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Analysis of Business Flow of MOC based on Business Process Model of Plant Lifecycle Engineering

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Management of change (MOC) has been a very important issue in process safety management. Individual change management is an instance of the plant lifecycle engineering (Plant-LCE), however a business flow of MOC has been hardly discussed. Engineering over the plant lifecycle is called Plant-LCE. On the other hand, the logical process safety management based on the business process model (BPM) for Plant-LCE has been proposed. In this study, the business flow of the MOC based on the BPM for Plant-LCE is analysed. To demonstrate the analysis of the business flow of the MOC, an example of MOC of minimum feed rate of a plant was traced in the BPM for Plant-LCE.

1. Introduction

MOC has been a very important issue in process safety management. Some studies and guidelines have been proposed for management systems for changes (CCPS 2008). Individual change management is an instance of the Plant-LCE, however a business flow for the MOC has been hardly discussed. The business flow of the MOC should be analysed based on the BPM for Plant-LCE. Shimada et.al. (2012a, 2012b) have been proposed the logical process safety management based on the BPM of Plant-LCE. In this study, the business flow of the MOC based on the BPM of Plant-LCE is analysed.

2. Plant -lifecycle

The plant lifecycle consists of the following engineering stages: development, design, construction, production, maintenance, and scrap (or dismantlement) (Figure 1). Over its lifetime, the product markets may vary and revamping of a plant's facilities are undertaken. Under the external and internal conditions, plant structure, processes, plant design, production and maintenance are changed. MOC are perpetual and vital. Many activities such as process hazard analysis (PHA), training, and so on are needed to achieve MOC. Modification of even a small part of a plant will be associated with other stages in the plant-lifecycle. Thus, the BPM for Plant-LCE should be needed to analyse business flow of MOC.

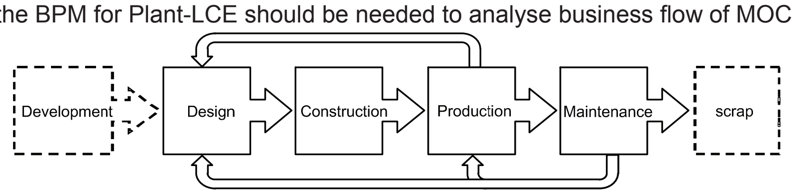

Figure 1: engineering stages through the Plant-Lifecycle.

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3. Basics of BPM for Plant-LCE

3.1 Template of BPM for Plant-LCE

The activities of the plant lifecycle engineering are hierarchically described as the BPM (Shimada et al. 2012a, 2012b). IDEF0 (Integrated DEfinition for Functional model standard, Type-zero) is adopted as a description format to develop the BPM. Each activity of the plant lifecycle stages hierarchically has own sub-nodes. Because of the too high degrees of freedom of IDEF0 format, it is difficult to generalize the model in IDEF0 format. Thus Fuchino et al. (2010) proposed a template for the BPM to enable a discussion of integrating each BPM for Plant-LCE as shown in Figure 2. The box represents activity and the flow represents information. The template proposed by Fuchino et al. (2010) consists of two functions; 'Performance in the form of a PDCA (Plan-Do-Check-Act) cycle' and 'Resource provision'. Based on the template proposed by Fuchino et al. (2010), Shimada et al. (2012a, 2012b) proposed the BPM for Plant-LCE.

