
How to communicate measurement information successfully in small and medium-sized enterprises: a regression model

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Abstract: The role of internal communication has been highlighted in the earlier literature on Performance Measurement (PM). This paper focuses on the predictors that explain the success of the communication of measurement information in Small and Medium-sized Enterprises (SME) operating in the manufacturing industry. The study is based on a survey carried out in eight companies. The results indicate that the quality of information and face-to-face communication are the main predictors of the success of measurement information communication in SMEs. The study suggests that SMEs should invest in the quality aspects of measurement information, in its exactness, reliability, intelligibility and usefulness.

Keywords: performance measurement; PM; information quality; internal communication.

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1 Introduction

To understand whether they meet their business goals, companies often put in place performance measures. Companies have different approaches to sharing the information gathered through these measures with their employees. A number of different frameworks for integrated and balanced Performance Measurement (PM) have been launched since the 1990s (Lynch and Cross, 1991; Kaplan and Norton, 1992, 1996; Neely and Adams, 2001; Tenhunen et al., 2003; Mettänen et al., 2004). Today, many companies apply PM to the operational levels of the organisation, such as units, teams and even individuals. These types of measures are behaviouristic – they measure human behaviour. A system measuring human behaviour will eventually change the behaviour – often positively (Neely et al., 1997). Because they are key stakeholders in its development and results, management is often very responsive to strategic PM. However, for company performance measures to have an impact on company performance through individual employees, management must communicate the measures, and employees must understand them. Communicating understandable and accessible measures and targets is a major challenge for management, whether they use a formal or an informal Performance Measurement System (PMS).

Lönnqvist (2002) has shown that communication of important targets is one of the main reasons why managers use PM. Kaplan and Norton (2001) state that communication and education are required to align employees with organisational strategy. Employees must learn about and understand the strategy if they are to help implement it. One of the main purposes of effective communication is to increase employees' understanding and knowledge of business goals. According to Ukko et al. (2005), successful implementation and use of PM at the operational level depends on the success of internal communication and information diffusion, as these increase the employees' understanding of the company's business and targets and thus, their motivation. Bourne et al. (2005) and Ukko et al. (2006) present that the interactive use of a PMS will lead to a higher performance of the company. These studies recognise the importance of communication about PM; what has not been studied is how companies have put it into practice; that is, through what channels companies present measurement information, the quality of that information and how well employees understand and act on it. Typically, the term measurement information refers to the targets and realisation of the targets of measures. At the company level the measures can be for example financial and customer-related, like increase in net sales and customer satisfaction. The measures at the team level can be, for example, the quality of products, delivery reliability and the competence of the

team members. According to Dumond (1994), a PMS can improve an individual's performance and can have an even greater effect when supported by specific types of interaction and information. The present study focuses on the question of what the right types of interaction and information are in SME.

Hewitt (2006) has studied the use of e-mail in internal communication in a large service organisation and compared it to face-to-face communication. He found that e-mail had a positive influence on communication climate, for instance. However, e-mail was less influential than face-to-face communication. Bourne et al. (2005) also emphasise the role of interactive face-to-face communication around the company's performance when reporting about a study conducted in a large company. Bititci et al. (2002) found a web-enabled, intranet-based PMS very useful in a large company. It can be assumed that face-to-face communication is important, irrespective of the size of the organisation. Electronic communication provides possibilities for larger companies which have units in different areas, countries or continents. Smaller companies are used to communicating face-to-face and usually operate in one location. Although electronic communication can support internal communication in SMEs, it does not replace face-to-face communication.

According to the definition of SME by the European Commission, a small enterprise is an enterprise which has fewer than 50 occupied persons and has an annual net sales not exceeding 10 million euros. A medium-sized enterprise is an enterprise which has fewer than 250 occupied persons and an annual net sales not exceeding 50 million euro. This definition is used in this study.

The purpose of the study is to clarify the special characteristics of SME concerning the success of measurement information communication, by answering the following questions:

- What are the practices by which companies communicate about measurement information?
- What is the quality of the measurement information and in what form is it presented?
- What are the main predictors behind the successful communication of measurement information?

In addition, it is examined how the information diffusion and communication should be implemented in the future.

The study focuses on companies operating in the manufacturing industry. Because the objective was to gather data from all the employees and not just a few representatives per company, the data were gathered with a structured survey. The participating companies were small and medium-sized and did not have any formal PMSs. However, they measured their performance with single targets and measures.

