

Safety Performance Measurement Maturity in Finnish Industrial Companies

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Abstract. Organizations typically have a lot of indicators for their safety performance. Nevertheless, the information is not always used efficiently, and the relationship between the indicators and safety outcomes is not clear. Maturity analysis can provide information on how safety performance measurement can be developed. The aim of this study was to analyse the level of safety performance measurement maturity in Finnish industrial companies. A maturity model for safety performance measurement was used to analyse the current level. Analysis was carried out with a survey (n=172) addressed to four companies. A maturity matrix was drawn up based on the results. The results showed that the current measurement practices were rather advanced while the use of performance information and commitment to performance measurement were inefficient. Several more detailed development needs were identified. Managerial support and employee commitment related to performance measurement and utilization of performance information (e.g. in planning safety procedures) were found to link positively to safety performance while performance measurement practices (e.g. scope of measures and supportive information systems) did not have this link. In the future, the links between performance measurement and management practices and safety performance should be studied in more detail. Also a further qualitative study can extend the explanations related to the results of this study.

Keywords: Safety Performance Measurement, Safety Management, Maturity Analysis, Maturity Model

1 Maturity in Safety Performance Measurement

Nowadays, safety is a priority and business value in many companies. Measuring and controlling performance is the foundation of any business management process, and there is no exception for safety performance management [1]. Organizations typically have a lot of performance information related to safety [2]. Nevertheless, the information is not always used efficiently [3], and the relationship between the indicators and safety outcomes is not clear [4]. Maturity analysis can provide information on how safety performance measurement can be developed. Maturity in safety can be defined as a certain level of effectiveness and performance with regard to the management of safety and occupational health and safety (OHS) risks [5]. Maturity in

performance measurement can be defined as a combination of three aspects: scope, sophistication and satisfaction of employees [6]. Scope means the various areas where performance measurement can be used and the scope of measures in use. Scope can be linked to the comprehensiveness of performance measurement [7]. Sophistication relates to the possibility to provide and use information at a more detailed way which means both in-depth measurement information and more specific organizational area. It is also important to acknowledge the context where performance measurement is used. The ultimate test for performance measurement is the decision of managers to utilize the provided information. Hence, employee satisfaction completes the understanding of performance measurement maturity [6].

Maturity models have been widely used in different fields such as information, strategy and performance management [6,8,9]. Maturity models typically define maturity levels which assess the completeness and sophistication of analysed objects. These objects are measured by multi-dimensional criteria with attributes describing the different stages or levels of maturity [10,11]. Maturity models can be used both as an assessment tool and as an improvement tool [12].

Current maturity models with regard to safety typically focus on safety culture and climate [12,13,14] or Occupational Health and Safety (OHS) management system [15]. It is known that good safety culture links to high safety performance [16,17]. Recently, Jääskeläinen et al. [18] suggested a new maturity model for safety performance measurement. The model has three main themes, namely A) Safety measurement practices, B) Commitment and culture related to safety performance measurement, and C) Use of safety performance information. The model provides information on why safety performance measurement might be flawed and how the information could be used better. However, more research is needed in order to understand the maturity level of safety performance measurement and management and its implications on safety performance. The aim of this study is to analyse the status of safety performance measurement maturity in Finnish industrial companies and to identify the link between performance measurement and management practices, and safety performance.

2 Materials and Methods

A self-evaluation survey was carried out in four companies participating the study (see **Error! Reference source not found.**). Industrial companies representing both manufacturing and service sector were selected as a target group. The survey tool was tested by two fellow researchers and four representatives of the target population. The testing resulted in minor changes improving the understandability and clarity of evaluation statements. The online survey was sent to 488 respondents, and 172 answers were received (response rate of 38%). The respondents included top management (9%), middle management (34%), supervisors (26%), safety experts (19%) and other expert duties (12%).

Table 1. The background information of the participating companies.

Company	Number of employees in Finland (approx)	Respondents	Response rate
Company 1	1400	59	27%
Company 2	1500	53	54%
Company 3	6000	41	41%
Company 4	450	20	45%

The survey was based on Jääskeläinen et al. [18] model and consisted of 20 evaluation items in three main themes: 1) Safety performance measurement practices, 2) Commitment and culture related to safety performance measurement, and 3) Use of safety performance measurement. Written evaluation criteria (see example in Table 2) for four maturity levels was chosen to differentiate the model from some earlier maturity surveys using Likert scales and to clarify the alternatives to the respondents.

Table 2. Example of item-level evaluation with written criteria.

Level	Item: links between safety performance measurement objects
Level 1	Linkages between measurement objects have not been considered.
Level 2	Linkages between measurement objects are discussed.
Level 3	Factors explaining the main measurement results are partially identified.
Level 4	Linkages between measurement objects are analysed and modeled (e.g. with a strategy map). There is a common understanding in the organization regarding the factors that should be improved in order to affect the main measurement results.