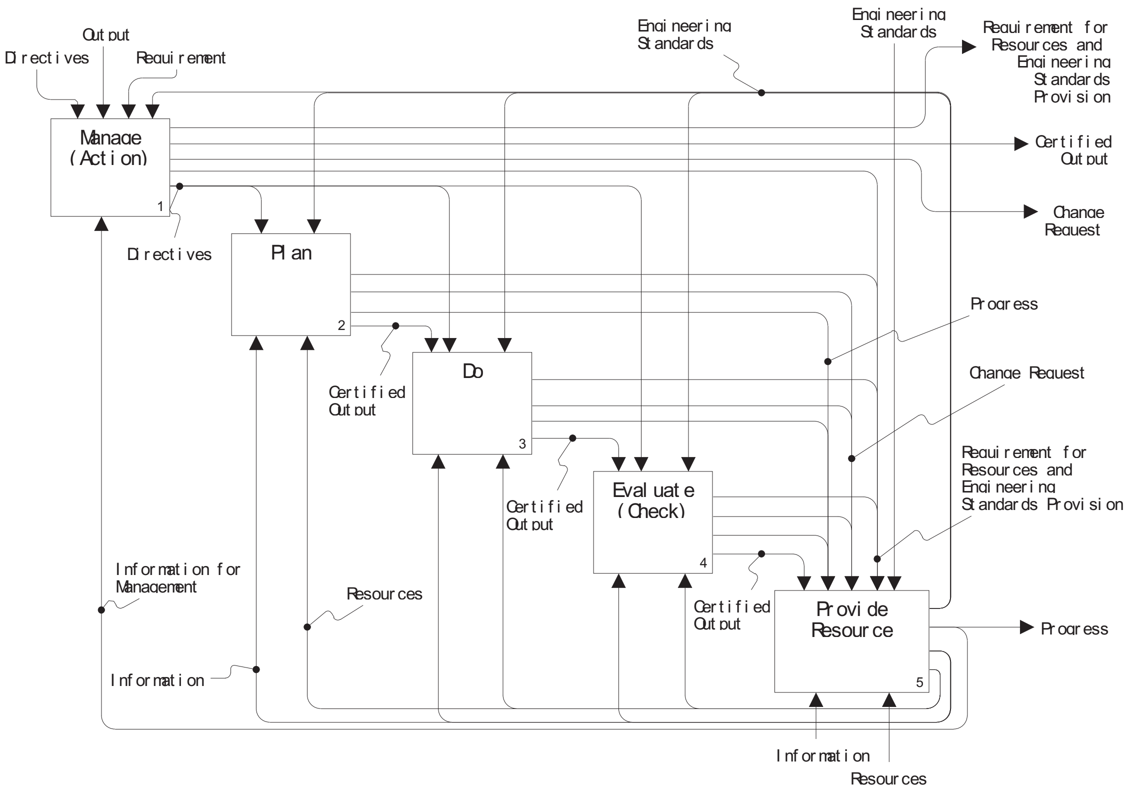

Figure 2: PDCA cycle and resource provision template for BPM.

3.2 Modified template of the BPM to trace a business flow

The BPM for Plant-LCE proposed by Shimada et al. (2012a, 2012b) consists of many nodes composing activities' hierarchy. Each node describes on an individual plane. Thus, to trace a business flow over many nodes passing many planes is complicated. Therefore, to trace the business flow of the MOC over many nodes of the Plant-LCE, the template proposed by Fuchino et al. (2010) is modified as following steps.

1. Summarize information and resources.
2. Summarize input and output for each node.
3. Summarize output from Plan, Do, and Evaluate (Check) activities.
4. Reallocate boxes for each activity.
5. Exhibit connections between upper activity and lower activities.

A modified template of the BPM for Plant-LCE is shown in Figure 3. Using the modified template, the BPM for Plant-LCE is described in a plane to trace a business flow of the MOC.

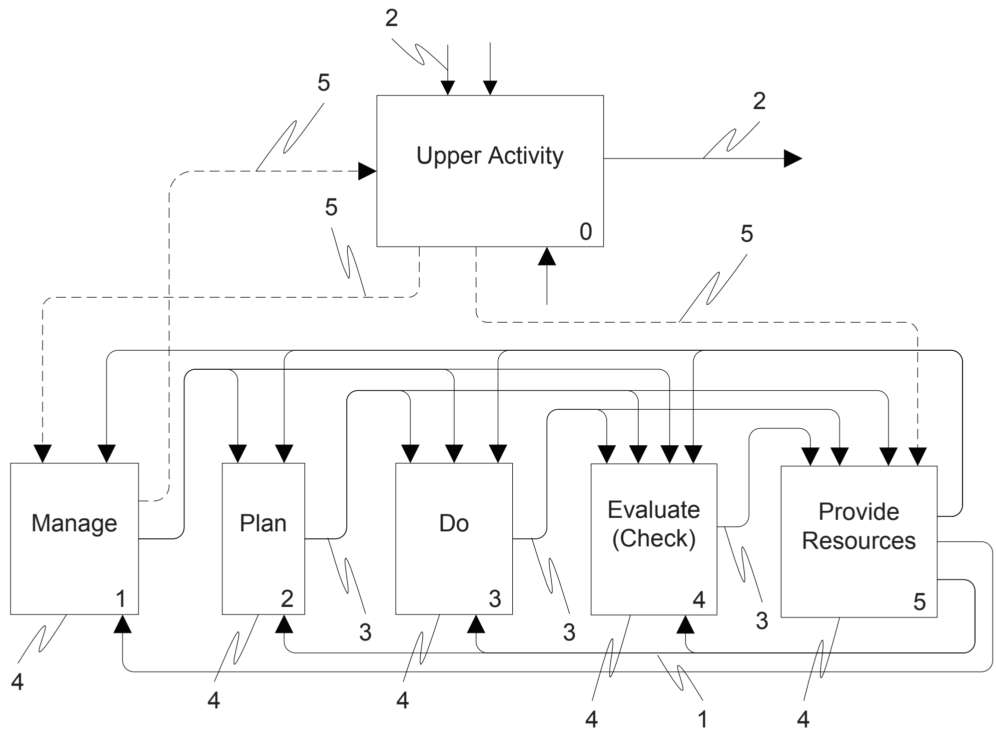

Figure 3: template for overview of BPM.

