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Vision zero: Developing proactive leading indicators for safety, health and wellbeing at work

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ABSTRACT

The importance of leading occupational safety and health (OSH) indicators in complementing lagging indicators is an emerging topic for the promotion of a prevention culture in organizations. The purpose of this paper is to describe the development process of a set of proactive leading indicators for safety, health and wellbeing (SHW) at work, which was carried out as part of the International Social Security Association's (ISSA) Vision Zero strategy. Principles of integrated knowledge transfer and exchange between research, policy and practice were followed in both the conception and development phases, and a mixed methods approach was applied across four stages consisting of: a literature review and input from industry; a quantitative evaluation through an online survey; a qualitative evaluation through feedback from organizational representatives and key stakeholders; and a consensus building workshop with the ISSA Steering Committee. A set of fourteen indicators was developed to complement the ISSA Vision Zero strategy, two in relation to each of its seven golden rules for promoting SHW at work. The indicators deal with integrating each aspect of SHW in e.g. visible and competent leadership, procurement, pre-work briefings, evaluating risk management and targeted programmes, learning from unplanned events, innovation and change, work organization, onboarding and refresher training. Results can be presented qualitatively and quantitatively as e.g. 'yes' or 'no' responses, on a Likert or continuum (five–point) scale, or with frequencies and percentages. The indicators are designed for use by both small and large organizations across all sectors, and can be used for benchmarking and as key performance indicators. They are not only intended to better direct and control SHW processes, but also to support the development of a prevention culture. Recommendations are provided on how the indicators can be refined and improved through future research.

1. Introduction

'Vision Zero' (VZ) at work is a transformational approach to prevention that integrates the three aspects of safety, health and well-being (SHW). It is based on the assumption that all accidents, harm and work-related ill-health are preventable. VZ is the ambition and commitment to create and ensure safe and healthy work and to prevent all accidents, harm and work-related diseases in order to achieve excellence in SHW. VZ should be understood as a journey, a process towards the ideal. It is also a value-based vision implying that work should not negatively affect workers' SHW, and if possible, should help them maintain or improve their SHW and develop their self-confidence, competences and employability (Zwetsloot et al., 2017b). VZ is regarded as a commitment strategy (Zwetsloot et al., 2013a; Zwetsloot et al., 2017a), which implies that the process of continual improvement is driven by the commitment of both (top) leaders and workers. In the implementation of VZ commitment, communication, culture, and learning, are key aspects (Zwetsloot et al., 2017a). A commitment strategy can start at any level of SHW performance, and trigger a continual improvement process. This implies that VZ is relevant for a large variety of organizations (not only for the well-known frontrunners, but also for small organizations).

This paper describes the development of a set of proactive leading indicators for SHW for the International Social Security Association (ISSA). ISSA and its fourteen sections for prevention launched their VZ strategy and the ISSA Global VZ Campaign in September 2017 at the XXI World Congress on Safety and Health at Work in Singapore. The strategy and campaign are run by ISSA partners in more than 80

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countries, and by the spring of 2020 more than 11,000 organizations had associated themselves with the VZ campaign, as did more than 1000 trainers (Treichel, 2020). ISSA's VZ concept incorporates seven 'Golden Rules' for prevention (ISSA, 2017). The concept is flexible, and can be adjusted to the specific SHW priorities for prevention in any given context.

Collaboration between organizations, companies and researchers in the research process has shown to be conducive to integrated knowledge transfer and exchange (KTE) in promoting occupational safety and health (OSH) (Van Eerd, 2019; Van Eerd & Saunders, 2017). The development of the proactive leading indicators described in this paper reflects this integrated KTE process, as it was carried out in response to suggestions from, and in collaboration with companies and other organizations that have associated themselves with the ISSA VZ strategy. They suggested the development of a common set of leading indicators in order to be able to benchmark globally and organize mutual learning. For ISSA it was important that the indicators are not only theoretically sound, but that they are recognized as useful by many organizations participating in their VZ strategy. This implies that the user friendliness of the indicators was considered from the start as an important condition. The seven Golden Rules (ISSA, 2017) formed the framework for the indicators, with two indicators being developed for each Golden Rule.

The focus was on developing indicators that were both 'proactive' and 'leading', recognizing that current indicators of SHW at work are often reactive, and do not provide directions for improvement e.g. accidents, injuries, sickness absence, and ill health. Leading indicators that are used by organizations are often related to aspects of good OSH management and are in line with ISO 45,001 (ISO, 2018), e.g. the time needed to close improvement actions or non-compliances. Proactive management of SHW requires new types of performance indicators, with an emphasis on proactive or primary prevention. However, there is currently no broadly accepted set of SHW leading indicators, and as a result, proactive companies often define their own sets of leading indicators. The variety of indicators used in practice hinders benchmarking and mutual learning.

Furthermore, it was recognized that most organizational practices tend to focus more on safety and to some extent health aspects, with less focus on wellbeing at work. Additionally, attention to work-related health and wellbeing is often limited to hazards and associated risks that stem, like safety risks, predominantly from technology-related aspects of production processes, such as the design of technical installations and workplaces. Often there is less organizational and systematic attention paid to health compared to safety, while psychosocial risks and wellbeing at work often remain out of scope (Bergh et al., 2014b; Leka et al., 2015).

However, SHW have more in common than many would expect (Zwetsloot et al., 2017b). SHW represent similar human and social values, and each is based on valuing people. There are also common 'supporting values' that are relevant for all three aspects (Zwetsloot et al., 2013b; Zwetsloot, 2019), e.g. trust is important for wellbeing, and it is important for a culture wherein people feel free to report incidents and near misses, or which address the health problems they may encounter. Being 'fit for work' physically and mentally is important for managing safety. In both areas, the following issues are important: (1) design and management challenges; (2) control of (work) processes and dealing with deviations; (3) improving accuracy and human behavior; and (4) proactive approaches to new developments, including reorganizations and outsourcing, increasing flexibility, job insecurity, etc. From the perspective of credibility for the employees, SHW are also closely associated. Credibility, taking care of the safety of people, implies that people (and their health and wellbeing) are valued. Several concepts and models that have been developed and are based on considerable evidence in one area, also seem relevant for the other area, for example, on job design and work organization (Leka et al., 2008) versus management systems, increasing risk awareness and safety culture (Clarke, 2006; Edwards et al., 2013).

