FROM 'SAFETY BY CARE' TO 'SAFETY BY DESIGN': STRUCTURAL REFORMS IN JAPANESE SAFETY MANAGEMENT

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Abstract
'Safety by Care', a safety management style heavily relying on training and workers' discipline, has been the long-standing doctrine of Japanese safety management in workplace. This paper discusses the origins and limitations of the doctrine and reviews recent initiatives of the government, industry and academia that are expected to help reform Japanese safety management systems into a style based on a new paradigm, 'Safety by Design'

1. Historical Overview of Safety Regulations in Japan

1.1 Industrial Revolution and Factory Law

As was the case in Britain and other predecessors, the industrial revolution in Japan, which began after the Meiji Restoration in 1868, was driven primarily by the cotton industry. Though the first modern state-run cotton spinning mill was established only in 1872, it reached a competitive level with Britain within the space of sixty years (see Fig.1). The rapid growth of the cotton industry was accompanied by rapid inflows of young female and child laborers from all corners of the country. The work environment in the factories was full of misery. In response to the rise of social concerns over these conditions, the first cross-industry labor safety regulation, the Factory Law, was legislated in 1911 after long years of debate and enacted five years later.

The major provisions of the Factory Law included: (i) minimum age and work-hours, (ii) prohibition of work in designated hazardous environments, (iii) obligatory sick pay and injury compensation by employers, and (iv) government inspections. The Factory Law was applied to all private factories employing fifteen or more workers. In state-owned firms operating in railway, post and telecom services, mutual aid associations (MAAs) with compulsory membership were established, and MAAs normally covered on-the-job injury and illness. When ILO was created in 1919, Japan became a member of the organization. Later in 1931, a similar injury compensation provision for outdoor workers in the construction and transportation industries was legislated by the Workers Accident Assistance Law. In the same year the Labor Accident Liability Insurance Law was legislated, through which employers' liability payments were insured by a nation-wide compulsory insurance mechanism. These laws constitute the major backbone in the history of workplace safety regulations in Japan.

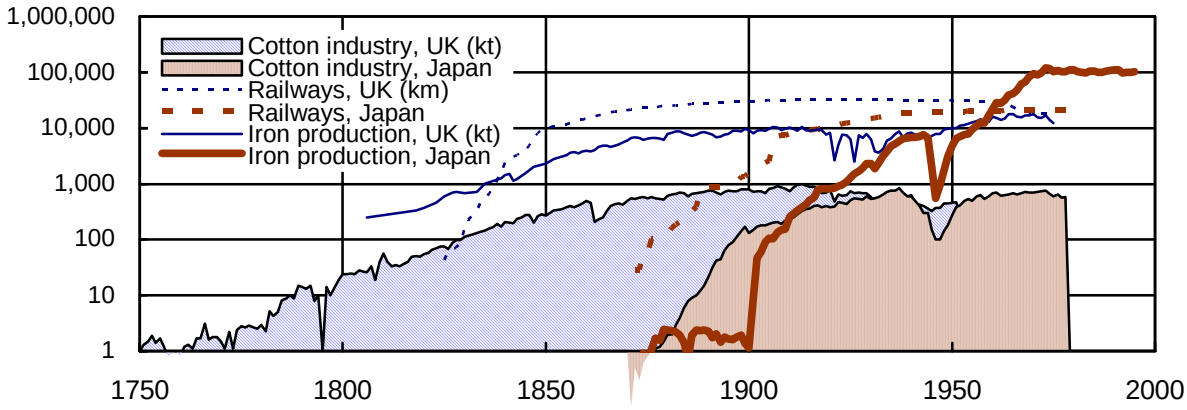

Figure 1. Major industrial indicators of Japan and the United Kingdom

Source: B. Mitchell, International Historical Statistics 1750-1993, Macmillan Reference Ltd., 1998
Note: Activity level of cotton industry is measured by raw cotton consumption in both countries.

1.2 Origins of Other Safety Regulations

There are several other categories of safety-related laws and regulations.

The second category is sector-specific industrial control laws. In the mining industry, a strategic sector at that time, all aspects of the industry were strictly regulated by the government, including safety. As illustrated in Fig. 2, the most serious and largest-scale accidents were recorded in that sector. The electric and gas utility industries were controlled by similar schemes (Electric Utility Regulation, etc.).