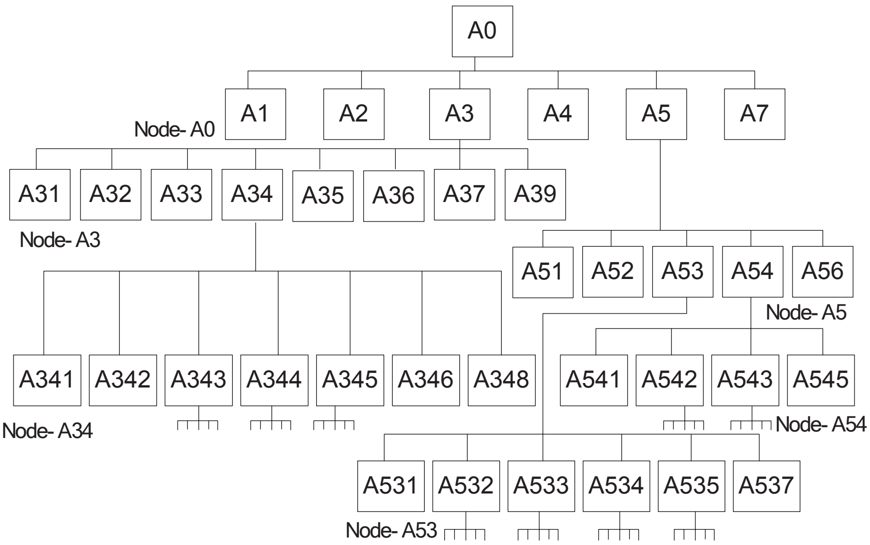

Figure 4: a part of activities hierarchy of the BPM for Plant-LCE.

3.3 BPM for Plant-LCE

A part of activities hierarchy of the BPM for Plant-LCE proposed by Shimada et al. (2012a, 2012b) to trace a business flow of MOC is shown in Figure 4, because whole of the BPM is too huge to present in this paper. The BPM has 36 nodes, 160 activities and 606 flows. Some activities such as A343, A344 and A345 have sub-activities. A part of description of activities of the BPM for Plant-LCE is listed in Table 1. Because the MOC is associated with over the Plant-LCE, a business flow of the MOC is analysed based on the BPM for Plant-LCE.

Table 1: a part of description of activities of the BPM for Plant-LCE

A0	Perform Plant-LCE		
	A1	Manage Plant-LCE	
	A2	Make execution plan for Plant-LCE	
	A3	Perform process and plant design	
		A31	Manage process and plant design
		A32	Decide concept for process and plant design
		A33	Perform conceptual process design
		A34	Perform preliminary process design
		A35	Perform detail process design
		A36	Perform preliminary plant design
		A37	Perform detail plant design
		A39	Provide resources for process and plant design
	A4	Perform construction	
	A5	Perform manufacturing	
		A51	Manage manufacturing
		A52	Make production planning
		A53	Perform production
		A54	Perform maintenance
		A56	Provide resources for manufacturing
	A7	Provide resources for performing Plant-LCE	

4. Analysis of business flow of MOC in BPM

4.1 Example

To demonstrate the analysis of the business flow of the MOC, an example of a business flow concerned with the MOC of minimum feed rate of a gasoline desulfurization plant was traced in the BPM. There were two selective hydrogenation units (called SHUs) in the gasoline desulfurization plant. The SHUs had minimum feed rate. When the feed rate to the SHUs was decreased, processed gasoline was recycled to the SHUs to keep the minimum feed rate. The recycle operation wasted much energy. For economical reason, lower minimum feed rate was assessed. There was not enough design information to decide the lower minimum feed rate. But its sufficient condition was that there was no thermal drift in the SHUs. Therefore test operations were examined to decide the lower minimum feed rate without thermal drift in the SHUs. Based on the test results, bases associated with change minimum feed rate of the SHUs were updated.

4.2 Traced results

A part of traced results is shown in Figure 5. The thick lines represent the traced business flow of MOC of the minimum feed rate of SHUs. The labels of the flows represent traced order as following.