There is increasing recognition in research and in practice of the need to overcome sub-optimizations of SHW and develop approaches and models that support the integration of the various specialist views on SHW (Jain et al., 2018). There is also a need to effectively combine traditional OSH and workplace health promotion (NIOSH, 2020; Jain et al., 2018). The development of the set of proactive leading indicators for SHW aims to provide organizations with a promising tool to measure the degree of proactivity of their SHW actions. The tool could provide organizations with feedback on the strengths and weaknesses in their efforts, which is useful for the process of continual improvement. In addition, the indicators can also facilitate internal and external benchmarking. In this way organizations will be able to put in place good practices that support the promotion of all three aspects of SHW in an integrative way, and as an integrated part of the business processes. At the same time, it is recognized that a full integration of SHW is likely to undervalue the importance of the health and wellbeing aspects if organizational focus has traditionally been on safety (Zwetsloot, 1994). It is therefore just as important that the indicators can differentiate between the three aspects of SHW.

Before the development process of the proactive leading indicators is outlined in detail, it is important to first consider the use of OSH indicators, including the key concepts of leading and lagging indicators, and the research and evidence base in this area.

1.1. The use of occupational safety and health indicators

OSH indicators should comprise condensed information on existing and emerging risks, exposures, hazards, as well as on preventive activities to (further) reduce the remaining hazards and risks (Alruqi & Hallowell, 2019). At the same time, the data thus obtained should be useful for evidence-based decision making. Proactive leading indicators for SHW reflect the actionable, current and ongoing processes, activities and performances that are doing more than merely controlling existing risks and safeguarding the status quo, but focus on recognizing, creating, using and evaluating opportunities for continual improvement, both specific short term improvements and the process of continual improvement. In this way they have a great potential to generate impact, both in the short and long term.

The performance indicators most frequently used by organizations reflect the OSH performance of the past (e.g. number of accidents and occupational diseases, lost time incidents or sickness absence). These have been called 'lagging indicators', because the information is lagging behind reality. They measure the 'outcomes' of the past OSH management process, rather than the qualities of the presently existing OSH management and leadership processes. 'Leading indicators' are complementary to lagging indicators; and have predictive value; they are valuable for improving SHW management and leadership, e.g. by intervening in risky situations before safety or health is affected (Jain et al., 2018). Leading indicators have been classified as active or passive indicators (Hinze et al., 2013). Passive leading indicators are typically implemented before work begins and remain relatively static once a project has begun, e.g. number of workers with a specific certification. In contrast, active leading indicators can be readily changed during work, e.g. pre-task planning meetings. These indicators are generally continuous in that they occur at a frequency or are measures of quality of implementation. However, not all leading indicators are by definition, 'proactive' leading indicators as defined above.

Using the bowtie metaphor, Swuste et al. (2016) provided a distinction for leading and lagging indicators, with leading indicators providing information on the left-hand side of the central event, and the lagging indicators on the right-hand side. Thus, leading indicators basically are proxies for hazards, for barriers, for scenarios and management factors, while lagging indicators are proxies of the central event, of 'loss of control' and of consequences (Grabowski et al., 2007; Øien et al., 2011). According to this approach, leading indicators provide

information on distortions of processes, and thus on the stability of a system. Furthermore, being achievable, meaningful, transparent, easy to communicate, valid, useful, and timely were identified as some of the valuable qualities of leading metrics. But perhaps most importantly, leading indicators should be actionable, that is, they can be utilized to identify and implement steps intended to reduce or eliminate risk (Sinelnikov et al., 2013).

It should also be highlighted that both in the literature and in practice, there are blurry delineations among OSH risk analysis, safety climate, and leading indicators, and it has been highlighted that the differences between these concepts might be merely theoretical and ideological (Alruqi & Hallowell, 2019). Due to this ambiguity, a more general terminology has also been suggested, such as key indicator, performance indicator, or key performance indicator (Eriksen, 2009; Grote, 2009; Guldenmund & Booster, 2005; Mearns, 2009; Øien et al., 2011; Saqib & Siddiqi, 2008). Some authors prefer the term 'positive indicators' to leading indicators (e.g. Podgórski, 2015), while the OECD (2008) uses the term 'activities indicators' to refer to (proactive) leading indicators, and 'results indicators' for lagging indicators. What is important to highlight is that irrespective of the term used, these concepts aim at developing a prevention culture (Bollman & Boustras, 2020; Kim et al., 2006).

The appeal of leading metrics is in their potential to predict and prevent adverse outcomes by giving organizational leaders an additional set of forward-looking OSH targets for improvement. Organizations also use leading metrics to support communication and employee morale building strategies aimed at transforming organizational culture from being passive and problem focused to being proactive and solution driven. A meta-analysis by Alruqi and Hallowell (2019) highlighted that nine common leading indicators are significantly correlated with worksite injuries: safety record, safety resource, staffing for safety, owner/leader involvement, safety training/orientation, personal protective equipment, safety incentives program, safety inspections/observations and evaluations, and pre-task safety meetings. The authors concluded that that these indicators are valid and generalizable across geographies, industry sectors, company types, and safety cultures.

