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## Holonic Business Process Modeling in Small to Medium Sized Enterprises

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### ABSTRACT

*Holonic modeling analysis which is the application of system thinking in design, manage, and improvement, is used in a novel context for business process modeling. An approach and techniques of holon and holarchies is presented specifically for small and medium sized enterprise process modeling development. The fitness of the approach is compared with well known reductionist or task breakdown approach. The strength and weaknesses of the holonic modeling is discussed with illustrating case example in term of its suitability for an Indonesia's small and medium sized industry. The novel ideas in this paper have great impact on the way analyst should perceive business process. Future research is applying the approach in supply chain context.*

*Key words: Business process, holonic modeling, operations management, small to medium sized enterprise*

### 1. Introduction

In unpredictable change of business environment, enterprises have to continuously introduce innovative programmes to remain competitive. Their continued competitiveness will depend on their ability to respond to internal pressures and external environment change (Porter and Ketels, 2003). This, in turn, require effective design of enterprise's processes through effort such as business process reengineering (BPR), enterprise integration (EI), and enterprise engineering (EE). All of these efforts normally incorporate three components namely: the theories of management, the process and implementation methodology, and the process modeling techniques of the enterprise.

BPR is concerned with radical, all or nothing approaches that cannot be accomplished in small steps. EI defines as the task of improving the performance of large complex processes by managing the interactions among participants (Petrie, 1992). EE attempts to take a more holistic approach than the often more narrowly focused BPR and EI approaches (Liles, Johnson, Meade, 1996).

Business process modeling (BPM) can be defined as the process of building functional activities of the whole or part as either current situation or a proposed situation (Tam, Chu, Sculli, 2001). BPM has the principal aim of helping identify critical processes and improve the overall performance of the business. There are three goals of BPM namely: form a tool for business process reengineering, help to identify appropriate strategies for software

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package implementation, help with software development.

There are several business process modeling techniques established today such as: IDEF0, data flow diagrams, flow charting, and Structural Analysis and Design Technique (SADT). Those techniques require an understanding of the systems thinking fundamentals.

A system usually have a name, inputs, feedback loops, elements, relationships between those elements, and a system boundary defining it from its environment. Figure. 1 shows the fundamental properties of a system. These fundamental properties can be applied to any system whether it is physical, social, or a combination of both.

This paper will present modelling methodology that supports a process centered approach to the design of enterprise especially small and medium sized. The methodology includes a modelling scheme for representing the enterprise and a technique prescribing the set of steps used to create a model. The scheme uses a holon based approach to enterprise modelling and adapts concepts from research in the object oriented and agent modeling areas.

The modelling scheme described in this paper uses a holon based approach to identify

and represent the activities and resources of an enterprise. This approach uses abstraction and enrichment rather for building hierarchy of business process models, rather than using aggregation and reduction which used by reductionism approach. The purpose of this unique approach and techniques is to be able to build process models that can be nested within hierarchy but do not adopt reductionistic principles.

## 2. Theories Background

### 2.1 Shortcomings of Current Methods

Current modelling methods are not fully supporting the needs of enterprise engineering (Giaglis, et al. 1996). In inter-organizational setting, process modelling becomes more difficult. Business process modelling should have the ability to: (1) represent multiple views of the enterprise, (2) support and integrate multiple means of analysis, (3) support top down design of business process and enterprises. Multiple perspective of an enterprise are required due to various questions and viewpoints of the end customers of a design effort. Most modelling method currently available focus on one or a few aspects at a time.

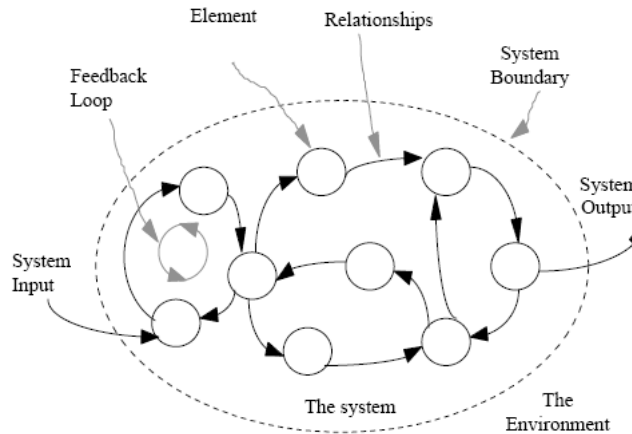


Figure 1: System Properties

## 2.2 History of Holon and Holarchies

The term “holon” was first proposed by Arthur Koestler (1989) as the basic unit for modeling biological and social systems in his book *The Ghost in the Machine*. The term is intended to describe any entity that is at the same time “a whole into itself and a part of other whole(s)”. A holon is taken to be a human activity system such as business process that contains all the fundamental systems thinking principles; it is considered to be part of larger system, and may itself contain other systems.