The answers were scaled from 1 to 4 points where 1 presented the lowest and 4 the highest level of maturity. Satisfaction related to each of the 3 main themes were also enquired and scaled with a 5-point Likert scale (from 1 very dissatisfied to 5 very satisfied). The final responses were further classified into four profiles by the average of performance points and the average of satisfaction points received (**Fig. 1**). The profiles can be interpreted as follows: 1. "Novice" (Low employee satisfaction and basic practices), 2. "Experimenter" (Low employee satisfaction and advanced practices), 3. "Facilitator" (High employee satisfaction and basic practices) and 4. "Advanced exploiter" (High employee satisfaction and advanced practices).

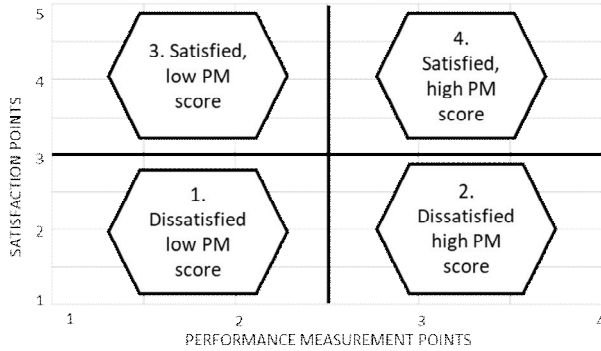


Fig. 1. Maturity matrix based on the results of performance measurement points and satisfaction points.

In addition, the level of safety performance in an organization (10 questions) was evaluated with 4-point Likert scale (from 1 totally disagree to 5 totally agree). Information about the current level of safety performance was gathered to measure if safety performance measurement is linked with safety performance. Linear regression analysis with bootstrapping of 1000 was used to investigate how performance measurement practices, commitment and culture and use practices of performance information drive the level of safety.

3 Results

Based on the results of the survey in four companies, a safety performance measurement maturity matrix was drawn up (**Fig. 2**). The averages of all companies' responses were similar. All the companies ended up in the category with high performance measurement (PM) scores and high satisfaction with the current practices. However, there is still room for improvement within maturity profile 4.

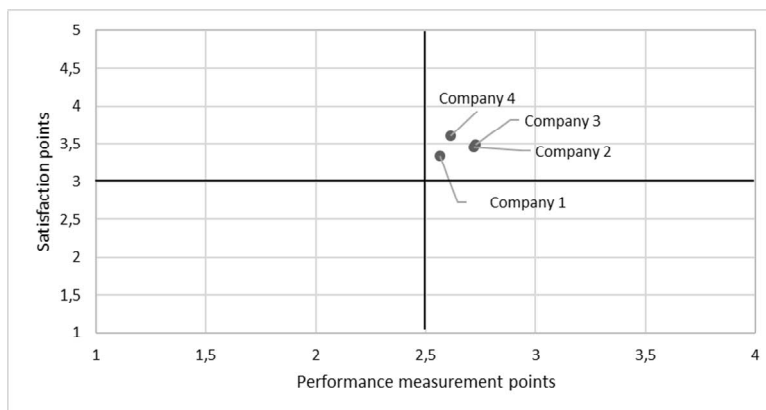


Fig. 2. Overall safety performance measurement maturity scores in four companies.

When maturity scores were analyzed by different respondent groups, the results showed that the top management had more positive picture of safety performance measurement than other respondents (Fig. 3) while supervisors especially had less positive perception.

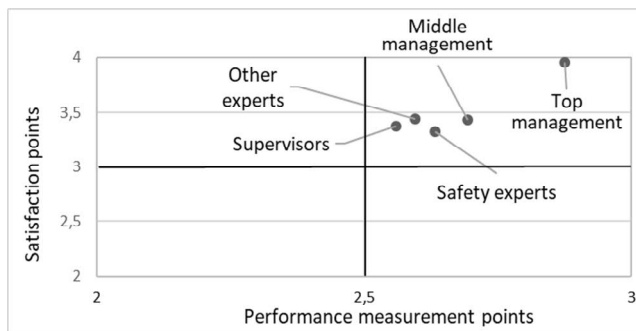


Fig. 3. Safety performance measurement maturity scores by respondent groups.

When maturity scores were analysed in the three main categories evaluated, the results showed that the performance points decrease when moving from category A (Safety performance measurement practices) to category B (Culture and commitment related to safety performance measurement) and category C (Use of safety performance measurement) (Fig. 4). The respondents were also less satisfied with the use of performance information than with performance measurement practices or related culture and commitment. However, in all categories the respondents were rather satisfied with the current situation.