While some recent research has shown that some safety leading indicators are predictive (Salas & Hallowell, 2016), provide early warnings of potential hazards (Guo & Yiu, 2015), and can be used as levers to improve future performance (Lingard et al., 2017), there is still limited scientific evidence currently available to indicate which leading indicators for OSH promotion should be used (Amick & Saunders, 2013). Hallowell et al. (2013) identified 13 proactive safety indicators that improve safety performance, including: near-miss reporting, safety observation, auditing program, pre-task safety meeting, housekeeping program, and worker involvement. Later, in a study of 261 contractors, Salas and Hallowell (2016) found evidence that empirically supported the following as predictive of improving safety performance: near-miss reporting, stop-work authority, upper-management engagement in safety activities, worker involvement, owner involvement, safety auditing and observation, and safety risk assessment.

Another prominent example for leading indicators developed in the area of OSH comes from the Ontario Leading Indicators Project, which the Canadian Institute for Work & Health has been running since 2008. The Organizational Performance Metric–Monash University (OPM-MU) has been reported to be a reliable and valid measure of leading indicators in OSH (Shea et al., 2016), and useful for not only safety but also health outcomes (Amick & Saunders, 2013). The OPM-MU has been associated with fewer incidents and fewer near misses. Aggregated OPM-MU scores have also been associated with lost-time and medical-treatment injury rates (De Cieri et al., 2016). This tool is similar to the Prevention Culture Index developed by IOSH-UK which consists of 10 indicators: management commitment and visibility; communication including feedback loops; productivity versus safety; information, instruction and training; safety resources; participation; shared perceptions about safety and risk; trust; autonomy; incentives; and reporting accidents and near misses, investigations and controls (White, 2015). In 2015, an online survey was conducted to explore whether the indicators included in the IOSH Prevention Culture Index are suitable for measuring a culture of prevention at company level. The survey was sent to senior OSH practitioners who are members of IOSH, of whom 840 completed the survey. The survey asked respondents to assess the importance of the indicators for an effective prevention culture and whether the proposed options are the right ones for measuring a culture of prevention. It also asked whether the maturity model is suitable for making statements regarding how each indicator contributes to improving the culture of prevention. The indicators rated as being the most effective were: management commitment and visibility, communication, and participation. The indicators rated as being the least effective were: safety resources (PPE available, posters etc.), productivity versus safety (time and pressure), and reporting (accidents and near misses, investigations and controls) (White, 2015).

Leading indicators for wellbeing at work have also been developed in the area of occupational health psychology. For instance, Bergh and colleagues developed a leading indicator for psychosocial risk (PRI) in the oil and gas industry, consisting of a condensed set of 11 items, addressing job demands, role clarity, relationships, job control and support (Bergh et al., 2014b). The PRI has been shown to effectively predict both near misses in terms of safety (hydrocarbon leaks) (Bergh et al., 2014a), and well-being at work (Bergh et al., 2018).

The literature on leading indicators also indicates some challenges in their development: conceptual clarity, whether to measure workplace policies and practices through self-assessment or external audit, how to interpret changes in scores, how to use indicators to improve prevention, and how much to tailor indicators to specific workplace contexts (Amick & Saunders, 2013). There is also little consensus on which methods should be used for identifying leading indicators (Raben et al., 2018). Another issue being discussed is whether there can be a common set of leading indicators at a "high level" across industries and organizational contexts within a country or internationally (Shea et al., 2016).

Recognizing these challenges, we adopted a mixed methods approach for the development of the proactive leading indicators for SHW, with stakeholder input and feedback throughout the KTE development process. The aim of this paper is to describe this development process which was implemented in four stages as detailed next.

2. Method

A mixed methods approach was applied for the indicator development process that included four stages: (1) a review of literature and input from industry; (2) a quantitative evaluation of a draft set of indicators through an online survey; (3) a qualitative evaluation through feedback from organizational representatives and key stakeholders; and (4) a consensus building workshop with the ISSA Steering Committee.

2.1. Stage 1: Review of literature and industry input

First, a literature review of the academic and grey literature was conducted on OSH/SHW indicators with a specific focus on leading indicators. The literature review process began with seeking familiarization with the range and diversity of data in this domain, and gaining an overview of the body of material gathered to be reviewed. This was primarily achieved through running preliminary searches of the (academic and grey) literature, and by sifting and sorting through identified sources of information. The following search terms were used:

a. Indicator OR measure OR benchmark OR precursor
   AND
b. Leading OR lagging OR proactive OR positive performance OR key performance

AND

c. Occupation OR work OR business
AND
d. Safety OR health OR wellbeing OR prevention culture OR zero OR vision zero OR zero accident vision OR anticipation OR weak signals OR procurement OR innovation OR restructuring OR reorganization.

Our systematic search of databases, Pubmed and Web of Science, provided 5218 hits. A search on Google Scholar provided 18,000 hits – and we took the first 150 (to get 100 unique hits, removing doubles) which were ranked by Google by 'relevance'. After reviewing the abstracts of these publications for relevance and avoiding duplication, 92 publications were included in our final literature database. The review focused primarily on studies published between 2014 and 2019. However, earlier studies were also reviewed with 17 of the 92 studies being from pre-2014. Most studies were published in the journal Safety Science (nearly 25%).

At the same time, input on SHW indicators and practical evidence was sought by organizations participating in ISSA's VZ network and the business networks of the researchers. Input was received from 32 organizations and experts from a variety of countries (9 Germany, 6 the Netherlands, 4 Finland, 3 Japan, 2 international, 1 Chile, 1 Costa Rica, 1 France, 1 Mexico, 1 Russia, 1 Switzerland, 1 UK, 1 Ukraine) and sectors (e.g. automotive, chemical industry, construction, electrical power, engineering, food processing, manufacturing, mining, and trade).

The first step was to identify what we regarded as a leading indicator. Both in the literature and from the input received, several referred to what we regarded as 'good practices' (e.g. exemplary behavior of leaders). We did not regard these as useful indicators, as these factors are not easy to measure quantitatively, and therefore are less useful for benchmarking. Such factors were therefore regarded by the project team as 'indications', not as potentially relevant leading indicators.