Holons belong to structures called holarchies that consist of self contained units capable of functioning independently but nevertheless are dependent on other units. The holarchy is a temporary assembly of holons with a specific set of temporal goals and objectives. The strength of a holarchy lies in its ability to construct highly complex, resource efficient systems which are highly resilient to

internal and external disturbances and are adaptable to changes in the environment.

The concept of holon and holarchies can be applied to social structures such as enterprises. A manufacturing enterprises can be considered to be a holon consisting a sets of holons representing various functions or organization of the enterprises. For example, a factory could be specified as five level of holons: facility, shop, cell, workstation, and equipment. Higher level holons set goals for lower level holon and coordinate overall control; the lower level holons are granted autonomy in their class actions and controls. The characteristics of holarchies are as followed:

- *Bi-directionality*: each holon can receive signals as well as send signals.
- *Level behaviour*: the holon at one level is not necessarily the sum of its subordinates. The characteristic of holons at one level are not representative of the characteristics of the level above or below them.

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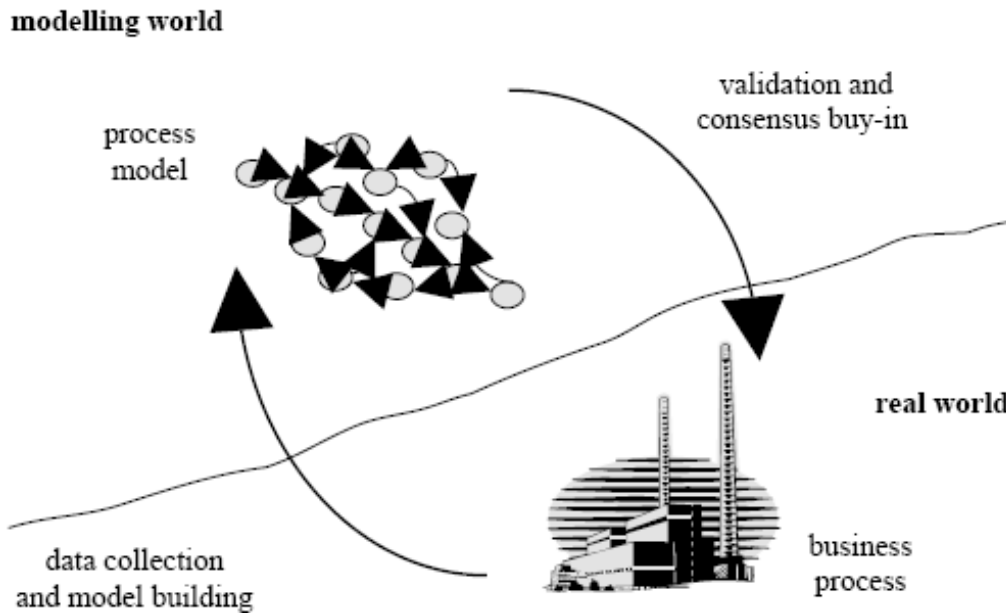


Figure 2. Division Between the Real World and Process Model

- *Flexibility*: holarchies are not rigid structures, they allow modification and adaptability. A holon can be part of multiple holarchies.
- *Open ended*: the top and bottom of the holarchies are not absolute. A holarchy can be augmented or interwoven with another holarchy.

### 3. Holonic Business Process Modeling

Business process modeling is only simple reflection of the actual business process represented. A process model is merely constructed to provide an insight into the behaviour of the real world process, see Figure 2 (Cleg, 2006).

Business processes are not purely physical systems and involve more than just lists of tasks to perform. They required people to make decisions about complex issues involving the use of tangible and intangible transformational resources used to transform a huge range of inputs (e.g. people, information, material) to outputs that fulfill the objectives of the process (e.g. finished products) (Johnson and Scholes, 2002). In order to investigate complex issues in processes that are characterized by low volume, high variation and long lead time (e.g. small medium sized enterprise), enrichment is a better way of building a hierarchy of models. The reductionism principles reduce core business process into sub-task, sub-sub-tasks and so on. This approach may be suitable way to proceed for producing product breakdown structures or task lists for chronological project plans but it is not considered suitable for explaining complex causal relationships within business processes. The core business process description is enriched by either adding supporting activity or by building a hierarchy of models to detail specific aspects of the model.