2 Internal communication and Performance Measurement (PM) in SMEs

2.1 Internal communication

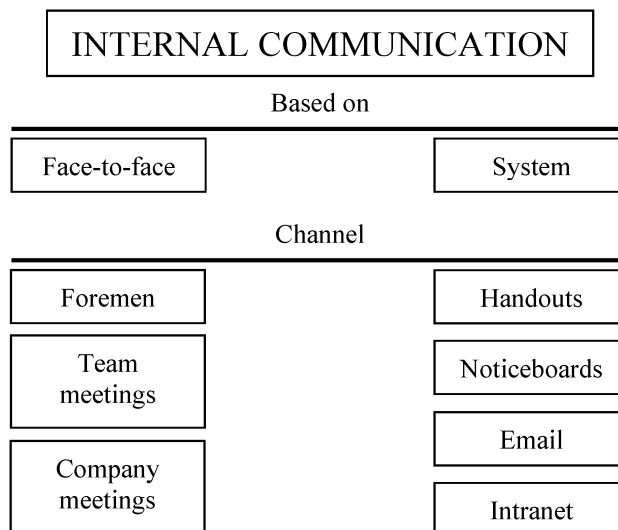
Organisational communication comprises internal and external communication. The objective of the communication is to deliver accurate and reliable information to the stakeholders of the company. External information covers the external stakeholders

(e.g., customers, financiers, investors), whereas internal communication concerns company employees (Kreps, 1990). The present study focuses on the internal communication of measurement information.

Åberg (1997) divides internal communication to three groups: face-to-face communication, written communication and electronic communication. He has later designed a more sophisticated classification concerning the channels of internal communication (Åberg, 2002). He divides internal communication into direct communication based on face-to-face interaction (e.g., foreman-employee interaction, team meetings, company meetings) and indirect system communication based on written and electronic communication (e.g., noticeboard, handout, e-mail and intranet). Åberg also divides the information channels into two groups, where the first group deals with a certain unit or individual and the other one concentrates on the whole work community. Daft et al. (1987) have studied message equivocality, media selection and manager performance. They group the richness of media channels, based on a blend of four criteria: feedback, multiple cues, language variety and personal focus. According to their classification, foreman-employee interaction is the richest communication channel. It enables instant feedback and simultaneous communication of multiple cues. It is also personal and entails a high language variety. Foreman-employee interaction, as the richest channel, is followed by meetings, electronic communication (e.g., e-mail, intranet) and, lastly, written communication (e.g., letters, handouts, noticeboards). On the basis of the categorisations presented above we have outlined a framework suitable for this study. The framework is presented in Figure 1.

In this study, the use of different communication channels is examined through face-to-face and system-based communication. The channels are divided into two groups (Figure 1). The first group includes *foreman-employee interaction*, *team meetings* and *company meetings* and these channels are based on face-to-face communication. The channels of the second group are *handouts*, *noticeboards*, *e-mail* and *intranet*. These channels are based on system communication.

Figure 1 Framework of internal communication



2.2 The role of communication in Performance Measurement (PM)

The importance of internal communication in the PM context has been strongly emphasised by researchers (Kaplan and Norton, 2001; Ukko et al., 2005). An interesting point of internal communication is the channels which companies use when they communicate measures and targets through the whole organisation. Traditionally, face-to-face communication has been the primary way to deliver information in organisations. Electronic communication, such as e-mail, the internet, intranet and PowerPoint, provides lots of new possibilities for the presentation and communication of measurement information in companies.

Bititci et al. (2002) have studied the management implications of web-enabled PMSs in a profit centre of a large manufacturing company. They state that after implementing a fully integrated web-enabled, intranet-based PMS there was some improvement in the areas of business benefits and performance, proactive management style and the behaviour of the operational staff, and significant improvement in the areas of confidence in the managers' decisions, the behaviour of the management, dissemination of knowledge and the visibility of information. Accuracy, reliability and credibility were also improved significantly after launching the web-enabled PMS. Thus, it can be assumed that the use of the intranet should be a very suitable way to communicate measurement information. Hewitt (2006) has examined the role of e-mail in internal communication in a large service organisation and found it to be less influential in comparison to face-to-face communication. However, e-mail was found to influence positively and specifically, the communication climate, shared objectives and goal alignment and perceived external prestige.