1. Assessment associated with the change of minimum feed rate of the SHUs was required by the enterprise management to A0 ‘Perform Plant-LCE’. The requirement was a requirement itself to A1 ‘Manage Plant-LCE’.
2. To decide scope of the assessment was required by A1 to A2 ‘Make execution plan for Plant-LCE’.
3. Assessment the change within the decided scope was required by A1 to A3 ‘Perform process and plant design’. A3 was broken down to many sub-activities.
4. According to the assessment results by A3, there was not enough design information to decide the lower minimum feed rate. But its sufficient condition was that there was no thermal drift in the SHUs.The assessment results and test operation requirements by A3 were sent to A7 ‘Provide resources for performing Plant-LCE’.
5. A7 logged the assessment results and test operation requirements and sent them to A1.
6. A1 required A5 ‘Perform manufacturing’ to perform test operation based on the test operation requirements. A5 was broken down to many sub-activities including A54 ‘perform production’ and A55 ‘perform maintenance’.
7. According to the test operation by A5, it was confirmed that the assumed lower minimum feed rate of SHUs was adequate. The results of the test operation by A5 were sent to A7.
8. A7 logged the results of the test operation and sent them to A1.

9. A1 required A7 to modify the various bases associated with the change from the existing minimum feed rate of SHUs to the confirmed lower minimum feed rate.
10. A7 required A3 to design the modified bases.
11. A3 sent the modified bases to A7.
12. A7 logged the modified bases and sent them to A1.
13. A1 outputted the assessment results of the change of the minimum feed rate of SHUs including the modified bases. The outputs were outputs themselves of A0.

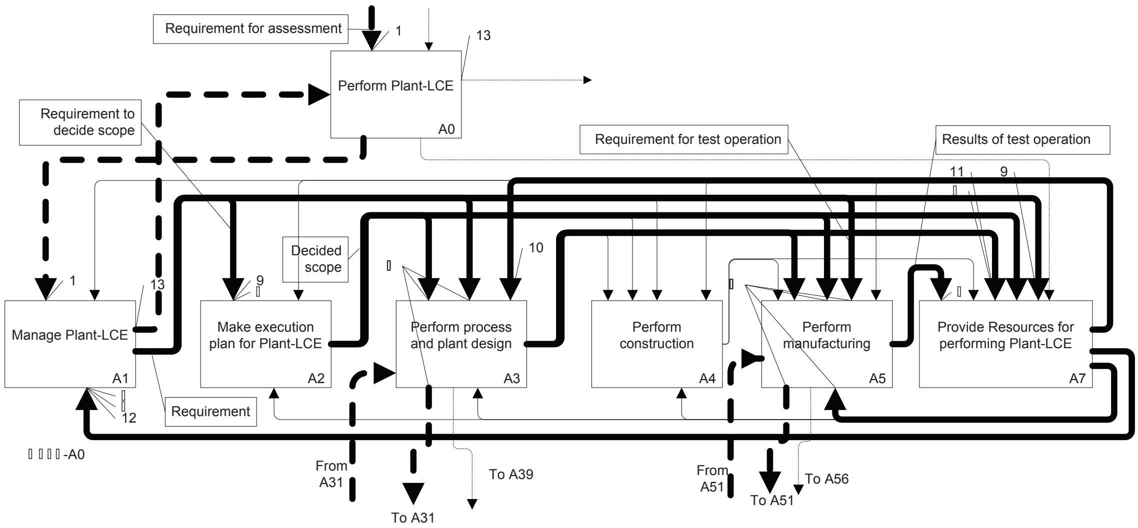

Figure 5: a part of the trace results.

4.3 Discussion

4.3.1 Importance of information about production and maintenance for design

The test operation requirements should contain test operation procedure, test period, criteria for safety operation, measurement basis for maintenance and so on. To decide the test operation requirements, information such as bases and records about production and maintenance should be useable in A3. Therefore, information should be shared among design, production and maintenance.

4.3.2 Role of the management

In this business flow, a 'manage' activity of each node manages assessment for the change to be performed in PDCA cycle in own node. The business flow of this MOC of minimum feed rate of SHUs is over the BPM of Plant-LCE. That is to say, the MOC is not expressed as one activity but whole of the managements of all nodes of this business flow.

4.3.3 Further investigation points

A3441 'Manage preliminary process design for SU/SD' assessed through A3442 'Perform preliminary process operational design for SU/SD', A3443 'Perform preliminary process structural design for SU/SD' and A3445 'Provide resources for preliminary process design for SU/SD' as shown in Figure 6. On the other hand, A34431 'Manage preliminary process structural design for SU/SD' directly returned assessment results. A person who executed A34431 implicitly performed the activity in his mind. Whether the assessment was performed through the other activities or not was not investigated. Some similar investigation points were discovered. Discovering the investigation points was one of the outcomes of this analysis.