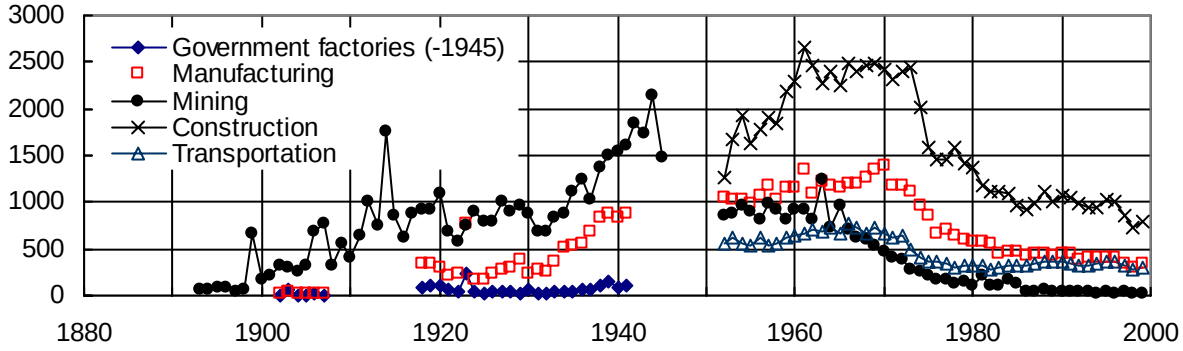

Figure 2. Number of workplace fatalities by industry in Japan 1892-2000

Source: History of the Ministry of Labor, Statistical Appendix, 2001.

The third category is hazard-specific safety regulations. Every firm that handles flammables, explosives, toxics, high pressure gases, and other hazardous materials is controlled by its respective laws. The growth of the iron, chemical and other heavy industries after the turn of the century necessitated this (see iron production in Fig. 1). These laws are administered by a few different ministries.

The fourth category is product safety regulations. These began as food and drug regulations, and later were extended to cover electrical and gas appliances as the use of these home appliances grew. Here again, safety standards and inspections are provided by the government.

1.3 The New Constitution and The Rights of Workers

A fundamental difference between pre- and post-World War II Japan is the recognition of basic human rights declared in the Constitution of Japan (1947), more specifically in the context of this article, the rights of workers. Workers gained the freedom to legally organize unions. Collective bargaining and wage-hike demonstrations became a part of the daily life of workers. These rights of workers are coded in a set of laws, the Labor Standards Law (1947), Labor Union Law, etc. Safety related provisions, inherited from pre-war legislations including the Factory Law, were initially included in a chapter of the Labor Standards Law, and later in 1972 became the separate Industrial Safety and Health Law. Under the new constitutional environment, most of the safety regulations were revised. The basic features of those, however, underwent only nominal changes. The prominent role of the state remains the characteristic feature of the system of Japanese safety management.

1.4 The Consumer Protection and Products Liability Law

A series of consumer protection regulations beyond food and drugs regulations have been legislated since the late 1960s, among them the Basic Law for Consumer Protection (1968) and the Consumer Product Safety Law (1973).. A safety mark (SG Marking) was also introduced, under which 130 product categories are given SG markings. However, it took many years before strict liability of manufacturers was coded in a law. The Products Liability Law was finally enacted in 1995, and since then about 70 cases have been concluded in courts.

1.5 Limitations of a Government-Led System

The government-led system of safety management in Japan is composed of several elements:

(i) Technical specifications are provided in the form of laws and cabinet/ministerial-level regulations
(ii) Inspection and accreditation bodies are organized as a part of government organizations
(iii) Inspectors and other professionals are accredited by the government
(iv) Sick pay or injury compensation is paid through the government-run insurance system

These may not be applicable to all cases, but have long been the fundamental features of the Japanese system..

Under such a system, legal compliance is inevitably given the top priority in company management and this tends to create a sentiment among the public and even among professionals