Bourne et al. (2005) have examined the differences in the use of a PMS in high-performing business units and average-performing business units in the same large company. They conclude that in high-performing business units the managers used the PM information interactively and communicated about the performance intensively, both in formal meetings and 'at every opportunity'. Ukko et al. (2006) have studied the impacts of PM on leadership in eight medium-sized and large companies and the findings show that the PM information has provided a more solid base for the discussions about employee development, as well as addressing difficult issues. Smidts et al. (2001) have studied the impact of employee communication and perceived external prestige on organisational identification in three large organisations. They present that if employees' identification with their organisation affects business performance, an attractive communication climate can contribute significantly to the long-term success of the company. Smidts et al. (2001) continue that managers should therefore pay serious attention to the internal communication climate by providing each employee with adequate information and opportunities to speak out, get involved, be listened to and participate actively. Based on the previous studies, face-to-face communication around the PM is appropriate and seems to enhance the performance of the company.

The quality of information is an essential factor in exploiting information provided by the PM. It is difficult to make decisions based on information which is not reliable, intelligible, useful and exact enough. According to Ittner and Larcker (2003), most companies track a large number of non-financial measures in their day-to-day operations. To avoid going to the trouble of collecting data that already exist, companies should take careful inventory of all their databases. They continue that this inventory should not limit itself to PMSs but should be extended to any information systems that may contain useful

data on key performance drivers. The other important issue, after gathering the data, is to turn it into useful information. Bourne et al. (2005) state that in high-performing business units the managers have multiple sources of data from different factors in taking action and the use of measures is more sophisticated. The study of Evans (2004) reveals that higher levels of maturity of measurement and analysis correlate with higher levels of performance. The study highlights the need for better approaches to analyse performance results and the need to incorporate more sophisticated statistical techniques, competitive comparisons and benchmarking in organisations' performance review processes. Thus, the scope of measures used to assess organisational performance, together with more sophisticated analysing techniques, will improve the quality of PM information. This enables companies to make the right decisions and will lead them to a higher level of performance.

One of the important issues concerning the communication of measurement information is the form the information should be presented in. According to Robson (2004), the measurement systems have to provide graphical, relevant, local and team level information to encourage a culture of high performance. The information should also be intelligible, available, presented in a familiar atmosphere and gathered cost-effectively (Lönnqvist and Mettänen, 2003).

2.3 Performance Measurement (PM) in SMEs

The PM in SMEs differs from that of larger companies. According to Gunasekaran et al. (2000), most SMEs operate with a poor forecasting and planning system. Barnes et al. (1998) state that SMEs are susceptible to business failure primarily due to poor risk management associated with inadequately informed decision-making. Typical characteristics of SMEs presented in the literature include shortage of human and capital resources, retention of competent staff, fire-fighting mentality and lack of strategic planning (Barnes et al., 1998; Hudson et al., 2000; Tenhunen et al., 2001; Garengo and Bititci, 2004). According to Laitinen (1996), a small firm is usually a simple system and, therefore, a very simple performance system will suffice. The same idea should be taken into consideration when designing the internal communication of measurement information. It can be assumed that if SMEs operate with poor PMS, they probably do not operate with very advanced information systems. Therefore, face-to-face communication may be emphasised in comparison to system information.

2.4 Summary of the literature review

As a summary of the literature review it can be stated that internal communication in all its forms seems to have positive effects on PM and, further, on companies' performance. Therefore it is interesting to study how SMEs have organised their internal communication of measurement information, what channels are used at the moment, what channels should be emphasised in the future and what is the quality of the measurement information. Small and medium-sized organisations differ from larger ones in many ways. They usually do not have such sophisticated systems for information or measurement, which may affect the quality of information.

3 Methodology

Methodologically, this study is quantitative, applying statistical methods of data analysis. The empirical data were gathered from eight manufacturing companies with the help of a structured survey in 2005. Manufacturing companies have measured productivity and effectiveness for a long time. So, they have a long history in the field of PM in comparison to service companies and especially to the public sector. To find a homogeneous group of respondents who are familiar with PM, we have focused the study on industrial manufacturing companies which have launched measurement at the team or even the individual level. The study also focuses on small and medium-sized companies and clarifies their special characteristics concerning the success of measurement information communication. First, we contacted approximately 20 manufacturing SMEs with a letter. After that we called the CEOs and arranged a meeting. Eight companies fulfilling the criteria were willing to participate in the study. There were intranet and e-mail available in all the participating companies. To achieve an overall view of the measurement information communication in the participating companies, all employees were asked to fill in the questionnaire.