We then reviewed, evaluated and synthesized the collected literature and industry input in an integrative way in order to identify the focus and content of the identified indicators, and cluster them according to the ISSA Golden Rule they were most closely associated with. In the case where the indicators were relevant to more than one Golden Rule, the authors clustered them by consensus according to the most relevant Golden Rule.

In discussion with ISSA, six core criteria for the selection of proactive leading indicators were applied, as well as six complementary criteria. Each individual indicator had to fulfil the core criteria; the complementary criteria were mainly relevant for a well-balanced set of 14 indicators (see Table 1).

The four authors of this paper individually ranked each of the identified indicators in terms of the core criteria, of which a comparison of rankings indicated a high degree of agreement (80%). As a result, two candidate proactive indicators were identified for each Golden Rule. One proactive leading indicator was then selected for each of the Golden Rules for the next stage: developing an associated factsheet, and including the indicator /factsheets in the pilot.

2.2. Stage 2: Quantitative evaluation

The next stage in the indicator development process was piloting the indicators through an online survey. A factsheet was first developed per indicator, with condensed information on one A4 page regarding: key concepts, aims, how to measure, limitations, and five good practices. The good practices were included to ensure a qualitative understanding in addition to the quantitative targets included in the factsheets (Oswald, 2020). After discussion with the ISSA Steering Committee a rating of the outcomes was added, with three options: excellent, on the way to excellent, and needs improvement. The idea behind this was ISSA's desire to trigger organizations to aspire to the qualification 'excellent'. The seven indicators that were included in the pilot are shown in Table 3.

The online pilot survey was conducted between September and the first week of December 2019. A website was developed where participants could access the survey that was hosted on Qualtrics. Information on the pilot was disseminated through ISSA to their VZ network of organizations and through the researchers to their business networks. Participants were asked to provide feedback to the following questions for each of the seven indicators:

1. Is this indicator relevant for your organization?
2. Is the indicator clearly understandable? If No/Not sure, why?
3. Does the factsheet provide clarity around the indicator's: Aim? Use? Good practices?
4. Is this indicator helpful to your organization as a part of your Vision Zero strategy? If No/Not sure, why?

Descriptive analyses of the survey findings are presented in the Results section. Additional open-ended questions were also included where participants could provide further feedback on each indicator and the set of indicators overall.

2.3. Stage 3: Qualitative evaluation

A qualitative evaluation of the indicators was conducted through the open-ended questions included in the online survey as well as feedback provided by key stakeholders and the ISSA Steering Committee and organizational representatives. It also involved discussions at international conferences such as: Working on Safety (Austria, September 2019), APA/NIOSH Work Stress and Health (USA,

Table 1
Criteria for the selection of proactive leading indicators for safety, health and wellbeing at work.

Core criteria	Complementary criteria
Proactivity	Complementarity and providing a good balance to lagging indicators
Relevance for each of the three aspects: safety, health, wellbeing	Ability to provide sufficient 'communicative power'
Evidence of effectiveness	Suitable for requiring good practices and a true prevention culture from contractors and suppliers
Relatively easy to measure quantitatively (no additional tools)	Suitable for use by smaller organizations
Identifying strengths and weaknesses – in key factors and processes that determine safety, health and wellbeing performance	Useful to improve the effectiveness of existing management systems and for the development of a prevention culture
Allowing for benchmarking within and between organizations and sectors, nationally and internationally	Comprising a mix of traditional and innovative indicators

November 2019), Vision Zero Summit (Finland, November 2019), and various ISSA network meetings.

Several interested organizations and individuals emailed more comprehensive feedback directly to the project leader, e.g. the Institution of Occupational Safety and Health (IOSH), The British Safety Council, the (Canadian) Institute of Work & Health, the American Industrial Hygiene Association (AIHA), and various organizations (e.g. Siemens). The feedback was documented and thematic analysis (Braun & Clarke, 2006) was conducted on all qualitative input.

2.4. Stage 4: Consensus-building workshop

The final stage in the development process involved a consensus-building workshop with the ISSA Steering Committee in January 2020. Six participants represented five ISSA sections for prevention: Electricity, Information for prevention, Mining, Transport and Trade. Consensus was reached on the following:

- A 'Guidance document' for the leading indicators should be developed to accompany the factsheets. It should include 'how to use the leading indicators both for high-level companies and for those starting with a VZ strategy. It should include suggestions on where to start, in case using all indicators may not be relevant or be too difficult, and to provide guidance on how to present the outcomes of using the indicators.
- It was emphasized that the overwhelming majority of organizations are small companies. Therefore, it was important to make the use of the indicators as simple as possible for small organizations. This would require differentiation in the options for using the indicators (measurement options).
- In line with the previous point, the titles of the indicators should be short (preferably no more than three words) and to the point.
- The factsheets should be made more attractive for smaller companies as well. They should start with the aims, while sections on measurement should be moved to the end of the factsheets. The ratings should move to the associated Guide. The ratings should imply a possibility and trigger each company, also 'beginners', to go to the next level. Suggestions to distinguish five development levels were already received through organizational feedback, and this was to be explored further.
- It was also agreed that it would be useful to provide guidance to organizations that may begin with a limited set of indicators, depending on their OSH situations and ambitions.

3. Results

3.1. Stage 1: Literature and industry input review findings

Table 2 presents a summary of the literature and industry input review findings. Sixty-four leading indicators were identified in the literature, and 72 in the input provided by industry. As shown, fewer indicators were identified under ISSA's Golden Rule 5, both through the literature and the industry input. Several additional success factors were identified; 39 in the literature review and 94 through industry input. These were not taken into consideration further, as they were not easy to measure quantitatively, and therefore were less useful for benchmarking.

The next step was the selection of a draft set of seven proactive leading indicators (Table 3). An accompanying factsheet was developed for each of these indicators, which then formed the input for the online survey in stage 2.

