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# Modeling and verification provisions of life insurance by formal method

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It proceeds everywhere of our daily life the computerization for information society or the so-called electronic society. The most important thing in realizing of electronic society is information system. It can be said that there is a close connection between daily life of people and the information system. When a problem occurs in the information system that relates to important infrastructure, it can escalate and cause a large damage to the society. An important infrastructure here we mean a big system that is used by large number of people such that it has some influence to the society. It is, for instance, a pension system, stock trading system, air traffic control system, etc. Furthermore, there is relation between law and the basis of the specification of such information system.

For instance, the salary calculation system has the residence tax, the income tax, the welfare annuity, the unemployment insurance, and the year-end adjustment, etc. It is understood that these are related to each relating law. Law can demand the specification of electronic society from this. In other words, it can be said that the law will have been embodied with the information system.

Life insurance is described here. We consider life insurance system one of the important infrastructures because in Japan there are about 100 million of contracts of private life insurance. The reason has about 100 million

numbers of contracts of private life insurers. When a defect happens to life insurance system, the effect which it has to society may become very large. Actually, it had effect on the society in the nonpayment of the insurance that happened in 2005 had been a hot topic for the media.

The cause of nonpayment of the insurance of the life insurer is assumed to be the difficulty to understand the provisions of the insurance contract.

The provision of life insurance contract is the important agreement to be followed after the contract is effective. If the provisions have some flaws or they deviate from what specified by the commercial law which is high-ranking law, the effect to society would be large.

In this research, we consider commercial law as a high ranking law, and provisions of life insurance contract as a low ranking law though it is not an actual law. We investigate the relations between a high ranking law and a low ranking law, indicate, formalize and verify the relations.

We describe about the possibility of formalizing high ranking and low ranking law, problems and feasibility in formalization.

This research begins by studying of the basics of life insurance to clarify the provisions of life insurance contracts. Then the laws related to life insurance provisions are examined. As a result, we found that commercial law and insurance business law are related to the provisions. As a result of our study, we consider commercial laws as high ranking law and provisions of life insurance contract as low ranking law. The relations between the high ranking law and low ranking law are elicited by human from the sentences in the commercial laws and provisions. Then, each related sentence is formalized as first-order predicate logic formula. The formulas of commercial laws and corresponding provisions are then checked and complemented for verification by automated theorem prover.

As for the result of this research, we pay attention to the relations of lower level than the sentences of commercial laws and provisions. The relation between a high-ranking law and a low-ranking law was considered either forcible provisions or the one side forcing provisions. The relation between forcible provisions and the one side forcible provisions can be seen as a generalization relation. For forcible provisions, the logical expression of commercial law and the provision become identical and the generalization relation is done. For one side forcible provisions, there are cases that

generalization works out right from the logical expression of the law and the provision, but in most cases it is not. This can be solved by modifying the formula on the law side to loosen the formula of the provision side. The formulas can then be formally verified.

Future tasks. The logical expression of the complementation might be necessary to verify the first by the one side forcible provisions. In this case, there is possibility that one becomes more advantageous than the other depends on how the complemented logical expression. So, it should be made clear about who create the complemented expression. Moreover, automatic checking of fairness may be necessary.

Next, the logical expression was made by only one man in this research. At that time, the logical expression of commercial law was made first. Next, when the logical expression of the provisions was made referring to the logical expression of commercial laws, the logical expression can be made efficiently and verified easily. When the expressions of laws and provisions are created by different person, the logical expression can be disagree even if the law and the provision have the same meaning. This make the verification task more difficult. We think that the creation of logical expression can be more effective, if we prepare templates for automatically or semi-automatically creation of logical expression.