The theme of the research questions emerged from the literature review presented above. The questions were selected based on earlier studies that provided some suggestions for a better way to communicate, regarding the use of different communication channels and the presentation and quality of information. The questions were formulated by three researchers and two other researchers commented on them. In the survey, we used a 5-point Likert scale (1 = strongly disagree... 5 = strongly agree). When the data of a study are gathered with a survey, the results and conclusions are usually based on the perceptions of the respondents. This is the case if the survey includes questions or statements and the respondents are asked to choose one of the five categories indicating the strength of agreement or disagreement with the initial statement or question. To find out whether the measurement information communication is successful or not, we believe it is appropriate to study it with the perceptions of the respondents who actually work in the studied companies. It is hard to find any other way to study the success of measurement information communication from the perspective of the employees. It can also be stated that the more respondents there are, the more reliable the results are. To achieve a higher response rate, the questionnaires were delivered personally, not by mail. The total number of valid responses was 210 and the response rate was 69%.

The data were analysed with SPSS software. Missing values were handled with listwise procedure in all analyses, which excludes cases that have missing values for any of the variables used in the analysis. Therefore, single questions with missing values do not necessarily make the whole survey unusable. After the data were described, factor analysis was conducted for a more efficient data analysis. On the basis of the results of the factor analysis, we formulated four sum measures. One purpose of this study was to find out the practices by which companies communicate, as well as the quality of information. In addition, it was investigated whether there were differences between companies. Thus, the means of the sum measures were compared with the analysis of variance, setting the company as an independent variable. To find out the main predictors

for successful communication of measurement information, we continued by conducting a regression model. The regression model requires a dependent variable and one or more independent variables which best predict the value of that dependent variable. When designing the survey we added question number 8 “I think that the internal communication of target information is successful” to get the dependent variable for the regression model. Because of its special role, question number 8 has been treated differently, that is, excluded from the factor analysis and sum measures.

4 Findings

4.1 Data description

Table 1 presents the background information of the respondents. As can be seen, the respondents are quite equally divided into age groups. The greater number of male respondents is typical for the manufacturing industry. The education level of the respondents is well in line with the total Finnish workforce. Most of the respondents are blue-collar workers (61.4%). 16.7% of the respondents are foremen.

Table 1 Background information of the respondents

		<i>n</i>	<i>Percentage</i>
Age	29 or younger	55	26.2
	30–39	47	22.4
	40–49	47	22.4
	50 or older	51	24.3
	Not responded	10	4.8
Sex	Male	125	59.5
	Female	84	40.0
	Not responded	1	0.5
Education	Non-professional	49	23.3
	Professional	100	47.6
	Bachelor’s degree or higher	58	27.6
	Not responded	3	1.4
Organisational position	Blue-collar worker	129	61.4
	White-collar worker	62	29.5
	Manager	18	8.6
	Not responded	1	0.5
Foreman	Yes	35	16.7
	No	161	76.7
	Not responded	14	6.7

The respondents represent eight companies, as Table 2 shows. The background information of the companies is also presented in Table 2.

Table 2 Participating companies and respondents per company

<i>Company</i>	<i>Industry</i>	<i>Net sales (EUR)</i>	<i>No. of employees</i>	<i>No. of responses</i>	<i>Percentage of all responses</i>
1	Furniture	726,000	13	11	5
2	Packaging	45,399,000	85	68	32
3	Machinery for construction	12,105,000	30	18	9
4	Furniture	4,280,000	40	33	16
5	Ventilation equipment	16,000,000	60	31	15
6	Clothing	8,376,000	35	17	8
7	Furniture	2,800,000	22	20	10
8	Furniture	2,400,000	20	12	6
<i>Total</i>			<i>305</i>	<i>210</i>	<i>100</i>

The mean and standard deviation for each research question (the numbering of the research questions is the same as in the questionnaire) concerning the present situation of communication are presented in Table 3. As can be seen, research question number 2 “Information of targets and target realisation is communicated in team meetings” reached the highest mean. The other two out of the top three means were achieved by questions 1 and 3, also concerning face-to-face communication. The lowest mean was in question 6 “Information of targets and target realisation is communicated via e-mail”. It can be stated that communication based on face-to-face interaction is the most trusted way to communicate target information, whereas electronic communication seems to be less used.

