Approach to Social Solutions

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Fujitsu Laboratories is developing social solutions to help establish the Human-Centric Intelligent Society. Collecting, unifying and analyzing data on personal activities, business activities and social circumstances, social solutions provide answers to composite social problems that cannot be solved by individual persons or individual enterprises. The application area of social solutions is vast and we have just started our research activities on them. However, some solutions that focus on realizing a safe and wealthy society are so mature that we can perform field experiments or user tests on them. In this paper, we introduce four solutions (proactive risk management, traffic safety management, market quality management and community energy management) to illustrate our approach to social solutions.

1. Introduction

Since the nuclear accident brought about by the Great East Japan Earthquake, nationwide power-saving measures have been implemented. To overcome this unprecedented critical situation, we need to maintain the stability of society as a whole, even if it is at the cost of some of efficiency or convenience of individuals or enterprises. At the same time, however, there are concerns that extreme voluntary restraint may lead to a loss of economic vitality. As shown in **Figure 1**, we are part of corporate activities and constituent members of society as well as individuals living everyday life. The senses of value from different perspectives of individuals, enterprises and society often compete or conflict and the optimum solution from a certain standpoint is not necessarily linked to optimization as a whole. In the power-saving measures mentioned above, how to balance efforts between individuals, enterprises and society is a major challenge.

To help establish the Human-Centric Intelligent Society, Fujitsu Laboratories is developing social solutions, which alleviate the conflict and confrontation between the different senses of value of individuals, enterprises and society for overall optimization. Social solutions are intended to provide answers from a broader perspective to composite social problems that cannot be solved by individual persons or individual enterprises by continuously running the cycle of:

1) Collection, accumulation and unification of data on personal activities, business activities and social circumstances by using sensors, social media and business systems;
2) Analysis of the collected data to predict the future and deduce measures for elimination of competition or conflict and overall optimization; and
3) Realization of optimization measures by changing people's judgment or behavior.

The application area of social solutions is vast and we have just started our research activities on them. However, some solutions that focus on realizing a safe and wealthy society are so mature that we can perform in-house field experiments or actual user tests on them.

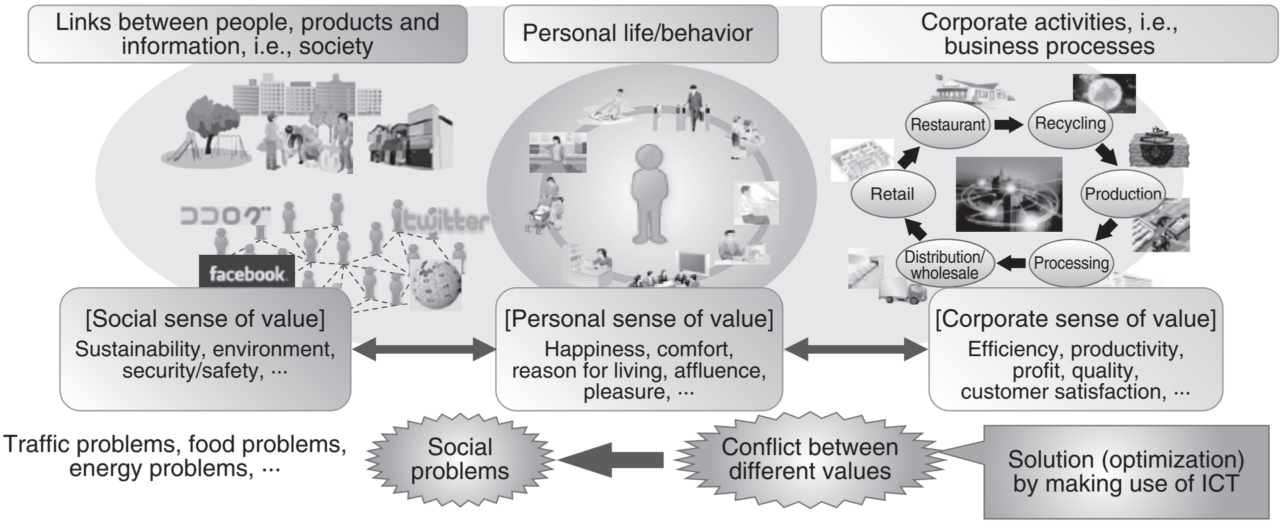

Figure 1
Social solutions.

