Positive Safety and Well-being Technology: Embracing Collaborative Safety for Workers' Safety, Health and Well-being at Work

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FOREWARD

Conventional activities in occupational safety and health have mostly focused on reducing risks to prevent workers injury, disease, and mental disorders caused by their work. In other words, activities were mainly intended to raise the status of workers by reducing such hazard rate within so-called the negative domain. Now, we should also focus on proactive approaches in the positive domain, i.e., to place the status of workers in a positive minded under safe environment. Acting on raising workers' safety, health, and well-being in positive domain will enable workers to engage in their work with the sense of ANSHIN (peace of mind), health, vitality as well as a sense of accomplishment.

1 POSITIVE SAFETY

No one would argue that the ultimate goal for working people is to work healthy, and happy in a safe environment. Safety activities, accordingly, should not only focus on activities in the negative domain, but also on activities in the positive domain, such as seeking more health, happiness, ANSHIN, comfort, and a sense of accomplishment.

Positive safety in the field of occupational safety aims not only to participate in activities within the conventional negative safety domain, where risks are minimized to acceptable levels, but also to broaden its scope to the positive domain. This includes embracing acceptable risks, liberating oneself from potential hazards, and actively, freely, optimistically, and comfortably pursuing advantages in the workplace. This goes beyond the concept of conventional safety alone. Similarly concerning health, the goal is to transition from activities in the negative domain, which concentrate on eliminating work-related illnesses (physical diseases and conditions), to the positive domain where individuals are physically, mentally, and socially well, actively participating in activities with energy and enthusiasm. Furthermore, in the realm of mental and emotional well-being, the aim is to expand activities from the negative domain, where there are no mental disorders or issues due to work, to the positive domain where individuals actively work with enthusiasm, seeking fulfilment, and happiness in their lives.

In this way, positive safety is not just about conventional activities that involve identifying hazards and reducing their risks but also focuses on safety activities that look at the positive aspects of working with positivity, cheerfulness, and a sense of purpose. Therefore, in positive safety, the concept of safety extends beyond the narrow domain of physical "safety". It expands into the broader areas of "health" and the mental domain (well-being), involving a sense of fulfilment and purpose in work, targeting "broad safety" which refers to safety, health, and well-being. The direction and targets align with what has already been demonstrated in Vision Zero initiatives. Figure 1 outlines conceptual idea of Positive Safety by human's physical and psychological attributes.
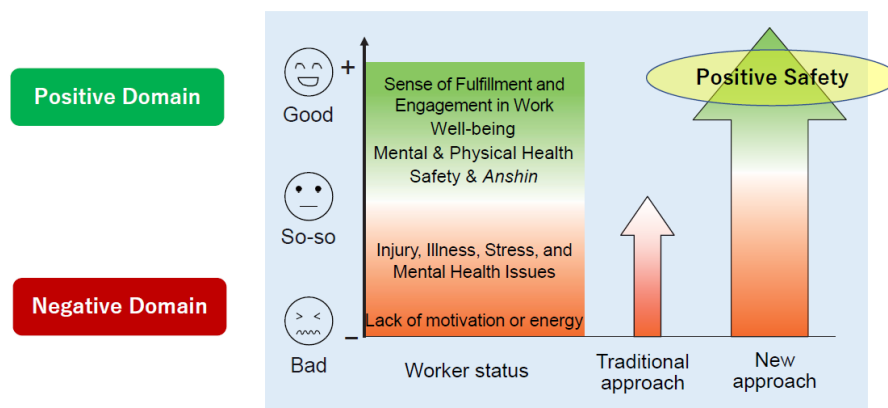