Table 3 Means and standard deviations of the research questions

<i>Research question</i>	<i>Mean</i>	<i>Std. Dev.</i>
2 Information of targets and target realisation is communicated in team meetings	3.72	1.045
1 Information of targets and target realisation is communicated by foremen	3.47	1.103
3 Information of targets and target realisation is communicated in company meetings	3.44	1.056
10 Information is reliable	3.40	1.090
11 Information is intelligible	3.34	1.000
12 Information is useful	3.26	0.959
14 Information is mainly verbal	3.22	0.941
13 Information is mainly numeric	3.05	1.061
9 Information is exact enough	3.04	1.096

Table 3 Means and standard deviations of the research questions (continued)

<i>Research question</i>	<i>Mean</i>	<i>Std. Dev.</i>
5 Information of targets and target realisation is communicated at noticeboards	2.92	1.312
15 Information is mainly graphics or pictures	2.92	1.083
8 I think that the internal communication of target information is successful	2.91	1.079
7 Information of targets and target realisation is communicated via intranet	2.77	1.437
4 Information of targets and target realisation is communicated by handouts	2.75	1.260
6 Information of targets and target realisation is communicated via e-mail	2.42	1.322

Table 4 presents the means and standard deviations of the research questions concerning the methods by which the communication should be done in the future according to the respondents. As can be seen, face-to-face communication is the most desirable way in the future and it was also the most common at the moment. Electronic communication did not receive much support.

Table 4 Means and standard deviations of the research questions about communication in the future

<i>Research question</i>	<i>Mean</i>	<i>Std. Dev.</i>
17 Information of targets and target realisation should be communicated in team meetings	4.23	0.825
16 Information of targets and target realisation should be communicated by foremen	4.21	0.885
18 Information of targets and target realisation should be communicated in company meetings	4.18	0.948
19 Information of targets and target realisation should be communicated by handouts	3.72	1.162
20 Information of targets and target realisation should be communicated at noticeboards	3.33	1.358
22 Information of targets and target realisation should be communicated via intranet	3.30	1.421
21 Information of targets and target realisation should be communicated via email	2.93	1.307

4.2 Factor analysis

The questions about communication channels and the quality of information at the moment were included in the factor analysis. Factor analysis and to be more specific, in this case, principal component analysis is essentially a method of data reduction that aims to produce a small number of derived variables (factors) that can be used in place of the larger number of original variables to simplify subsequent analysis of the data (Landau and Everitt, 2004). The principal component analysis produced four factors with an eigenvalue over 1.00. The factor model is presented in Table 5. The model explains a total of 63.2% of the variance. The communalities of the variables (questions) are

relatively high, with the highest value in question 12 ‘Information is useful’ and the lowest in question 1 “Information of targets and target realisation is communicated by foremen”.

Table 5 Factor analysis (loadings only over 0.4 presented)

<i>Variable (question)</i>	<i>Factor 1</i>	<i>Factor 2</i>	<i>Factor 3</i>	<i>Factor 4</i>	<i>Comm.</i>
1 Information of targets and target realisation is communicated by foremen	0.453		0.482		0.441
4 Information of targets and target realisation is communicated by handouts	0.457	0.580			0.595
5 Information of targets and target realisation is communicated at noticeboards	0.627				0.452
9 Information is exact enough	0.702				0.647
10 Information is reliable	0.778				0.705
11 Information is intelligible	0.841				0.734
12 Information is useful	0.841				0.766
6 Information of targets and target realisation is communicated via email		0.806			0.708
7 Information of targets and target realisation is communicated via intranet		0.754			0.657
2 Information of targets and target realisation is communicated in team meetings			0.813		0.720
3 Information of targets and target realisation is communicated in company meetings			0.743		0.671
13 Information is mainly numeric				0.804	0.716
14 Information is mainly verbal				-0.540	0.486
15 Information is mainly graphics or pictures				0.695	0.548
Eigenvalue	4.912	1.607	1.258	1.069	
Percentage of variance explained	35.089	11.477	8.982	7.634	
Cumulative	35.089	46.566	55.548	63.182	
Principal component analysis – Varimax rotation					
KMO measure of sampling adequacy 0.839					

Table 6 presents the final four factors with Cronbach’s alpha values. Below each factor there is a list of the research questions that the factor includes. The sum measures for further analysis have been formulated on the basis of Table 6.

