioSpecification, dataInputAssociations, dataOutputAssociations, loopCharacteristics, boundaryEventRefs
Service Task		id, name	id, name, implementation, operationRef, ioSpecification, dataInputAssociations, dataOutputAssociations, loopCharacteristics, boundaryEventRefs
Message Start Event		id, name, messageEventDefinition	id, name, messageEventDefinition (either ref or contained), dataOutput, dataOutputAssociations
Send Task		id, name	id, name, messageEventDefinition (either ref or contained), dataInput, dataInputAssociations
Event Based Gateway		id, name, eventGatewayType	id, name, gatewayDirection, eventGatewayType
Catching message Intermediate Event		id, name, messageEventDefinition	id, name, messageEventDefinition (either ref or contained), dataOutput, dataOutputAssociations
Catching timer Intermediate Event		id, name, timerEventDefinition	id, name, timerEventDefinition (contained)
Error End Event		id, name, errorEventDefinition	-
End Event (None)		id, name	-

Conclusion

In this article, the importance and impact of a company's process maturity on overall company performance has been presented. Process maturity is commonly classified into six process maturity levels, starting at the non-existent and ending at the highest, optimized process maturity level. We also presented the fact that with the increasing level of process maturity, the importance and impact of BPMN models and supporting IT tools is increasing, and becoming critical for overall business process management success.

Ironically, there is a relationship between the lowest, non-existent and highest, optimized process maturity level. Both process maturity levels, share a commonality – the process participants are “not aware” of processes. At the non-existent level, a company's employees and their management are not aware that they produce value by performing processes. On the other hand, at the optimized level, the processes are managed on the best practice level. This means that process participants are commonly performing their work by using some sort of workflow management system. By using this kind of IT support, the employees don't need to think about the sequence of activities and information flows, since the workflow management system takes care of them. Therefore, they can stay focused on their TO-DO lists, meaning that they do not “need to be aware” of the underlying processes.

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