Of those, this paper presents four major solutions including proactive risk management, traffic safety management, market quality management and community energy management to illustrate our approach to the R&D on social solutions.

2. Proactive risk management

We are living daily life and carrying out activities while being surrounded by various risks. Once risks are realized, critical situations may often arise such as financial or human loss, loss of corporate or brand trust and economic loss at a national level. While completely eliminating risks is usually difficult, appropriate management and containment of, or coexistence with, risks is the top-priority issue for realizing a safe and secure society.

Risk management has two aspects: loss reduction, to minimize loss by handling problems after they have occurred; and risk reduction, to reduce the problem occurrence probability by formulating and implementing problem prevention measures. Risk reduction can be further classified into reactive approaches for preventing recurrence of critical problems by taking reactive measures, and proactive approaches for preventing critical problems from occurring by proactive measures.

Of these types, Fujitsu Laboratories has developed a proactive risk management solution. This solution has successfully provided a system in which cases of incidents that arise before developing into critical problems (minor problems) and near misses (cases that fortunately did not become problems) are collected and analyzed. Via analysis, factors and patterns that may lead to critical problems are identified, thereby preventing the occurrence of critical problems (**Figure 2**).

The key to proactive risk management is the risk mining technology[1)] independently developed by Fujitsu Laboratories, which has realized sophisticated risk management by using the following three elemental technologies.

1) Visual text mining technology for visualizing the descriptions in a large quantity of problem reports as a concept map to overlook the general tendency of problem occurrence[2)]
2) Risk scenario analysis technology for automatically constructing problem occurrence models based on the descriptions in problem reports to identify the root

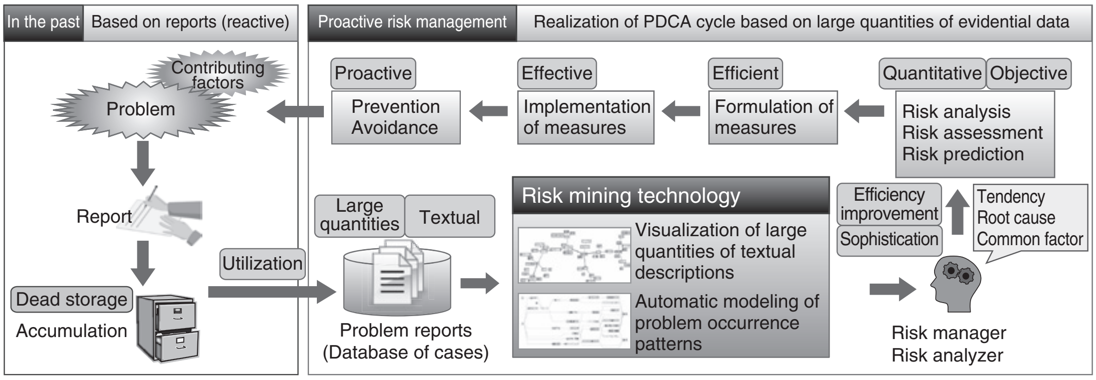

Figure 2
Proactive risk management.

causes, common factors and extent[3)]

3) Compound data analysis technology that realizes multi-aspect analysis by combining various types of information such as problem reports (textual data) and sensor data (numerical data)

Field experiments of the technologies were conducted in the fields of aviation, railway and nuclear energy as part of the Information Grand Voyage Project (2007 to 2009) led by the Ministry of Economy, Trade and Industry (METI). The results of the experiments substantiated the solution's effectiveness and usefulness as compared with the conventional techniques as described below.[4)]

1) Improvement of analysis efficiency can speed up the risk management cycle.
2) Large quantities of data can be used to provide a top-down approach overlooking the entire picture.
3) Ease of trial and error allows multi-aspect analysis based on unrestrained thinking.
4) The evidence-based approach allows objective judgment and explanation with subjectivity eliminated.