that *the rule is given*. No room remains for private sectors to develop safety codes, inspection or insurance mechanisms by their own initiative. What those who follow the rules can do is to pay due care and attention to best following them, and to give appropriate training to workers. This is why the authors coined the expression 'Safety by Care'. This approach seems to have worked fairly successfully for many years in Japan, helped by high-quality and disciplined workers. But at the same time it has created a lack of private sector's proactive participation in the construction of a self-governing mechanism for safety, unlike the situation widely found in industrialized countries. Such a system is composed of safety code development, third party inspection and insurance. Once an accident occurs, the injured worker is compensated by a government-run insurance scheme. It seems perfect as a social welfare policy, but compensation is not everything. Insurance schemes also contribute to loss prevention through a mechanism described by one safety pioneer a few decades ago: "[g]overnment intervention never commanded insurance companies to prevent accidents in the workplace. It simply created worker's compensation; it thereupon became profitable for insurance carriers to engage in loss prevention'" [1]. The German equivalent, *Berufsgenossenschaften* (special liability associations), is also said to have helped reduce workplace risks in different ways [5]. Bearing this accident prevention function in mind, the authors question the performance of the government-run insurance mechanism, under which public attention tends to focus on whether rules have been violated or who is to blame, and not always on the more important question, what the real cause of the accident is. Thus due attention to the up-stream stage of the accident sequence is replaced by concerns over legal-compliance of users or operators. Even worse, the data found by government inspectors or police are seldom disclosed to the public.

2. Private Sector Contributions: Kaizen in the Workplace and Safety

2.1 Individual Efforts by Companies: A Japanese Way

The lack of private sector involvement described in the previous section is balanced by the efforts of individual companies to ensure workplace safety. As legislations define only minimum requirements, major players in industries have implemented more stringent requirements on a company basis. It is worth pointing out a parallelism between this and the fact that labor unions are also organized on a company basis in Japan. A comparative study on the social welfare systems of Germany and Japan concluded that the system is based in the firm or firm group in Japan and based in the industrial sector in Germany [5]. The following sections discuss how the private sector has contributed to workplace safety through individual company programs.

2.2 QC, Kaizen and Safety

Since the introduction of the quality control (QC) system to Japan by W. E. Deming in 1950, it has penetrated into all sectors of industry and has evolved into a refined form of bottom-up activities organized by workers. This evolution of QC was made possible through integration with Japanese company management style and culture. QC primarily focused on quality when it began in the United States, and remained so when it first reached Japan. The motto *'kaizen'* (continual improvement) also refers to a workplace 'quality' strategy.

But later the target of QC circle and kaizen activities was extended to cover not just a quality. For example, *'muri, mura & muda'* is a famous motto of Toyota Motor Corporation. These Japanese words are the three 'bad things' to be eliminated from the workplace. *Muri* literally means 'overstrain' but should be understood as anything which could cause various unexpected results, *mura* means unevenness of quality, and *muda* means waste. All three are the target of QC and Kaizen activities of the Toyota production system today. This means that in the pursuit of eliminating *muri*, *mura* and *muda* not only quality but also safety, cost reduction, and even waste reduction should be achieved in an integrated manner.

2.3 'Safety by Care' in Company Practices

One safety professional cautions, "As long as the labor relation office keeps playing a pivotal role in workplace safety issues, remedies might have limitations. Major and more proactive responsibility should be attached to engineers working on the design and planning of process and products." [3] As shown in this statement, safety is still considered as a company welfare program for workers and is mainly handled by the labor relations office in many companies. Training programs for workers are the major and even the sole initiative of the company. When a system safety approach is to be taken, more integrated approaches should be adopted within a company.

2.4 Limitations of Company Based Approach

The main motivation behind the company-based approach is a cost-benefit calculation, and this gives a healthy momentum to safety protection. But there are also limitations. The major problem is that the best practice invented in a company is not always shared with other companies even when the latter is facing the similar problem, because of considerations that the best practice may also affect competitiveness. State of the art safety management can be created only through the open sharing of ideas.

3. Reforms Associated with Globalization

3.1 Complaints Filed at the Trade Ombudsman

Impulses from abroad have often acted in Japan as invincible forces, and have even defeated domestic political and social resistance. Safety regulations are no exception. It is interesting to review the types of complaints filed by trading partners of Japan. From 1989 to 1996, 671 complaints were filed at the Office of Trade and Investment Ombudsman (OTO) in Japan. Table 1 gives a breakdown of these classified by type of action requested. The largest number of complaints request simplification of custom and other procedures and prompt processing of applications. But this is followed by more serious types of complaints which require more structural responses, such as reduction or elimination of government interventions, changes in domestic technical standards, acceptance of test data provided by foreign inspection bodies, etc. When classified by laws, as shown in Table 2, the largest number of complaints targeted drugs and food, followed by hazardous products and materials. Most of the complaints are related in one way or another to safety regulations in Japan.

