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An Application of Reinforcement Learning
to the Supply Chain Management

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The purpose of this study was to construct with the frame of the Reinforcement Learning, to execute, and to consider the Decision Making System based on Supply Chain Management (SCM). However, to treat quite a lot of information, supporting the decision making of SCM by the information system is attended with the difficulty. Therefore, the selection of method is a problem of itself in this kind of Study.

In this study, Total Systems Intervention (TSI) and Soft Systems Methodology (SSM) are applied clarifying an important point under discussion for SCM, and these methodologies are used to construct the simulation model. TSI is a Meta System Methodology to which an appropriate methodology is requested by analyzing things from various sides. TSI is composed of three phases of Creativity, Choice, and Implementation. SSM was selected from the phase of the Choice as a predominant methodology for SCM. SSM presents an executable improvement idea by which interests are adjusted (accommodate) from an indistinct situation where the purpose exists together. In SSM, the situation assumed to be a problem is expressed as a Human activity system, the system is shown as a Root Definition, and the Conceptual Model has been made in working out finally. The opinion of possible debate is led by comparing these Conceptual Models with the perceived reality world.

In this Study, using the simulation compares the Conceptual Model and the perceived reality world. The problem concerning SCM, which was called the Beer Game, was selected as a theme of the simulation. In the Beer Game, the retailer, wholesaler, the deliverer, and the fac-

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tory have affected as a trader who handles the beer. The Beer Game shows the phenomenon that the change of the Supply Chain expands by the amounts of the order of the customer doubling. To analyze the Beer Game by applying SSM to the beer game, and to execute appropriate some SCM, we proposed the improvement idea for the Beer Game.

We assumed the Root Definition to be "System which did cooperation of labor SCM which suppressed the stock cost working, and canceling the order backlog to construct the supply chain with high CSM" from one of Relevant systems concerning the beer game. Next, the Conceptual Model was constructed with the Root Definition. The frame of the Beer Game simulation model is constructed based on the Conceptual Model.

In this study, a heuristic function and the Reinforcement study were applied as a Decision Making algorithm of each player in the Beer Game simulation model. A heuristic function was assumed to show the Decision Making of the SCM, which does not cooperate with other player. The Reinforcement Learning shows the decision making of the SCM, which do cooperate with other player It is necessary to treat two or more information which affects the Supply Chain when the cooperation of labor working. Those information cannot finish being processed by a heuristic function. The reward of the Reinforcement Learning was assumed to be cost per CSM because of two evaluations important in the Conceptual Model.

The phenomenon of the expansion of the change was generated in the Supply Chain to which either algorithm was applied. However, when the Reinforcement Learning was applied to the SCM, the cost of 40%-60% could be reduced compared with the case of a heuristic function. Moreover, when the Reinforcement Learning was applied to the SCM, CSM also showed an equal numerical value compared with the case of a heuristic function. Finally, the graph of the career concerning the average of stock-order backlog showed certain constant amplitude. As a result, it is understood that the frame of the Reinforcement Learning was able to acquire some policies to stabilize SCM.

It has been understood that the Reinforcement Learning can execute effective SCM because the frame of the Reinforcement Learning could improve the evaluation of the efficacy, efficiency and effectiveness as a conclusion of this study. The Reinforcement Learning is one of appropriate methods of showing the improvement idea to convert SCM. Thus, it was an appropriate selection to have applied SSM from the methodology of TSI as a methodology of the search for the problem of SCM.