The solution is now commercialized as a practical solution and marketed mainly for the industrial sector.

3. Traffic safety management

The proactive risk management described above is premised on the problem reports that have been collected and accumulated, and this has the following challenges.

1) Problem reports contain information that may be disadvantageous to the people concerned, which means that a system or culture of continuous collection is difficult to build.
2) While information about incidents and near misses is useful, the criteria for deciding whether or not to report it depend on individual subjectivity and objective information gathering is difficult.

For this reason, it is often impossible to collect sufficient reports to analyze in the first place, unless a system and culture for risk management is established.

One useful method to use in this situation is an approach that makes use of sensors. In the field of transportation and traffic, for example, installing a drive recorder, which uses an acceleration sensor to detect sudden braking or sharp turns of the steering wheel and makes video records of the driving conditions, is growing popular especially for taxis and trucks. Networked digital tachographs, which send fleet management data such as the vehicle speed and location to a data center, are also becoming widespread and the environment to allow real-time collection of large quantities of data is taking shape.

Fujitsu Laboratories is working on a traffic safety management solution (**Figure 3**), which collects and accumulates large quantities of sensor information obtained from terminals on vehicles to automatically generate a near miss map (showing points with frequent unsafe events) by:

1) Using speed and acceleration information to extract unsafe driving patterns; and
2) Identifying points with frequent occurrence of unsafe driving patterns.

Through the field experiment, it has been proved that the near miss map automatically created indicates points that coincide with the hazardous points widely known. It has been also proved that the technology can extract unknown hazardous points.

In the future, we plan to enhance the capability of identifying factors that lie behind unsafe driving by combining various types of information including the driver's conditions and personal attributes, weather and traffic situations.

4. Market quality management

Recently, in a variety of business fields such as automobiles, consumer products, food and drugs, it is often the case that critical defects of products are found after shipment and they lead to social problems. With such a situation in the background, there has been a growing tendency toward protecting and placing priority on general consumers' benefits and safety. An example of this is the enforcement of the Product Liability (PL) Law and the establishment of the Consumer Affairs Agency. This has prompted enterprises to position market quality management after products' arrival on the market as a major management issue.

The first challenge of market quality management is to collect defect information. Once products are on the market, direct monitoring for and control of the occurrence of defects is impossible. Hence, collection and accumulation of market defect information such as complaints from consumers, accident reports and repair records is necessary. The second challenge of market quality management is speed. Quickly detecting market defects so as to promptly handle them can minimize damage to both consumers and enterprises. Conversely, if there is a delay in responding to defects that may lead to harmful rumors or class actions, often multiplying the damage.

As a system to solve the problems described above, Fujitsu Laboratories is developing a market quality management solution. It makes