Figure 1. Conceptual image of Positive Safety

2 WELL-BEING TECH

2.1   Technological measures of Collaborative Safety

As evident from the description in clause 1, positive safety involves not only things (machinery and equipment) and organizations (systems and structures) but also the human mind and spirit. To achieve positive safety technologically, the concept of collaborative safety where humans, machines, and environments including organizational aspects work together to ensure safety, is implemented by applying recent technologies such as ICT and AI. Unique term of Safety2.0 which is the technological aspect of collaborative safety plays a crucial role in this. It enables occupational safety and health activities that can consider the psychological aspects of human beings, extending beyond the industry sectors such as manufacturing or construction scenes, and into the entire office environment. In this way, Well-being Tech refers to technology aimed at ensuring the safety and health of individuals, with promoting a sense of ANSHIN, and fostering fulfilment in the work. Figure 2 shows the inter-relations among Collaborative Safety, Well-being Tech and Safety2.0 to achieve the ultimate goal of Well-being.
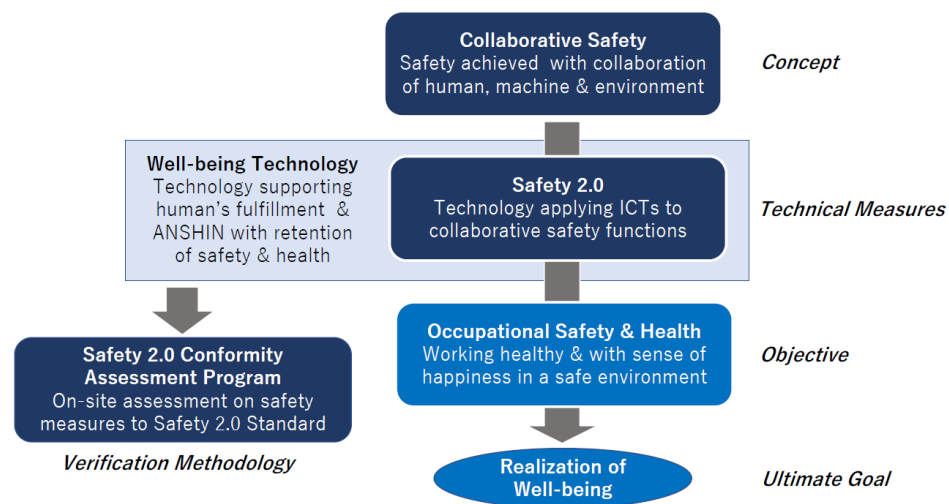
Figure 2. Interrelation among Essential Elements Consisting of Positive Safety

2.2   Safety2.0 applications under Well-being Tech

This clause provides several Safety2.0 registered examples currently being in practice on-site. Figure 3 shows four typical examples of application indicated below.
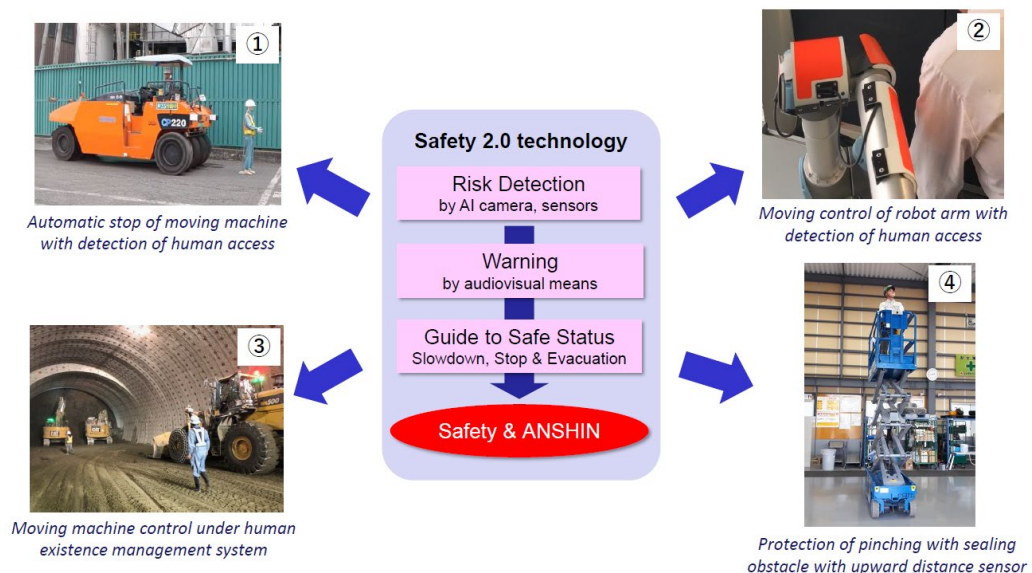
Figure 3. Examples of Safety2.0 Application