3.2. Stage 2: Online survey results

Sixty organizations participated in the online survey, representing a wide variety of sectors, and the majority of them were large (75%, with 250+ employees). The organizations operated in various countries, while twenty were multinational. Eight organizations came from Germany and seven from the UK, four each from the USA and Denmark, three from Norway, and two each from the Netherlands and Poland - thus the majority came from Europe. Most of the respondents were in-company SHW professionals. A high drop-out of participants affected the survey, with 60 responses received in relation to questions on the first factsheet, and only 34 responses received on the last factsheet. Table 4 presents an overview of the responses to the survey in relation to the questions asked for each indicator.

The majority of respondents found the indicators to be clearly understandable and relevant for their organization. They also thought that

Table 2
Proactive leading indicators for safety, health and wellbeing at work - outcome of literature and industry input review.

No.	International Social Security Association's 7 Golden Rules for Vision Zero	Leading indicators		Success factors (indications)	
		Literature	Industry	Literature	Industry
1	Take leadership – demonstrate commitment	12	6	6	17
2	Identify hazards – control risks	7	10	3	10
3	Define targets – develop programmes	14	8	6	12
4	Ensure a safe and healthy system – be well-organized	10	24	8	18
5	Ensure safety and health in machines, equipment and workplaces	1	5	2	9
6	Improve qualifications – develop competence	10	8	2	12
7	Investing in people – motivating by participation	10	11	12	16
Total		**64**	**72**	**39**	**94**

Table 3
The pilot tested draft of proactive leading indicators for safety, health and wellbeing (SHW) at work.

No.	International Social Security Association's 7 Golden Rules for Vision Zero	Draft indicator
1	Take leadership – demonstrate commitment	Frequency of pre-work SHW briefings
2	Identify hazards – control risks	Percentage of evaluations after SHW risk assessments and actions
3	Define targets – develop programmes	Percentage of inductions in which SHW are integrated part of the process
4	Ensure a safe and healthy system – be well-organized	Number of leading SHW Key Performance Indicators (KPIs)
5	Ensure safety and health in machines, equipment and workplaces	Percentage of innovations and changes used to reduce SHW hazards and risks in the design stage
6	Improve qualifications – develop competence	Percentage of leaders and workers trained in SHW before they start their job
7	Investing in people – motivating by participation	Percentage of adequate follow-ups on suggestions for SHW improvements

Table 4
Online survey responses on proactive leading indicators for safety, health and wellbeing at work*.

Survey questions	Draft proactive leading indicator													
	1		2		3		4		5		6		7	
	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
Is this indicator relevant for your organization?	52	8	37	5	32	7	26	10	28	7	30	5	29	5
Is the indicator clearly understandable?	48	7	37	5	32	5	28	7	30	5	33	2	33	1
Does the factsheet provide clarity around the indicator's aim?	47	4	36	6	34	3	29	6	33	2	34	1	33	1
Does the factsheet provide clarity around the indicator's use?	44	3	33	5	32	5	27	9	29	5	29	7	33	2
Does the factsheet provide clarity around the indicator's good practices?	45	2	33	6	35	2	30	6	28	7	32	3	33	2
Would this indicator be helpful to your organization as a part of your Vision Zero strategy?	39	10	31	10	28	9	25	11	28	7	26	9	29	5

*Differences in total numbers are due to non-completion of items.

the indicator factsheets overall provided clarity around their use and good practices, and would be a helpful tool as part of their VZ Strategy.

3.3. Stage 3: Qualitative findings

The qualitative feedback received through the open-ended questions included in the survey, key stakeholders from the ISSA Steering Committee, and organizational representatives was analyzed thematically, and the key issues (themes) that emerged are presented below.

Clarity

The majority of respondents highlighted the need for simplicity in presenting and describing the indicators, in terms of short, clear titles, definitions, use of examples, and measurement. They suggested looking for ways to further simplify the factsheets.

In relation to indicator 2.1, some respondents mentioned that the target of this indicator was unclear. It was suggested that it should more clearly apply the hierarchy of controls. Furthermore, it was suggested that indicator 4.1 did not seem to trigger clear improvement actions the way it was presented. As one participant stated in relation to indicator 4.1:

> "My company has "simplicity" as a value and having an indicator on indicators is not compatible with this value" (medium sized organization).

Relevance to smaller organizations

Some participants from smaller organizations found the indicators to be too high level for them. For example, in relation to indicator 2.1, they felt it was not practical for a small company and highlighted the need for some examples. The majority of respondents from smaller organization found indicator 4.1 on SHW Key Performance Indicators (KPIs) to be too general and not useful in their context.

For indicator 6.1 it was suggested that it is hard to do all training before the start of a job. Therefore, this indicator is likely to be discouraging, particularly for smaller organizations. As one respondent from a small organization put it:

> "I feel this has been developed for middle- to large-sized businesses or organizations. My business (a shop with 6 part-time sales personnel, including 3 students) would require a severely scaled down version for it to be practical and, more importantly, used. SHW of my staff and customers is of high importance to me, but for a business of my size, this document is too dense. One size doesn't fit all" (small organization).

The user friendliness for smaller organizations was also a concern of the ISSA Steering Committee, as SMEs are an important target group for the ISSA members (mainly national social security agencies).

Measurement

The majority of participants highlighted the need for more examples in relation to measurement. For example, in relation to indicator 1.1, it was suggested that the indicator would require much effort to measure. It was also suggested that pre-work SHW meeting quality is difficult to measure. While the majority of respondents found indicator 5.1 relevant for their organization, some respondents thought that there were three entirely different entities combined into one topic, which would complicate measurement in practice. The measurement ratings were thought to be too ambitious in some cases:

> "I would suggest to give some more thought on ratings for measurements, e.g. 'Excellent' 95%, 'On the way to excellent' 80% to 94%, 'Needs improvement' less than 80%. For most enterprises even 80% is for them a fantastic result. It would be reasonable to make the scale lower, but in several years, with the growth of maturity, the scale can be proposed higher. This is something to consider" (large organization)."

Finally, it was suggested that an overview diagram for all indicators would be useful to include that would enable organizations to trace progress.