Factor 1. The first factor explains 35.1% of the variance and its eigenvalue is 4.912. This factor has seven main loadings. Questions number 11 ‘Information is intelligible’ and number 12 ‘Information is useful’ have the highest loadings. The other main loadings are in questions numbered 1, 4, 5, 9 and 10. The reliability of the factor was measured with Cronbach’s alpha. In this case, a higher value of alpha was achieved when questions 1, 4 and 5 (highlighted in italics in Table 5) were deleted from the factor. Finally, the Cronbach’s alpha for this factor is 0.892. All the remaining questions represent a certain quality of the communicated information. Therefore, this factor can be labelled as the information quality factor.

Factor 2. The second factor, with an eigenvalue of 1.607, captures 11.5% of the variance. This factor includes three main loadings. Question number six “Information of targets and target realisation is communicated via e-mail” has the highest loading. Also the questions about communication via the intranet and by handout receive loadings. The Cronbach’s alpha of this factor is 0.683. The setting suggests that the factor is associated with a pattern characterised by some systematic communication and for this reason, the factor can be labelled as the system communication factor.

Factor 3. This factor accounts for 9.0% of the variance, with an eigenvalue of 1.258 and with three main loadings. Question number 2 “Information of targets and target realisation is communicated in team meetings” has the highest loading. The other main loadings are received by questions 1 and 3. All these represent internal communication based on face-to-face interaction. This factor can be labelled as the face-to-face communication factor. The Cronbach’s alpha of this factor is 0.670.

Factor 4. The fourth factor explains 7.6% of the variance and its eigenvalue is 1.069. This factor has three main loadings and the highest one is in question 13 ‘Information is mainly numeric’. The other main loadings are in questions 14 and 15. In this factor higher reliability (higher Cronbach’s alpha) was achieved when question 14 (highlighted in italics in Table 5) was deleted from the factor. The Cronbach’s alpha for this factor is 0.632. The setting suggests that the factor is associated with presenting information in quantitative form. Therefore, this factor can be labelled as the quantitative information factor.

Table 6 Final factors

	<i>Cronbach’s alpha</i>
<i>Factor 1. Information quality</i>	<i>0.892</i>
9 Information is exact enough	
10 Information is reliable	
11 Information is intelligible	
12 Information is useful	
<i>Factor 2. System communication</i>	<i>0.683</i>
4 Information of targets and target realisation is communicated by handouts	
6 Information of targets and target realisation is communicated via email	
7 Information of targets and target realisation is communicated via intranet	

Table 6 Final factors (continued)

	<i>Cronbach's alpha</i>
<i>Factor 3. Face-to-face communication</i>	0.670
1 Information of targets and target realisation is communicated by foremen	
2 Information of targets and target realisation is communicated in team meetings	
3 Information of targets and target realisation is communicated in company meetings	
<i>Factor 4. Quantitative information</i>	0.632
13 Information is mainly numeric	
15 Information is mainly graphics or pictures	

4.3 Differences between companies

Based on the factor analysis, four sum measures were formulated. The differences between companies were analysed with the analysis of variance. The results are presented in Table 7. The analysis of variance shows whether there is a significant difference or not, but it does not reveal the companies between which the difference occurs. Thus, a Tukey's post-hoc test was used to find out the companies between which the difference was significant.

Table 7 Comparison of the means of sum measures

	<i>Company</i>								<i>F-value</i>
	<i>1</i>	<i>2</i>	<i>3</i>	<i>4</i>	<i>5</i>	<i>6</i>	<i>7</i>	<i>8</i>	
Information quality	3.30	3.18	3.29	3.24	3.78	2.84	3.28	3.04	2.152*
System communication	2.05	2.99	3.30	1.93	3.54	2.26	1.88	1.81	15.573***
Face-to-face communication	2.88	3.57	3.81	3.54	3.85	3.31	3.62	3.17	2.526*
Quantitative information	2.27	3.33	2.94	3.06	3.19	3.03	2.14	2.42	6.307***

Significance * $0.01 < p \leq 0.05$.

Significance ** $0.001 < p \leq 0.01$.

Significance *** $p \leq 0.001$.

Concerning information quality, a significant difference was detected between companies 5 and 6. Representatives of company 5 were more satisfied with the information quality than the representatives of company 6.