1. Wheel-loader Control System for asphalt mixing site (NIPPO Corporation)

Automatic machine-stop system distinguishes workers & other obstacles by AI stereo cameras equipped on the backside of machine, and stops the machine to move when the workers behind the machine is identified by the cameras. By this system, machine operation is maintained with minimizing potential risk for both workers and wheel-loader operators without lowering working efficiency.

2. Moving Control System of Robot Arm (IDEC Corporation)

Static capacitance sensor attached to the robot arm detects human access before physical contact and stops movement, thus the system leads the reduction of human threat of physical contact with moving robot arm.

The system enables friendly co-existence environment of workers & robot, giving workers the mind of "free from threat" to be accidentally hit by the robot arm.

3. Risk Reduction System of Tunnel Construction Site (Shimizu Corporation)

Safe working environment is retained by workers access detection system using AI cameras on both sides and behind the machines, and by the sequential lighting system of moving direction of machine linked with driving wheel under the overall human existence management system within the tunnel. By the system, working efficiency is maintained with safe human and machine co-existing environment in a limited space, thus operators & workers can work with the feeling of freedom from hazard threat.
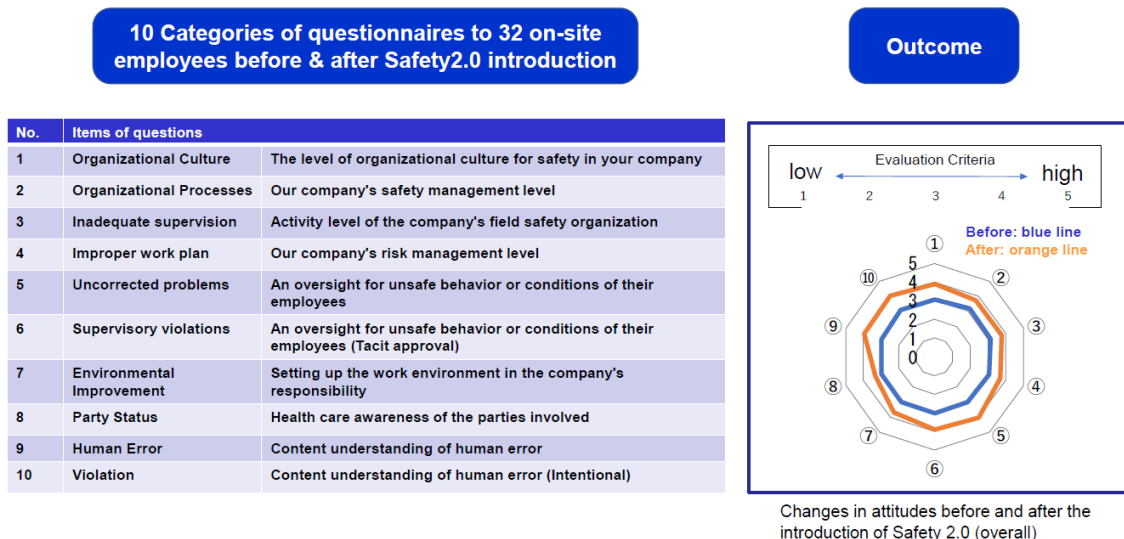
4. Pinching Protection System of Elevation Machine (Daiwa House Industry. Co. Ltd.)

Height of the working wagon on the elevation machine stops moving upward to protect pinching of human body against sealing obstacle for the sealing work, by the operation of the upward distance sensor and the enable switch equipped with the wagon. By this system, the worker can concentrate on the assigned task with freedom from any psychological pressure and threat of pinching, and thus working efficiency is retained.