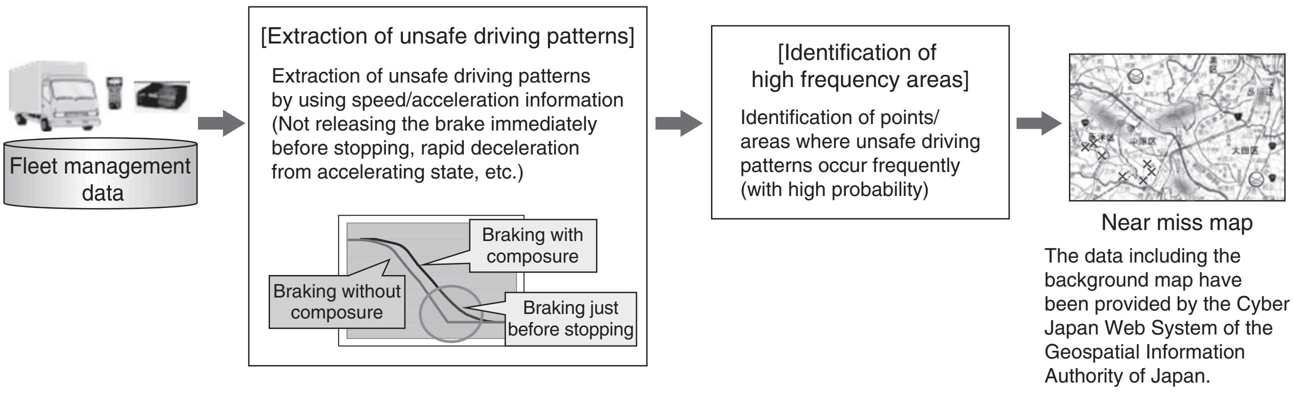

Figure 3
Traffic safety management.

use of compound data analysis of market defect information inside and outside the company to detect signs of, monitor for and predict abnormalities such as the spread of harmful rumors or forced recalls (**Figure 4**). As a result of a field experiment using real data, we have verified that the solution is capable of predicting product recalls with high accuracy. In the future, we intend to work on predicting the impact after abnormalities arise.

5. Community energy management

The existing smart grid in Japan has focused on achieving a low-carbon society by stably supplying power generated by nuclear power and other means and introducing renewable energy. However, the situation has greatly changed since the Great East Japan Earthquake. Energy management systems (EMSs) are becoming increasing important as a way to optimize the balance between supply and demand at a regional level, with a power supply shortage assumed.

As a requirement of a social infrastructure after the Earthquake, people are demanding a disaster-resistant, sustainable and low-carbon energy supply infrastructure. To that end, local production for local consumption of energy is an important phrase. One example of it is effective local use of renewable energy generated by photovoltaic (PV) generation units, introduced in large quantities in a regionally distributed manner.

Services such as virtual power plants, which collect surplus power by PV generation from residential areas in the daytime to supply to commercial-scale customers in shopping areas, seem likely to develop in the future. We believe community EMS will be introduced in view of ensuring a priority supply of this power to hospitals and administrative agencies in the regions in the event of a disaster.

One technological challenge of community EMS is the need for more advanced technology for predicting and optimizing supply and demand. The existing EMSs for power systems have been intended to predict macro demand for power so as to optimally operate centralized generation functions such as thermal, nuclear and hydraulic power generation from an economic point of view. Meanwhile, community EMSs intended for mutual interchange of renewable energy pose technical difficulties in terms of the following two

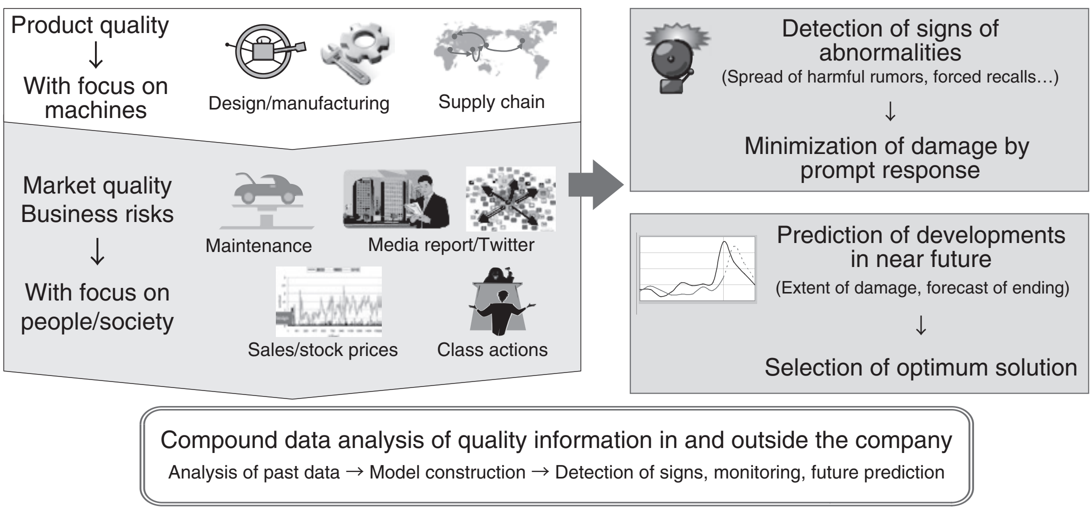

Figure 4
Market quality management.

points.