Prioritization

A final key issue that emerged was around prioritization of the indicators. Many participants suggested that it might be difficult for organizations to find time to measure all the indicators. The possibility of ranking or prioritization of the indicators was highlighted in relation to those that would achieve most impact with fewest resources:

> "Is it possible to make a priority order in relation to what will contribute with most impact and less resources? If you don't have the possibility to mobilize resources for all seven….it would be nice to see some specific examples of how this could work as well" (large organization).

Some respondents suggested that organizations could choose the indicators that were most suitable to them. Finally, it was reported that it may be a challenge for all indicators to include all three aspects of safety, health and wellbeing, as maturity may be different across organizations, and as responsibility for developing them, training and follow-up lies within different functions of the organization, e.g. human resources with a focus on health and wellbeing.

3.4. Stage 4: Consensus building: Proactive leading indicators for safety, health and wellbeing

The feedback and issues raised during the pilot were discussed at the consensus building workshop with the ISSA Steering Committee. Several changes were implemented to the first seven indicator drafts and associated factsheets, as well as the seven additional indicators and factsheets that were developed.

Clarity: The titles of the indicators were simplified (shortened) - the measurement scales (frequencies or percentages) were not included in the title anymore. Indicator 4.1 'The number of leading SHW KPIs', was replaced by another indicator where relevance to SHW was more direct. The indicator 'Frequency of pre-work meetings' was moved to Golden

Rule 4, as its relationship with leadership was rather indirect.

Relevance to smaller organizations: To increase the relevance for smaller organizations and make the (set of) indicators more user-friendly, the following changes were made: the factsheets were redesigned, whereby the 'how to measure' box (regarded as the greatest bottleneck for small organizations) was transferred to the bottom of the factsheet; and two simpler options for 'how to measure', in particular a qualitative Yes' or 'No' option, were introduced.

Measurement: The 'how to measure' section in the pilot test explained how to measure the indicator quantitatively. Two simpler modes of using the indicators were introduced. As a result, for each proactive leading indicator three options for measurement are given: qualitative, semi-quantitative, and quantitative. The qualitative measurement option ('Yes' or 'No') is simple and user friendly; it can be useful for any organization, also for small organizations. The semi-quantitative option (a five–point scale from 'Always' to 'Never') makes it easier for medium-sized organizations to measure and benchmark, while the third option retained the frequency and percentage calculations. For example, in relation to indicator 7.2 Investing in people – motivate by participation: Recognition and reward, the following options are available:

- Option 1: Are workers given recognition for excellent SHW performance? (Yes/No)
- Option 2: How often are workers given recognition for excellent SHW performance?

(Always or almost always, Frequently, Occasionally, Rarely, Never or very rarely)

- Option 3: Determine the number of identified cases of excellent SHW performance, and calculate what percentage were recognized in the past 12 months.

Each measurement option can be used to differentiate five levels of organizational performance: Starting, Learning, Progressing, Advancing and Achieving. Results can be derived on a monthly basis, so as to be able to use them proactively, and allow for follow-up and learning in a timely manner. Monthly trends for an indicator can be plotted over the last twelve months, and summary results for the indicators in each of the seven Golden Rules can be plotted in e.g. a radar diagram.

Prioritization: A Guide was developed that provided more explanation and useful background of the set of indicators and guidance for the users. In the Guide a description is provided of why it may not be necessary to use the full set of indicators. Examples are given of how to tailor the set of indicators to a number of organizational contexts, and how to prioritize the indicators.

Table 5 shows the final set of the ISSA proactive leading indicators for SHW at work.

4. Discussion

The multi-stage mixed-methods approach that was implemented for the development of the proactive leading indicators, balancing the use of evidence with usability and knowledge transfer, has previously been highlighted as good practice in the literature. To provide practical recommendations for the formation of a leading indicator program Guo and Yiu (2015) presented a model for developing leading indicators based on four major steps: define the system and analysis level (conceptualization), include only measurable constructs (operationalization), develop leading indicators (indicator generation), and validate selected leading indicators (validation and revision). In this study, these four steps were followed to develop a set of leading indicators for SHW which can be used by enterprises implementing Vision Zero. The development process began with a discussion on the varying conceptualizations of leading SHW indicators identified in the literature and by practitioners in industry, which was used to operationalize and generate a set of indicators across ISSA's seven golden rules. In stages 2 and 3 of the study the indicators were validated, and then revised in stage 4 to develop the final set of 14 proactive leading indicators for SHW. Likewise, the set of proactive indicators fulfil the qualities identified by Sinelnikov et al. (2013), being achievable, meaningful, transparent, easy to communicate, valid, useful, timely and actionable. Furthermore, in line with Alruqi and Hallowell (2019) the indicators include a focus on resources, leadership, training, rewards, preventive actions, evaluations and pre-task meetings.

It should also be noted that the indicators are interrelated, and although they have been associated with specific ISSA golden rules, many of the indicators will in practice have an effect on more than one golden rule. For example, indicator '4.1 Pre-work briefings' can have a positive effect on 'Rule 1 Taking leadership – demonstrating commitment', 'Rule 2 Identifying hazards and controlling risks', 'Rule 6 Improve qualifications – develop competence', and 'Rule 7 Investing in people – motivating by participation'.

In terms of their proactivity, there seem to be at least five relevant mechanisms that make leading indicators work. The first is that indicators should support a commitment strategy or the development of a prevention culture. Examples include visible leadership commitment to SHW, suggestions for improving SHW, and recognition of excellent SHW performance (indicators 1.1, 7.1 and 7.2). Furthermore, indicators should stimulate subsequent SHW prevention right at the start of any process or activity. Competent leadership and integrating SHW in job induction, organization of work, innovation, procurement and training (indicators 1.2, 3.1, 4.2, 5.1, 5.2 and 6.1 respectively) are examples of such indicators. It is also important that indicators stimulate early active anticipation. Such indicator examples include learning from unplanned events and integrating SHW in pre-work briefings (indicators 2.2 and 4.1). They should support processes for organizational learning and continual improvement (e.g. evaluating risk management and evaluating targeted programmes (indicators 2.1 and 3.2). Finally, they should facilitate the translation from planning to implementation, e.g. though refresher training (indicator 6.2).