Table 1. The number of complaints filed at OTO, classified by type of actions requested, 1989-1996

Simplification of procedures and prompt processing of applications	188
Reduction or elimination of government interventions	144
Clarification of technical specifications	134
International harmonization of technical standards	114
Acceptance of test data provided by foreign inspection bodies	45
Improved transparency of regulatory information	39
Total (including others not shown in this table)	671

Source: The Advisory Committee's Recommendation to the OTO, June 18, 1997

Table 2. The number of complaints filed at OTO, classified by laws (selected), 1989-1996

Related Laws	*Number*	*Related Laws*	*Number*
Explosives Control Law	12	Consumer Product Safety Law	2
Fire Defense Law	17	Electrical Appliance & Material Safety Law	12
Poisonous and Deleterious Substances Control Law	4	Liquefied Petroleum Gas (LPG) Law	1
High Pressure Gas Safety Law	30	Law for the Control of Household Products Containing Harmful Substances	3
Petroleum Complexes Law	2	Road Vehicles Law	31
Industrial Safety and Health Law	11	Building Standard Law	13
Pharmaceutical Law	79	Law concerning Examination & Regulation of Manufacture of Chemical Substances	10
Food Sanitation Law	127		
Plant Quarantine Law	38	Agricultural Chemicals Regulation Law	6

Source: Office of Trade and Investment Ombudsman (OTO) website, http://www5.cao.go.jp/

Piecemeal remedies have been implemented to respond to those individual claims during the last few decades, but the larger and more structural changes were implemented after the establishment of WTO and the Agreement on Technical Barriers to Trade (TBT) in 1995. The following sub-sections give an overview of the changes that have taken place since the WTO/TBT came into force.

3.2 Reformations of Certification Schemes

As described in the first section of the paper, safety inspections and certifications were earlier provided solely by the government, but are now in the process of transfer to the private sector. For example, the Japan Industrial Standard (JIS) marking system has been in place for more than a half of century, since 1949. It gives its mark to a factory certified as a manufacturer of products conforming to JIS. At its peak, more than 16,000 factories were accredited. However, since 2005 a new scheme has been

implemented which authorizes competent third parties to give conformity certification. As of September 2005, 172 third parties had been accredited. Another example is the case of construction inspection. The Building Standards Law requires an ex-ante certification of building plans for all kinds of construction works. The certification was the responsibility of the local government officer until recently, but in 2003 the law was amended and currently more than half of all certifications- are processed by private third parties.

3.3 Harmonization to International Standards

Harmonization of standards had been on the agenda since the adoption of the GATT Standard Code in 1989, and was further accelerated after the TBT agreement, which requires member countries to align their domestic technical regulations with international standards when available (Article 2.4). The Japanese government decided to promote the review of existing national standards. In the case of the Japan Industrial Standard (JIS), there exist nine thousand JIS standards. Of these the ratio of those identical to JIS (IDT) or modified with permitted changes to corresponding international standards (MOD) is steadily increasing (Fig.3).

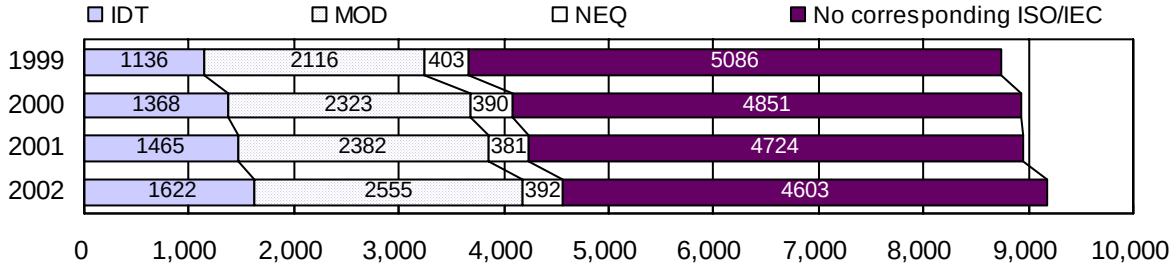

Figure 3. Number of JIS, counted by level of correlation with international standards

Source: Japanese Industrial Standards Committee (JISC).
Note: The acronyms indicating the level of correlation are based on ISO/IEC Guide 21: IDT (identical), MOD (modified but changes are permitted and clearly explained), NEQ (not equal).