1) Demand prediction for relatively small areas such as towns cannot provide much of a statistical scale effect and the prediction accuracy is reduced.
2) In addition to power demand, prediction of distributed power generation, which is difficult to control and depends on weather conditions, is needed for more fine-tuned supply and demand control.

For the former, we need to develop demand prediction technology including modeling of demand variation based on customer-specific information obtained from smart meters with regional characteristics taken into account. For the latter, in order to ensure a balance between supply and demand, we believe demand response for controlling power demand according to the state of power supply is an essential function of community EMSs.

Fujitsu Research and Development Center Co., Ltd. (China) is developing technology to more accurately predict the demand by using large quantities of data from smart meters.[5] Fujitsu Laboratories is developing a technique to optimally control supply and demand plans by means of probabilistic prediction. This is intended to ensure optimum supply and demand planning in view of multiple insolation patterns with probabilities when the output of PV generation is predicted based on weather prediction (insolation prediction), for example. We intend to develop optimization control technology integrating these technologies in the future.

We are also developing demand response models including those that incorporate the extent of power-saving actions taken by customers. We are doing so in view of characteristics such as links with people and communities and awareness of contribution as well as economic incentives. In relation to this, we are also working on demand response models by using social simulations that deal with the uncertain behavior of people.

With the EMS control simulator that uses these prediction and optimization technologies positioned at the core, we are now developing comprehensive community EMS simulation technology. It combines a power grid simulator, social simulator for constructing demand models and business feasibility assessment simulator, which have been separately developed (**Figure 5**).

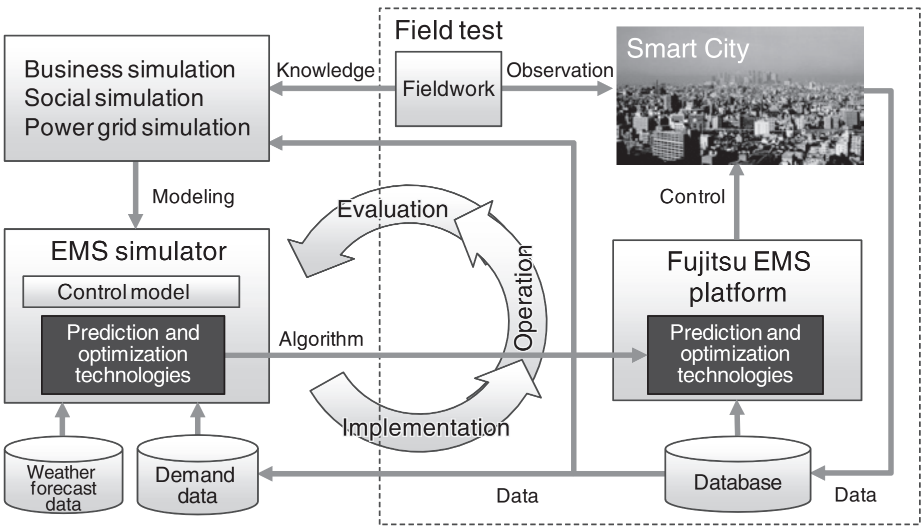

Figure 5
Developing community EMS simulation technology.

We will proceed with R&D on EMS optimization technology while using its evaluation obtained in field experiments to improve it.

6. Conclusion

This paper has described the state of R&D on social solutions with the focus on solutions for a safe and wealthy society. In addition, Fujitsu Laboratories is moving ahead with research on new social solutions by making use of information and communications technology (ICT) such as education and life log analysis, which could not be presented here. In the future, we intend to commercialize the solutions developed and work to create new solutions so as to achieve the Human-Centric Intelligent Society.

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