KTE is a process of "making relevant research information available and accessible for use in practice or policy" (Van Eerd & Saunders, 2017, p.1). The applied integrated KTE process (Van Eerd, 2019; Van Eerd & Saunders, 2017) in this study proved fruitful whereby ISSA, organizations, companies and researchers were all actively engaged in the conceptual phase and all four research stages of the project. The request from organizations involved in ISSA's VZ strategy triggered the initiation of the research project. In all stages of the project, the ISSA sections for prevention were actively involved by providing critical feedback and stimulating associated organizations to also provide input (in terms of sharing indicators and practical evidence, and participating in the online survey and qualitative evaluation). The KTE process is still underway, with ISSA and its various industrial sectors taking responsibility for the initial global dissemination of the indicators and the accompanying guide, thus contributing to making the research information available and accessible for use in policy and practice.

The development of the proactive leading indicators for SHW that can be a common set of leading indicators at a 'high level' across industries and organizational contexts internationally (Shea et al., 2016) was ambitious in various ways. The development process addressed issues relating to conceptual clarity, measurement, interpretation of results, and applicability of indicators to specific workplace contexts (Amick & Saunders, 2013). Applicability for all areas of safety, health and wellbeing was one of the key criteria that were used in their development. This created the dilemma of integration versus separate measurement. Conceptual integration in terms of the same indicator being used for all areas was maintained in the developed indicators, to ensure they become an integrated part of business processes. However, it is advised that measurement addresses the three aspects separately to ensure that health and wellbeing are prioritized in the same way that

Table 5
International Social Security Association's (ISSA) proactive leading indicators for safety, health and wellbeing (SHW) at work.

Rule No. 1: Take leadership – demonstrate commitment	
Indicator No. 1.1 *Visible leadership commitment*	Through visible leadership commitment and being exemplary role models, leaders demonstrate their commitment to SHW, and actively promote and support SHW improvement processes and the development of a prevention culture.
Indicator No. 1.2 *Competent leadership*	Committed and competent SHW leadership is essential to drive the development processes of VISION ZERO. Such leaders are intrinsically motivated to improve SHW and promote SHW as personal and organizational core values. Leaders then regard SHW as integrated parts of business processes, and support processes of continual improvement of SHW, while creating a strong prevention culture.
Rule No. 2: Identify hazards – control risks	
Indicator No. 2.1 *Evaluating risk management*	Evaluation of the effectiveness of SHW risk management shows leadership focus and commitment to improving SHW, and stimulates active participation and influence of workers. It allows leaders and workers to improve the effectiveness and sustainability of SHW promotion measures as an integrated part of business. In addition, it allows for organizational learning and continuous development.
Indicator No. 2.2 *Learning from unplanned events*	Learning from unplanned events (incidents, events, cases) is necessary to prevent similar undesirable events from reoccurring, and to create a culture of SHW prevention and learning. Adequate follow-up of reported unplanned events will increase reporting and learning.
Rule No. 3: Define targets – develop programmes	
Indicator No. 3.1 *Workplace and job inductions*	Integrating SHW in induction (on-boarding) processes demonstrates that SHW are an integrated part of each job and each business process. SHW are an essential part of leaders' and workers' new job in a workplace. It can be both a formal and informal way of welcoming new personnel to an organization, group and/or job function, and highlights SHW purpose, values and goals.
Indicator No. 3.2 *Evaluating targeted programmes*	Evaluating targeted programmes (e.g. temporary campaigns) that integrate SHW in work processes helps to verify that they are implemented as intended, and that the improvement goals for SHW are met.
Rule No. 4: Ensure a safe and healthy system – be well organized	
Indicator No. 4.1 *Pre-work briefings*	Integrating SHW in pre-work briefings allows leaders and workers to identify context specific hazards, risks and prevention measures. This shows leadership focus and commitment to SHW, and a commitment to stimulating the active participation and influence of workers.
Indicator No. 4.2 *Planning and organization of work*	Planning and organization of work are essential for the success of every organization and for ensuring SHW. This is because planning can make an organization competitive and efficient. Several issues need to be considered in effective planning and work organization in order to promote SHW. Good planning and work organization promote good morale and a healthy organizational culture.
Rule No. 5: Ensure SHW in machines, equipment and workplaces	
Indicator No. 5.1 *Innovation and change*	Technological, organizational and personnel changes occur frequently in organizations. Instead of assessing SHW risk after the changes, these changes should be considered proactively, and to utilize innovation to improve SHW right from the start in the design phase.
Indicator No. 5.2 *Procurement*	The indicator aims to trigger the systematic use of procurement for SHW improvement. Procurement, particularly of hardware, can determine SHW risks for a long period, while procurement of services such as maintenance, is often associated with increased SHW risks.
Rule No. 6: Improve qualifications - develop competence	
Indicator No. 6.1 *Initial training*	Competence is key to ensuring good SHW. Being proactive requires training/qualifying leaders and workers in advance, before they start their job. It also shows that no job or task should be carried out without the relevant SHW competences, and that SHW are an integrated part of any job or profession.
Indicator No. 6.2 *Refresher training*	Developing SHW competence should be an aspect of continuous professional development. Refresher training ensures that leaders and workers' knowledge and skills on SHW remain up to date and include new SHW insights.
Rule No. 7: Invest in people – motivate by participation	
Indicator No. 7.1 *Suggestions for improvement*	In the development of a prevention culture and the active involvement of workers, it is important that suggestions of workers for SHW improvements are welcomed and are taken seriously. This will stimulate workers' active commitment to SHW and demonstrates their leaders' commitment to improving SHW.
Indicator No. 7.2 *Recognition and reward*	Providing timely, proactive and relevant recognition and reward for excellent SHW performance to both leaders and workers is essential for fostering a SHW culture that is based on trust, respect, participation and cooperation.

safety issues are. In many industries there is the tradition of managing safety, but much less a similar tradition in managing health and well-being. The indicators developed are explicitly meant to support all three SHW aspects, both individually and jointly. The indicators may inspire safety professionals to address health and wellbeing in similar ways to safety. It may also help health and wellbeing professionals to put these issues higher on the agendas of the senior leaders of their organizations. The indicators may then support a shift to a more comprehensive perspective and fruitful cooperation between the various SHW professionals. As the management of psychosocial risks and wellbeing is generally least developed, the indicators imply a great potential for improvement in these areas. Whether this potential will be used or not, will, of course, mainly depend on organizations in various sectors.