5. Conclusion

This paper tried to analyse a business flow of the MOC. Because the MOC is associated with over the Plant-LCE, a business flow of the MOC was analysed based on the BPM for Plant-LCE. Tracing the business flow of the MOC based on the BPM, the following results could be achieved:

- The business flow of the MOC can be described based on the BPM for Plant-LCE.
- The information about production and maintenance is very important for design.

- The MOC is not an activity but whole of the managements of all nodes of this business flow.
- Investigation points whether the assessment was performed through the other activities or not were discovered.

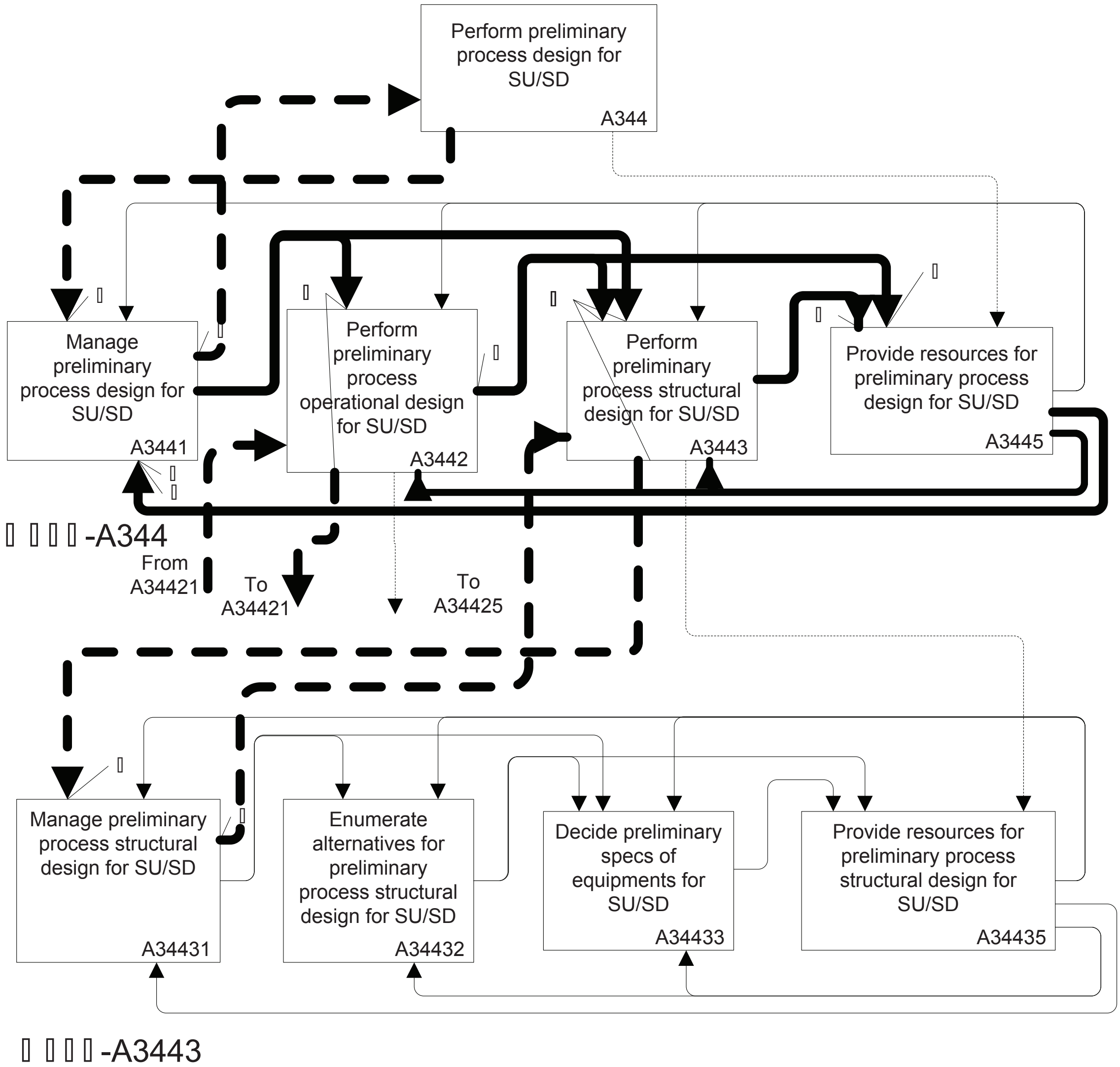

Figure 6: a part of trace results from A344 to A34431.

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