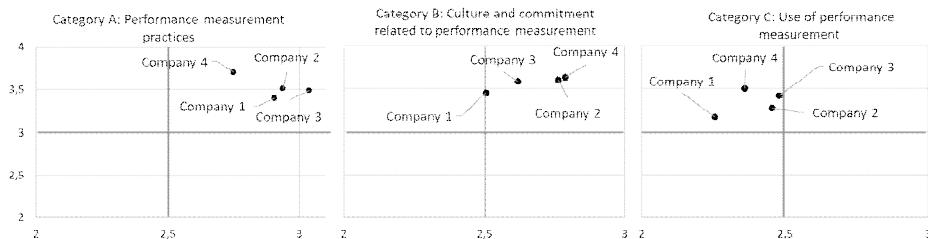


Fig. 4. Company-specific maturity scores in three different evaluation themes.

In Category A, most practices were at a satisfying level but measuring safety-related costs was an issue for all companies. In addition, companies take notes of factors predicting occupational safety, but the focus is still on lagging indicators and the links between safety performance measurement objects are not fully identified. In Category B, major development needs are related to employees' commitment and engagement in developing measurement practices as well as resources for systematic analysis of the current indicators. In Category C, major development needs were related to systematically utilizing safety performance information in planning, development, rewarding, benchmarking and supplier evaluating.

The level of safety performance was on average pretty high, 3.86 (1-5 Likert scale). It appears that the safety climate is good in the studied organizations, since employees can talk freely about safety. However, employees might take risks when the schedule is tight. It is the only statement where any of the participated organizations received results below 3. Interestingly, high score was received in relation to supervisors' encouragement for employees to work by safety rules – even when the schedule is tight. It seems that encouraging is not enough to ensure that rules are followed.

Regression analysis shows that the level of safety performance is most essentially driven by the culture and commitment towards performance measurement in an organization (Table 3). Also the practices of using performance information have a role in improving safety performance. Surprisingly, it appears that performance measurement practices as such are not significantly linked to the level of safety performance. Overall the examined variables explain around 25% of the variance in safety performance which is a decent amount. However, it is clear that several other aspects than performance measurement and its supportive practices and structures explain the level of safety performance.

Table 3. Links between performance measurement and management practices, and safety performance.

Factor explaining safety performance	Performance measurement practices	Culture and commitment	Use of performance measurement
Regression coefficient	0.024	0.353	0.241
p-value	N.S.	<0.001	<0.05
R2		0.249	
Adjusted R2		0.237	
F statistics		20.308***	
F change		20.308***	

* p-value <0.05; **p-value <0.01; ***p-value < 0.001

4 Discussion

This study answered to the need to analyse the maturity of safety performance measurement and the performance implications of safety performance measurement practices. It gave an overview of the current level of safety performance measurement maturity in four Finnish industrial companies. A recently developed safety performance measurement maturity model [18] was used to analyse the current situation.

The results showed that the level of safety performance measurement is in a rather good state and the organizations are quite satisfied with their current practices. Even though the measurement practices were satisfying, the use of performance information was inefficient and commitment to performance measurement was insufficient. Resources for using performance information are limited and systematic ap-

proach for using the information was lacking. Safety performance measurement is not always being regarded useful in the community and the views of employees are not taken into account when developing measurement practices. These observations explain the argument by Sinelnikov et al. [3] stating that turning data into action is a real struggle for many organizations and their indicators are often data-collecting machines rather than means for continuous improvement efforts. However, the results also show that only the use of performance information (e.g. in planning safety procedures) as well as supportive employee commitment and managerial support relate positively to the level of safety performance. It is therefore clear that the next development efforts should highlight these supportive practices and structures of performance measurement [16,17]. In addition to ensuring sufficient resources and commitment of employees, performance information usage needs to be improved by paying attention especially to the use of performance information in developing OHS competencies, in incorporating different examination levels to safety management (e.g. whole company, business lines, units) and in managing safety of suppliers.

The results gave new understanding of the factors affecting safety performance, its measurement and related development needs. In practice, the companies can clarify their weaknesses and strengths and use the information to develop these further. Moreover, the companies can utilize the analysis to follow the suggested evaluation criteria to give direction to the advanced maturation levels, i.e. the evaluation instrument would give insights on the next level of practices. In the companies participating in this study, the results will be utilized through discussions with employees and identification of targets for improvement by evaluating the individual items of the survey. According to Chen [15], organizations often fail in following a sequential maturation that models suggest. Hence, after the analysis, organizations will need resources and support in order to reach the higher levels of maturity.

A further qualitative study could identify more detailed explanations for the results observed in this study. Also the quantitative data set could be extended in order to enable comparisons of different regions and industries. Further, the links between measurement practices and safety performance should be studied in more detail. This could include mediation analysis and use of more detailed variables for safety performance measurement, its use practices and the level of safety performance.

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