3 POSITIVE SAFETY AND MANAGEMENT

Traditional occupational safety and health activities, primarily focused on the negative outcomes caused by work, often lead to perceiving safety costs as expenses. There is a tendency to cut safety costs whenever there is even slight progress in safety. On the other hand, positive activities in occupational safety and health activate both safety and productivity, enhancing the sense of happiness for the workers. Through these initiatives, the company's activities can contribute to societal well-being. In this scenario, from a business management perspective, there is a shift in considering safety-related costs not as expenses but as investments. Consequently, occupational safety and health are expected to be actively incorporated into the cycle of management initiatives as a crucial business issue.

Management includes one crucial point on how the "Well-being" concept can be measured as a result of any tool and means is supplied to the employees, as it is hard to see the quantified value of well-being. In this regard, one solution might be to make a periodic questionnaire to the employees on the physical and psychological effect by well-being measures introduced, based on "Plan-Do-Check-Act" cycle for the continual improvement under the management system.

10 Categories of questionnaires to 32 on-site employees before & after Safety2.0 introduction

Outcome

No.	Items of questions	
1	Organizational Culture	The level of organizational culture for safety in your company
2	Organizational Processes	Our company's safety management level
3	Inadequate supervision	Activity level of the company's field safety organization
4	Improper work plan	Our company's risk management level
5	Uncorrected problems	An oversight for unsafe behavior or conditions of their employees
6	Supervisory violations	An oversight for unsafe behavior or conditions of their employees (Tacit approval)
7	Environmental Improvement	Setting up the work environment in the company's responsibility
8	Party Status	Health care awareness of the parties involved
9	Human Error	Content understanding of human error
10	Violation	Content understanding of human error (Intentional)

Changes in attitudes before and after the introduction of Safety 2.0 (overall)

Figure 4. *Questionnaires & their outcome before and after Safety2.0 introduction*

One example is the case of Shimizu Corporation which is one of biggest Japanese construction company in Figure 3. The company management made the questionnaire to the workers, operators and supervisors of on-site tunnel construction before and after the Safety2.0 conformity registration, as shown in Figure 4.

Outcome of their responses clearly shows from the chart that the working environment and their working motivation were improved with reliance to the Safety2.0 measures introduced and registered. This methodology is just one example of how to measure the effect of introducing Safety2.0 that influences positively to the human psychological safety aspect.