3.4 MRAs with Trading Partners

To extend the Mutual Recognition Agreement (MRA) network with trading partners is another important area of reform. In 2001, the first MRA was signed with the EU in four areas; radio & telecommunication terminal equipment (R&TTE), electrical products, Good Laboratory Practice (GLP) for the chemicals, and Good Manufacturing Practice (GMP) for medicinal products. Since then, four European conformity assessment bodies (CABs) and three Japanese CABs have been mutually recognized under the agreement. In the R&TTE area, 448 certificates issued by European CABs were accepted by Japan in fiscal 2006, corresponding to 9% of the certificates issued in Japan that year. The EU-Japan MRA was followed by an MRA with Singapore in 2002 and with the USA in 2007. Although the current scope of MRAs is still limited, such an agreement will improve market access on both sides.

4. Recent Reform Initiatives

4.1 Introduction of Risk-Assessment Concepts into Safety Legislations

A series of events, the formation of ISO 12100:2003 in particular, has made a big impact on safety professional circles in Japan. More attention is now being given to upstream stages (planning and design) of the safety management cycle. One response from government has been the introduction of a mandatory risk assessment provision in workplace in the Labor Health and Safety Law. The revision was made in 2005 and an implementation guideline was published. Though similar provisions had already been legislated for food safety and medical equipment regulations, it is the first step in the area of workplace safety in Japan.

4.2 Initiatives by Industry

The introduction of the risk assessment (RA) provision created a serious concern among industries, above all, the serious shortage of experienced safety professionals who can manage the whole cycle of RA. To remedy this shortage, an accreditation scheme for safety professionals, Safety Assessor, has been created by the leading members of the Nippon Electric Control Equipment Industries Association (NECA) [2].

4.3 Initiatives by the Higher Education Sector

Academia has also taken action. A professional development program for safety engineers, the Graduate Course for Safety of Machinery at Nagaoka University of Technology, the first of its kind, was created in April 2002 and revised to become the Graduate Course for System Safety in April 2006. Most students are employed, with many years of exposure to process/product safety issues. Classes are offered at weekends or through web-based learning materials, and the curriculum covers the full range of system safety disciplines. In addition, Meiji University has announced that it will launch a Master's Course for Safety in April 2008.

4.4 Expansion of Risk Assessment Programs to New Areas

There are emerging areas in technology and service that safety management needs to be concerned with, but where no conventional laws and regulations apply. One such area is service robots. It is widely recognized that the largest population of industrial robots is utilized in Japanese factories. But robots are now leaving factories and starting to serve various other needs, in a new frontier for robots. This is also a frontier for safety management, because no conventional laws or regulations cover this area. One of the authors is currently working to fill this vacuum with a new approach to a safety management framework [4].

5. Agenda Ahead

5.1 The Fundamental Issue: Duties of Manufacturers and Designers

The Guarding of Machinery Convention (ILO, 1963) states, 'The sale and hire of machinery of which the dangerous parts specified in paragraphs 3 and 4 of this Article are without appropriate guards shall be prohibited by national laws or regulations or prevented by other equally effective measures' (Article 2.1). In advance of the ratification of this convention in 1973, Japanese government revised its labor laws and passed the Labor Health and Safety Law, which prohibited the use of designated machinery in the workplace. But because of its nature as a labor law, it could not prohibit the sale of machinery itself and could only define the duties of employers, not the duties of machinery manufacturers. When the paradigm should move from 'Safety by Care' to ''Safety by Design', the duties of manufactures, more specifically the duties of designers, should be defined as the European Union has defined it, through the Machinery Directive.

5.2 Proactive Participation of Safety Professionals

Since the Meiji Era, millions of engineers have been trained and hundreds of engineering societies have been formed in Japan. The activities of these societies, however, have mainly focused on academic matters and not on other matters important to the profession, such as the development of safety standards, accreditation of professionals, etc. The 'Safety by Design' paradigm can only be realized through the proactive participation of safety engineers. Here it would be appropriate to quote the words of an editor of the professional journal *Machinery*. He wrote in 1910, "the time to safeguard machinery is when it is on the drawing board" [6].

6. Conclusion

The historical origins of the government-led system of safety management in Japan are reviewed and its limitations are analyzed. Based on this, authors addressed the necessity of shifting the paradigm of Japanese safety management from 'Safety by Care' to 'Safety by Design'. In order to fully achieve this shift of paradigm, something equivalent to the adoption of New Approach in Europe would be needed.

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