Another one of the key criteria for the development of the indicators was their applicability across different types of organizations, including SMEs. This was a challenging aim in the development process, as was highlighted through the feedback received during the pilot. It is widely acknowledged that SMEs often lack structure, a strategic outlook and resources (Champoux & Brun, 2003). Several changes were made to the indicators to make them more applicable to SMEs, including additions of new indicators and introduction of new measurement options. The measurement options allow for a qualitative evaluation that may be more applicable to smaller organizations. However, it is acknowledged that some of the indicators may still be ambitious for smaller organizations to use. Furthermore, it is acknowledged that not all organizations will use all indicators. They may choose to begin with those that make sense in their context, level of knowledge, processes and immediate priority issues. However, they can be useful in providing guidance in terms of good practices across organizational contexts and help organizations develop a more long-term strategic perspective on the basis of prevention in all areas of SHW.

Benchmarking was another one of the key criteria in the development process. That fact that the indicators were to be useful for

benchmarking implied that in the process of selection of proactive leading indicators, it was important to choose indicators that could be measured quantitatively. Sometimes quantity can be realized at the expense of quality. To compensate for the fact that qualitative factors are neglected in the indicators, each factsheet contains five good practices. However, it is important to note that all three measurement options would need to be tested in practice in order to establish how feasible and useful they are, and the level of resources they require, as e.g. option three will require more resources and would be more suitable for larger organizations. This would allow further development to enable benchmarking. Organizational performance could then be compared with high performers and targets could be set in the short and longer term.

The development of this set of proactive leading indicators was triggered by a request from industries that had associated themselves with the ISSA Vision Zero campaign. The need for a harmonized set of leading indicators is illustrated by both the high numbers of indicators identified in this study, and a study by Searcy et al. (2016), who identified 892 distinct work environment indicators in 100 Canadian CSR reports. Indeed, there is a need for a set of (proactive) leading indicators that is broadly accepted, in order to allow benchmarking within and between industries, countries and continents. Now that this set of 14 indicators is available, industries can start using it, and ISSA and its affiliated organizations will promote the use in the more than 80 countries involved in the global Vision Zero strategy.

Furthermore, the proactive leading indicators are not only useful to organizations that have committed themselves to VZ. Leading indicators, including the 14 indicators developed in this project, overlap with those covered by instruments which measure safety climate and OSH management systems, which in turn overlap with process safety indicators and management system performance (ANSI/API, 2010). The indicators support a continual improvement process and can be used by any organization that genuinely aims to continually improve SHW. While VZ has been criticized for focusing too much on outcomes rather than processes, and that counter-productive and costly effects are likely to stem from the inaccurate ways of interpreting and implementing VZ (e.g. Dekker, 2014), these proactive set of leading indicators may clearly help to overcome the scepticism and poor practices, as the nature of the indicators will support organizations to be innovative, and by making leaders or organizational units accountable for objectives related to the indicators.

This study implemented good practice through the use of a multi-stage mixed methods approach based on KTE principles. However, it is important to recognize some shortcomings. First, the study would have benefited from a large sample size in the pilot study, with more representation from SMEs and companies in a more diverse range of industrial sectors. Furthermore, a drop-out was observed in the pilot survey, as more feedback was provided for the initial four indicators than the last three, which is a common issue with online surveys. The pilot focused on the evaluation of seven indicators (one for each golden rule) where measuring quantitatively was the only measurement option. This implies a limitation, as in every situation qualitative factors are also important. Finally, the ISSA VZ golden rules for prevention were used as a guiding framework for the indicator development. This implies a possible conceptual limitation, however, the extensive review and KTE processes ensured that the indicators were evidence-based and had practical value.

5. Conclusion

A set of proactive leading indicators for safety, health and wellbeing at work was developed to support ISSA's Vision Zero strategy. Principles of knowledge transfer and exchange were integrated in a mixed method approach in four stages. The result is a set of 14 proactive leading indicators, two for each of ISSA's Golden Rules for VZ, with associated factsheets and a Guide which will be available on ISSA's VZ website (http://visionzero.global/indicators). The proactive leading indicators are not only intended to better direct and control SHW relevant processes, but also to support the development of a prevention culture. Indeed, even the qualitative use of the indicators can support agenda-setting for proactive activities. The 'communicative power' of the indicators is important for VZ and a prevention culture (Zwetsloot, 2014; Zwetsloot et al., 2017a). Due to the fact that we included only indicators that do not require additional tools, they are relatively easy to communicate and understand. Several of the proactive leading indicators also could have a symbolic message which may have a positive impact on the development and credibility of a prevention culture (e.g. when leaders and workers are trained before they start their job).

It is important to stress that this is only the beginning of the process and a first step towards a harmonized/standardized set of SHW indicators. It is vital that the indicators are used in practice and are tested in organizations across sectors, sizes and countries. This will allow the development of evaluation case studies to ascertain the impact of the use of indicators in practice, their usability and potential further developmental needs both within and outside the VZ framework. If the indicators are implemented sufficiently and benchmark options are developed, this may lead to an informal standard on proactive leading indicators, which can be refined and improved after future research.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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