4 CREATION OF GLOBAL PLATFORM

4.1 Holistic approach towards international standardization

Safety, health and well-being at workplace is a global and universal objectives for any industry sector, and the concept of positive safety can contribute largely to this objectives. Although it is hard to quantify the effect of positive safety measures as mentined in earlier section, it might be possible to set the platform to help establishing the positive safety environment in a company, which is the international standardization of collaborative safety as a core part of Well-being Tech. In order to build the collaborative safety platform at workplace, technical measures of system level are quite essential but at the same time personnel competence to justify the correct installations/integrations and operations, and their overall management to maintain sustainably the system operations are equally important. Finally the common rule making by holistic approach to the international standardizations of both technical standard and its conformity assessment can make it possible to create the tool/reference for industry activities on a global basis to contribute UN SDGs, especially Goal 3 and 8. Taking this holistic approach into consideration, a private standard and conformity assessment program were developed by the leadership of IGSAP, and in parallel, implemented on-site basis in manufacturing, civil engineering and construction industry sectors which are expecting to minimize any hazardous event for their employees and to work with positive motivations without feeling any stress and threat of safety hazard by employing advanced safety technology. Figure 5 shows the outline of holistic approach in technology, management, personnel and the rule making of them.
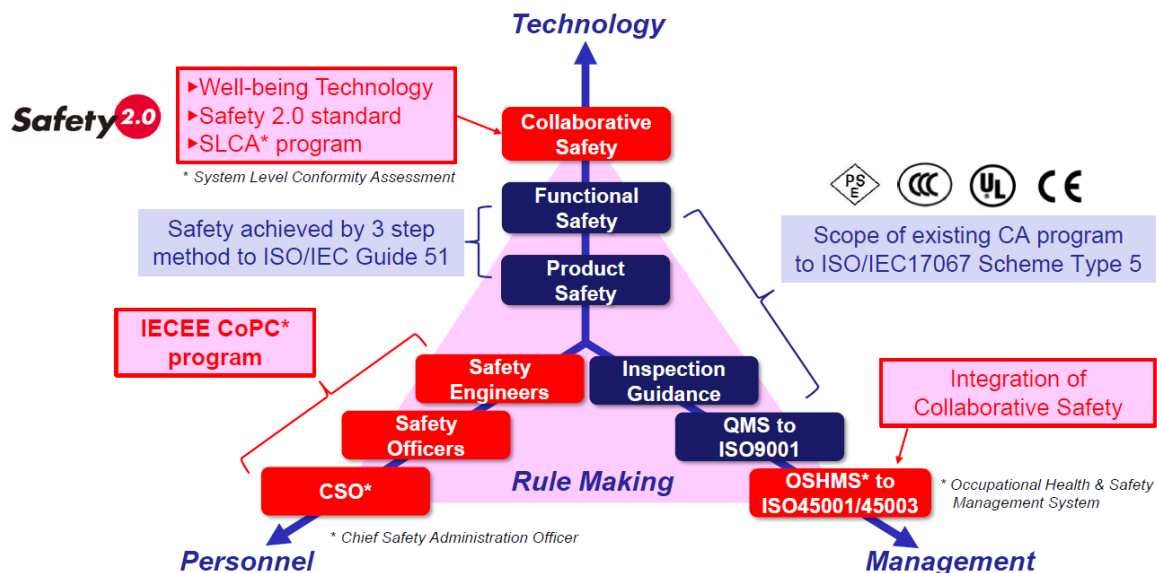

Figure 5. Outline of holistic approach to international standardization of collaborative safety

4.2 Action items

Safety standards are currently developed in two standard developing organizations (SDOs) of ISO and IEC. In the past years, these standards have been developed based on the common guidance of ISO/IEC Guide 51:2014 "Safety Aspects – Guidelines for their inclusion in standards". These documents have been largely contributed to prevent workplace and workers from possible physical hazards on a global basis. Now, when we consider the positive safety aspect as described in this paper, a question arises whether the current document can sufficiently cover the new aspects such as human mental and psychological safety under the broader meaning of safety, as these

documents are developed mainly on the hardware oriented with the viewpoint of product designers and suppliers. Based on the consideration of such situation, IGSAP has been taking the leadership in the following actions.

1. Publication of IEC Whitepaper "Safety in the future"
IEC has a unique function to make a feasibility study on the future standardization called Market Strategy Board (MSB) consisting of global operation companies CTOs, and its annual output is to publish the IEC Whitepaper so that the IEC community of standards and conformity assessment group can take any appropriate action. In 2020, IEC Whitepaper "Safety in the future" was published after the intensive discussion of safety experts assigned as a project members under the leadership of IGSAP. The Whitepaper outlines future societal changes influencing workforces, collaborative safety principle leading to the new concept of positive safety, and recommendations to other IEC management boards of Standardization Management Board (SMB) and Conformity Assessment Board (CAB).

2. Safety2.0 technology
 Private Safety2.0 standard and its conformity assessment program developed by IGSAP has been improved in accordance with on-site implementation of Safety2.0 conformity assessment activities to the standard. Especially the focal points for the improvement are, the sufficiency of risk assessment in a system integration and operations, reliability of safety measures utilizing the emerging technology and its trustworthiness by the workers, and the retention of working efficiency, and productivity by the safety measures introduced. The principle of this standard was proposed to the IEC ACOS (Advisory Committee on Safety) under SMB to help developing IEC Guide on collaborative safety.