Business process model typically requires a mix of graphics, language, and codification. The language should describe the process in

familiar terms to those operating it, explaining relationship and behaviours of the process as an integral part of the model. Codification for numbering of task, sub task, and people; should be used in minimum number. Graphics can be the key to reach the right balance between natural language and codification.

Each individual business process model should be given an objective and should be reflected in its name. It is the purpose why the process exists. For example, consider a process called "product design": all the fundamental properties of the process should contribute to the objective of delivering a product design by being either part of the core business process or supporting activities.

### 4. Business Process Modeling Methodology

The modeling methodology embeds both creative systems thinking and the logic of input-transformation-output process analysis which is loosely based on Deming's plan-do-check-act cycle.

- *Plan*: scope process model and define process.
- *Do*: gather data, retain original language, define logical dependency, reflect not recreate.
- *Check*: build, enrich and abstract model as part of validation, minimize codification.
- *Action*: implement process model findings within business process.

### 5. Business Process Modeling Template

The template of business process modeling as shown in Figure 3, reflects one business process holon which includes the rigors of input-transformation-output type process analysis. The application and interpretation of this is the bases of every business process model which in turn can be built into a non reductionistic and

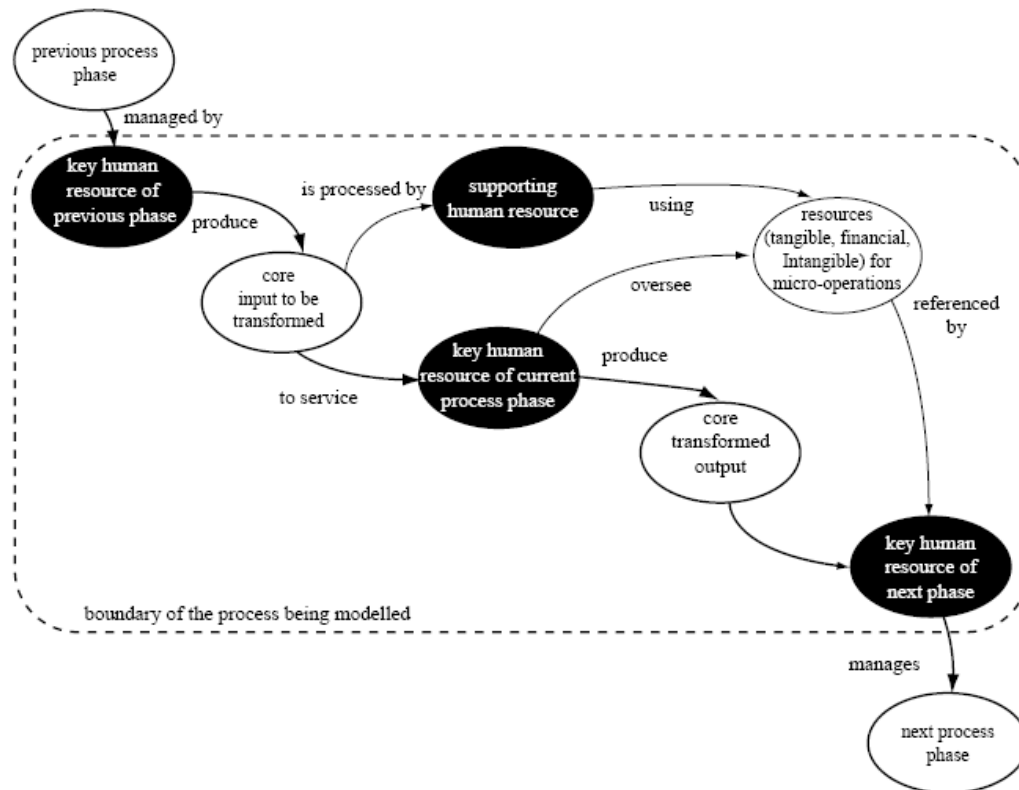


Figure 3. Holonic business process

aggregational hierarchy. The explanation of each element inside the template is as follow:

- *Previous key human resource and activity:* input from previous process phase, key human resource of previous phase produced core inputs.
- *Input:* core input to be transformed.
- *Key human resource:* key human resource of current process phase, oversee resources, supporting human resource.
- *Performs an activity:* produces core transformed output, oversee processing of resources for micro operations, uses resources in essential for producing core transformed output.
- *Output:* core transformed output, resources for micro operations.
- *Next key human resource and activity:* output to next process phase: key human resource of next phase manages next phase.

## 6. Application

The company concerned is medium sized company based in West Java Indonesia. The major business of the company is performing West Java (Sundanese) traditional entertainment (e.g. music, dance) and producing a famous music instrument made from bamboo called “Angklung”. This company has cultural workshop consisting of performance venue, bamboo handicraft centre, and bamboo instrument workshop. Apart from that, it has an honourable function as an educational laboratory and training center to preserver the Sundanese culture.