Concerning system communication, significant difference was found between two subsets. The first subset includes companies 1, 4, 6, 7 and 8 and the second subset includes companies 2, 3 and 5. So, according to the respondents, in the companies of the second subset the internal communication of target information was more based on some system than in the companies of the first subset.

One significant difference was found concerning face-to-face communication between company 1 and companies 3 and 5. Internal communication of target information was strongly based on face-to-face interaction in companies 3 and 5, whereas face-to-face communication was considered rather poor in company 1.

Significant differences were found in the quantitative form of information. Between companies 1 and 2 there was a significant difference, as well as between companies 2 and 8. There was one more significant difference. Companies 2, 4, 5 and 6 formed a subset. Between that subset and company 7 a significant difference was found. The target information is presented mainly in quantitative form in company 2, whereas in companies 1, 7 and 8 the information is less quantitative.

As a summary of the differences between the companies it can be stated that company 5 has the best organised internal communication of target information. Companies 2 and 3 also succeed quite well concerning communication of target information. System communication is emphasised in companies 2, 3 and 5 in comparison to other companies. Although face-to-face communication is the most common at the moment and the most desirable in the future, the successful communication of measurement information may need support from system communication. Concerning information quality, there was a big difference between companies 5 and 6. Although there were interesting differences between companies, they do not reveal how to succeed in the communication of measurement information. For that purpose, a regression analysis of the sum measures was performed.

4.4 *Regression model*

The aim of the regression analysis was to find out the predictors for success in the communication of measurement information. We conducted the regression analysis with the help of the sum measures presented above. Because we wanted to investigate how to succeed in the communication of measurement information, we set question number 8 “I think that the internal communication of target information is successful” as the dependent variable and the sum measures as independent variables. The universal form of the regression model can be written as:

$$y = \alpha + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_i x_i + \varepsilon, \quad (1)$$

where y is a dependent variable, α is a constant, β 's stand for regression coefficients, x 's represent predictors and ε is a residual.

Before making a regression analysis, it has to be secured that the data contain enough subjects. There are two rules-of-thumb, which suggest how many subjects are needed to do a regression analysis (see e.g., Green, 1991). The number of subjects should exceed

- $50 + 8m$
- $104 + m$,

where m is the number of predictors. In this case m is 4, so the number of subjects should exceed 82 (first rule-of-thumb) and 108 (second rule-of-thumb). From the data of this study the missing values were excluded listwise. It means that only subjects with valid values for all variables were included in the analysis. With this operation, 196 subjects remained, which is enough.

When operating with regression analysis, the collinearity or multicollinearity may cause problems. It means that one independent variable is a linear function of other independent variables. To check for multicollinearity, we used the Variance Inflation Factor (VIF). If the VIF value is >10 (Landau and Everitt, 2004), there is a problem of multicollinearity. In our analysis there was no multicollinearity problem, because the highest VIF value was 1.446.

We conducted the regression analysis with the stepwise procedure. It started with the best single predictor in the specified group of independent variables, which included four sum measures:

- information quality
- system communication
- face-to-face communication
- quantitative information.

The stepwise procedure proceeds as follows: it selects the next best predictor and adds it into the model. After adding each variable, all variables in the model are rechecked to see if they remain significant. The criterion for a variable to enter is the F -value's $p \leq 0.05$ and the criterion to remove it is $p \geq 0.1$. The stepwise procedure achieves the final model when the specified group of independent variables does not contain any statistically significant variable to be included into the model. Using this procedure we got a regression model which included two predictors (information quality and face-to-face communication) and a constant. The model is presented in Table 8.

Table 8 Regression model (success in communication of measurement information as a dependent variable)

	<i>Df</i>	<i>Analysis of variance</i>		<i>F</i>
		<i>Sum of squares</i>	<i>Mean square</i>	
Regression	2	139.132	69.566	156.918***
Residual	193	85.562	0.433	
<i>Variables in equation</i>				
<i>Variable</i>	<i>B</i>	<i>Std. Error</i>	<i>Beta</i>	<i>t</i>
Information quality	0.848	0.064	0.709	13.274***
Face-to-face communication	0.164	0.069	0.127	2.383*
(Constant)	-0.430	0.220		-1.953+

Multiple R 0.787.

R^2 0.619.

Adjusted R^2 0.615.

Significance * $0.01 < p \leq 0.05$, + $0.05 < p \leq 0.1$.

