

論文 / 著書情報
Article / Book Information

題目(和文)	ビジネスプロセスモデルに基づくエンジニアリングプラスチック産業のリエンジニアリング
Title(English)	A Study on Business Process Model-Based Reengineering for Engineering Plastic Industry
著者(和文)	柴田朝彦
Author(English)	Tomohiko Shibata
出典(和文)	学位:博士(工学), 学位授与機関:東京工業大学, 報告番号:甲第11907号, 授与年月日:2021年3月26日, 学位の種別:課程博士, 審査員:淵野 哲郎,久保内 昌敏,関口 秀俊,青木 才子,松本 秀行
Citation(English)	Degree:Doctor (Engineering), Conferring organization: Tokyo Institute of Technology, Report number:甲第11907号, Conferred date:2021/3/26, Degree Type:Course doctor, Examiner:,,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	要約
Type(English)	Outline

A Study on Business Process Model-Based Reengineering for Engineering Plastic Industry

Summary

Engineering plastic has superior mechanical properties and is applied to replacement of metallic parts. Engineering plastic parts are designed based on pre-existing or standard parts, and they are modified to fulfill required qualities. The qualities of engineering plastic parts are realized by three features: a product shape, material and a production process. Since these three features relate to and affect each other, whether the required qualities are satisfied can be confirmed only after a design process is finished. Further, the design process is concurrently performed by a plurality of companies (e.g., an OEM, a part manufacture, a material supplier, etc.). In addition, development of the engineering plastic parts is managed on a project basis, and the part manufacture holds competitions to select counterparts in charge of the development. The design process cannot be proceeded with a specific counterpart, and the companies hesitate to share information used in the design process.

To accomplish the design process efficiently, unnecessary work needs to be removed. However, the current design process is not composed in a way that the required qualities are realized with minimum studies. In the design process, when an output of the step is not applicable in a successive step, these steps are repeated to cause unnecessary iterations. Due to the unnecessary iterations, efficiency of the design process does not improve. Although the unnecessary iterations need to be obviated, due to the project-based management, the companies cannot have consistent information and criteria to carry out the design process. A countermeasure for concurrently performing the design process is required even if the inconsistent information and criteria are used.

Currently, it is not clarified in which step the unnecessary iteration is observed. The design process is performed implicitly based on experiences of previous projects, and the iterations of steps are managed in an ad hoc manner. However, the ad hoc approach does not dissolve the unnecessary iterations. To address the unnecessary iterations by a systematic approach, the reason to cause the unnecessary iterations needs to be identified. The current design process is implicitly performed, and we do not have an explicit description of the same. For analyzing the current design process, we need to represent the design process in the explicit manner.

In this work, to explicitly describe the design process, we used the IDEF0 method to develop an activity model. In addition, we introduced a template to help develop a generic reference activity model. The reference activity model helps analyze the current design process to identify the reasons causing the unnecessary iterations, and develop the generic framework to reengineer the design process. In this connection, the whole design process is too broad to represent. Thus, we set the scope (viewpoint) of the design process to be analyzed as a product design process for utilizing the CAE environment and resolving the unnecessary iterations.

To analyze the current product design process and perform reengineering thereof, the reference activity model should incorporate characteristic features of the product design process. Specifically, the reference activity model should consider that the product design is made by the part manufacture, whereas evaluation thereof is performed by the material supplier, and the material supplier provide the part manufacture with the design proposal in addition to results of simulations.

Then, we analyzed the product design process with the reference activity model and successfully identified the reason to cause the unnecessary iteration as the inconsistent engineering standards used to evaluate the product design. In other words, due to the project-based management, the engineering standards of the part manufacture used for revising the product design are not consistent with those of the material supplier used for evaluating the same.

In view of the project-based management, changing their engineering standards to be consistent with each other is not feasible. Thus, for developing the framework to resolve the unnecessary iteration, we proposed the approach of coordinating the engineering standards so that the engineering standards of the part manufactures or the material suppliers are made partially (and temporarily) consistent with those of the counterparts by changing parameters of the engineering standards.

To concretely discuss the framework enabling the coordination, we specified the contents of the engineering standards. The engineering standards are assumed to comprise the codes and the design standards. The design standards are defined to comprise the guidelines and the standard design. The standard design corresponds to the pre-existing parts to be modified and comprises a standard shape; standard materials; and a standard production process, and the guidelines are used in combining and/or modifying the standard design. We clarified activities to develop the design standards as sub-activities of “Provide Resources” of the template.

On a basis of the developed sub-activities, we developed the framework. Since the design standards comprise the guideline and the standard design, the coordination may be performed at least one of them. With respect to the standard design, the reference activity model incorporates activities to output requests for changing the standard design. On the other hand, with respect to the guideline to modify the standard design (technical guideline), we set forth activities to update the engineering standards for formulating the technical guideline in the framework. The framework was developed for the part manufacture and the material supplier separately in line with the duplicate design revision structure. We confirmed that the developed framework is effective to resolve the unnecessary iterations by simulating two illustrative examples.