The main problem of interest of this company is capacity of “Angklung” production which is still incapable to meet demand. Business process example of the production unit of this company is presented on Figure 4.

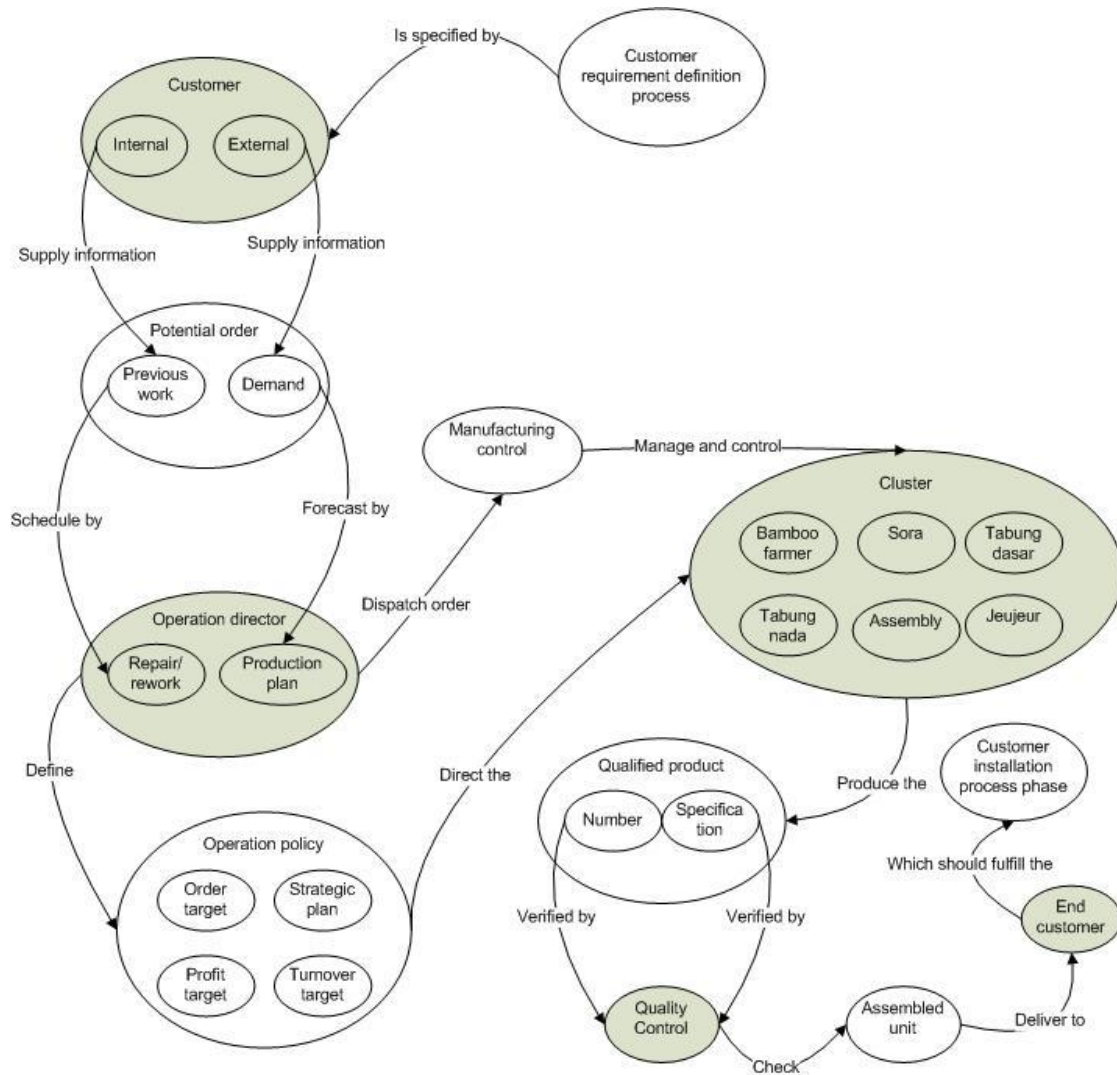


Figure 4 Holonic business process representation of production unit of medium sized company

## 7. Conclusion

Holonic business process modeling has been developed using test cases from medium sized company having main business in culture's products. It has been found to have better description of business process that are hard to define, which typically having low volumes, high product variation, and lengthy period of time to complete. Standard techniques for process modeling often focus on well-defined processes with high volumes, low variation in delivery and short lead times.

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