Significance ** $0.001 < p \leq 0.01$.

Significance *** $p \leq 0.001$.

The coefficient of determination (R^2) of this model is 0.619. This means that 61.9% of the variance of the dependent variable can be explained by the variations of the predictors. Thus, it can be argued that information quality and face-to-face communication explain

the success in communication of measurement information well. As can be seen in Table 8, the *t*-test results prove that the coefficients in the equation should not be considered as zero. Based on the high R^2 , combined with the *t*-test results, it can be stated that the regression model represents the relationship between the success in communication of measurement information and its predictors, independent variables. The regression model can be written as follows:

$$y = -0.430 + 0.848x_1 + 0.164x_2 + \varepsilon, \quad (2)$$

where y is success in communication of measurement information, x_1 is information quality and x_2 represents face-to-face communication.

The excluded variables are system communication and quantitative information. A closer look at the statistics of the excluded variables shows that system information was actually quite close to being entered into the equation. It did not pass the selection criteria of the stepwise procedure, although its regression coefficient in the equation would have been 0.1 (*t*-test's significance 0.053).

5 Discussion and conclusions

The study shows evidence of the importance of the quality of information and face-to-face methods in the communication of measurement information in SMEs operating in the manufacturing industry. The quality of information has the strongest influence on the success of communication of measurement information. Furthermore, it can be assumed that success in communicating measurement information will have a positive influence on the performance of companies. According to the results of the regression analysis, high information quality leads to success in the communication of measurement information. The quality of information, including exactness, reliability, intelligibility and usefulness could not be considered good, except in company 5. Furthermore, the mean of the question "I think that the internal communication of target information is successful" was 2.91 (scales 1–5), which indicates that the companies have not succeeded in it. So, it can be concluded that the quality of measurement information needs strengthening. SMEs may still operate with poor management systems, which is quite well in line with the findings of Gunasekaran et al. (2000). Both the studies of Evans (2004) and Bourne et al. (2005) highlight a more sophisticated use and analysis of performance measures. Also, our findings support the notion that SMEs in the manufacturing industry have a need for more sophisticated systems to improve the quality of measurement information. The study suggests that SMEs should invest in the quality aspects of measurement information, in its exactness, reliability, intelligibility and usefulness. This will lead to a better understanding of measurement information and will thus provide a more solid base for decision-making.

In addition to information quality, face-to-face communication is the lynchpin of internal communication of measurement information and it has a significant contribution to the regression model. In comparison to system-based communication it can be argued that in small manufacturing companies, where most of the employees do not work with a computer daily, electronic communication (e-mail, intranet) may be a waste of resources. When communicating face-to-face, an employee personifies the information to the person who communicates it. This can be considered as an advantage of face-to-face

communication. Face-to-face communication was also seen to be the best way to communicate measurement information in the future. The findings were parallel with the study of Bourne et al. (2005), when they conclude that the interactive use of performance information together with communication about performance intensity both in formal meetings and 'at every opportunity' will lead to a higher performance of the company.

In the future, the best success in the communication of measurement information will be achieved, when the quality of the information is good and it is communicated face-to-face and maybe supported by some system communication. Although system communication was not included in the regression model, it may have a positive influence on the communication climate, as Hewitt (2006) has presented, concerning e-mail. In SMEs, system communication does not necessary mean e-mail or the intranet, but handouts and noticeboards.

The findings of our study represent the overall view of the personnel of the studied companies. However, as a limitation of the study, the empirical evidence is based on data from eight organisations only. Further, the success in measurement information communication is based on perceptions only. Although the data on success are based on perceptions, they include the perceptions of the managers as well as blue- and white-collar workers and they do at least give some indication that the communication of measurement information has been to some extent unsuccessful. To be generalised, the regression model needs to be tested in practice. Furthermore, the findings of our study can cautiously be generalised to concern SMEs operating in the manufacturing industry. Despite the limitations, we believe that this study provides a contribution to the current literature.

For further research, it would be interesting to compare these results with the results of a similar study carried out in large companies. It can be assumed that system communication is emphasised in large companies, because face-to-face communication may not be possible in every situation. Another interesting issue is how employees in larger companies perceive the quality of measurement information. Generally, it is assumed that larger companies apply more sophisticated analysing techniques to provide more quality to the information. Hence, it can be assumed that larger companies will succeed better in the communication of measurement information.

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