3. Management
Occupational health and safety management system (OHSMS) standard ISO45001 and ISO45003 are the useful tool of securing sustainable operation of safety measures and has been implemented in various industry sectors. By the introduction of collaborative safety as a key element of positive safety, there might be a need for review of the current description to integrate the new principles, especially in ISO45003 that is focusing on the management of psychological risks and promotion of well-being at work. For this purpose, IGSAP experts have started feasibility study to make a formal proposal to ISO TC283

4. Personnel competence
Based on the Japanese experience of personnel competence program operation, new conformity assessment program called CoPC (Certification of Personnel Competence) program was proposed by Japan to IECEE dealing the CB Scheme for product certifications. This was realized by the MoU between IEC and NECA (Nippon Electric Control Equipment Industry Association) that is the scheme owner of the program, after the agreement to supply NECA's own information on program operation to IEC. CoPC program is currently on-going discussion in IECEE to start with machine safety sector as a pilot case, and planned to be expanded to the CoPC program on collaborative safety in future.

Figure 6 shows overview of collaborative safety standardization.
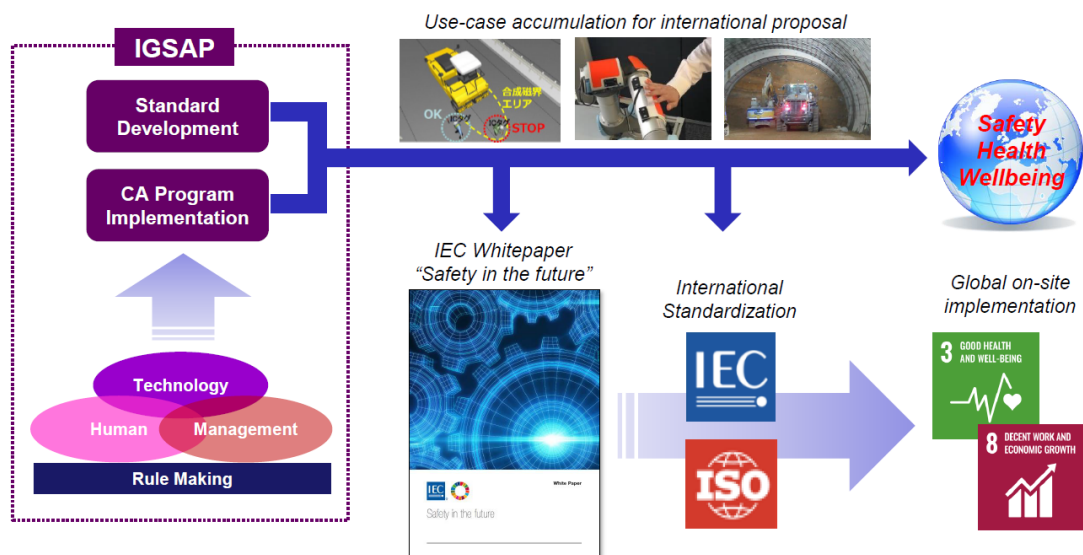
Figure 6. Overview of collaborative safety standardization

5 CONCLUSION

Traditional occupational safety and health activities have primarily focused on industries such as manufacturing, where machines and humans can be somewhat isolated, aiming to achieve zero occurrences of serious accidents. Future occupational safety and health activities need to expand beyond these manufacturing industries to include a wide range of sectors, including service industries, where machines and humans work together in the same workplace. At that time, it is essential to ensure not only a physically safe environment and maintained health but also workplaces that value human psychological aspects, including worker satisfaction and a sense of purpose. An important perspective here is that, along with the transition from the negative domain, adopting a positive safety approach—progressing from negative to positive domains—becomes crucial. It is believed that now is the time to shift the mindset of future occupational safety and health activities towards the direction of positive safety. For this purpose, international standardization of collaborative safety can be used as an efficient tool to help create a global platform that realizes a positive safety environment in the workplace.

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