

# THE IMPACT OF ENTERPRISES SYSTEMS ON SALES PERFORMANCE: A STUDY OF ERP SYSTEM IMPLEMENTATIONS IN POLISH SMES

Justyna Patalas-Maliszewska<sup>1</sup>, Irene Krebs<sup>2</sup>

<sup>1</sup> *University of Zielona Góra, Institute of Management and Production Engineering, Poland*

<sup>2</sup> *Brandenburg University of Technology Cottbus-Senftenberg, Chair of Information Systems in Enterprises, Germany*

## Corresponding author:

*Justyna Patalas-Maliszewska*

*University of Zielona Góra*

*Institute of Management and Production Engineering*

*Szafrana 4, 65-516 Zielona Góra, Poland*

*phone: +48 607 847 207*

*e-mail: J.Patalas@iizp.uz.zgora.pl*

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## ABSTRACT

While having been the object of numerous studies, the link between ERP implementation and SMEs performance still requires understanding. This paper documents the effect of investments in Enterprise Resource Planning (ERP) systems on a firm's sales performance and profitability measure such as return on sales (ROS). The models are based on a sample of 240 during time of defined activities in the sales process realized during the each month by 40 knowledge workers in each of 5 Polish SMEs announcements of ERP implementations. Our analysis of the financial benefits of these implementations yields mixed results. Our results are encouraging that we find the business activity that can persistent evidence of sales performance associated with ERP investments. This should help alleviate the companies that some have expressed about the viability of ERP given the highly publicized implementation problems at some firms.

## KEYWORDS

Enterprise Resource Planning (ERP) systems, sales performance, SMEs.

## Introduction

Additional value for SMEs can be defined by an effective implementation of an ERP system. SMEs with integrated IT systems also gain a further advantage in relation to the company because it enables them to have an insight into every aspect of its operation with a precise and correct evaluation of the company's financial situation.

The global market for enterprise resource planning (ERP) has registered significant growth since 2008: \$65 billion in 2008, \$61 billion in 2009, and \$65 billion in 2010 [1–4]. Many ERP vendors have recognized the market needs for the use of these systems in the SME companies.

Led by the Small and Medium-Sized Enterprises in Poland 2010–2011, Polish SMEs definitely play a pivotal role in the national economic growth: ac-

counting for 99,8% of all enterprises (about 1,69 million SMEs), 60,3% of all employees (3,9 million employees), and 47,6% of total production in 2009.

Cotteleer and Bendoly state, that the operational performance and continuous learning leading to continuous improvements in performance are benefits for the organisation undertaking the ERP project [5]. Furthermore, Law, Chen and Wu define, that the degree of ERP information system success directly affects information timeliness, the extent to which business processes are combined, and the efficiency of organizational cooperation [6]. The authors argue, that the benefits of an integrated system can generally be evaluated using time and cost perspectives [7].

So, the authors discuss the issue of the ERP being used to improve the sales performance in Polish SMEs. This article addresses the following research

question: What is the impact of ERP implementation on the sales process in Polish SMEs?

It will be illustrated based on data collected from 240 during time of defined activities in the sales process realized during the each month by 40 knowledge workers in each of 5 Polish SMEs announcements of ERP implementations using Group Method of Data Handling.

The structure of this paper is as follows. The following section introduces the theoretical framework consisting of ERP in SMEs. The subsequent methodology section provides the details of research model. The fourth section presents the findings of the analyses. The final section summarizes the conclusions of the study and provides the implications for future research.

## **Theoretical background**

To enable the efficient flow of information from source to user, and their effective use, you have to create a system capable of collecting, storing and transferring information within the organization. An enterprise resource planning (ERP) system is implemented in an organization to support its cross-functional business process integration and standardization [8].

Ko, Kirsch, & King state, that ERP systems have become critical organizational resources [9]. The primary factors that induce SMEs to implement the ERP system include: the need for access to information resources, the need for access to studies, the need for current, timely information, the need to share relevant information both inside and outside the organization, the need to standardize processes across the enterprise.

SMEs are aware of the need to computerise, there is very little thought given to more than increasing operational efficiency.

According to the report: "Information Society in Poland. Statistical results from the years 2006–2010" published in November 2010) in a group of small companies with ERP software in Poland had in 2010: 6.6% of enterprises (5.4% in 2009), and medium sizes enterprises: 22% (20.1% in 2009).

Knowledge workers create, distribute or apply knowledge within their jobs. The authors discuss the possibility of the reducing the duration time of activities realized by knowledge workers in the sales department through the implementation of an ERP system.

Velcu [10] and Colmenares [11] found that statements of accounts and improved service of accounts

in accounting tasks are benefits derived from ERP implementation. Furthermore O'Leary [12] defined the implementation of ERP systems affects: inventory reduction, financial close cycle reduction, personnel reduction, management improvements, IT cost reduction, on-time delivery, information/visibility, integration, flexibility, better decisions, financial controls, new reports – reporting capability. Federici [13] found that organisational change had a positive influence on operational efficiency and economic results, in other words, ERP system output performance.

Nicolaou [14] tried to measure financial performance after the implementation of an ERP system using a set of eight different financial indicators, such as ROA (return on assets), ROI (return on investment), ROS (return on sales) and OIS (operating income over sales).

The authors can conclude from the relevant literature that enterprise resource planning systems' implementation has an impact on the sale department of the enterprise. More specifically, ERP systems seem to increase flexibility, integrate sales processes and improve gathering and processing of data. Nevertheless, there is a need for empirical research on the impact of ERP in terms of sale advantages.

The authors argue with Hunton et al. [15], that organisations tend to achieve performance gains two to three years after ERP implementation.

So, the aim of this study is to understand the reasons whether ERP system implementation influences sales performance in SMEs by defined business processes realized by knowledge workers.

## **Research model**

The impact of ERP implementation is understood as the reducing the duration of activities defined in the sales process after the implementation of the ERP system. The authors formulated the time duration for each defined activity realized during the each month for each knowledge worker in the sales department in a company announcements of ERP implementations (Table 1).

As presented in Fig. 1, the research model posits from the preceding argument that ERP implementation in Polish SMEs will have a positive influence upon the sales performance in these firms.

So, the authors formulated a research model using the Group Method of Data Handling to present, the impact of enterprises systems on sales performance understood as an indicator: return on sales (ROS) – according to Nicolaou [14]. A research model can be presented, as shown in Fig. 1.

Table 1  
Research matrix.

$n$ -year of ERP implementation in a company, $n \in N$	Activities in the sales process in SMEs, $p \in N$	Duration of the activity		
		Knowledge worker $W_1$	...	Knowledge worker $W_m$ , $m \in N$
$n - 2, n$	$A_1$	$t_{(n-2)A1W1}$	...	$t_{(n-2)A1Wm}$
$n - 1$		$t_{(n-1)A1W1}$	...	$t_{(n-1)A1Wm}$
$n$		$t_{(n)A1W1}$	...	$t_{(n)A1Wm}$
$n + 1$		$t_{(n+1)A1W1}$	...	$t_{(n+1)A1Wm}$
$n + 2$		$t_{(n+2)A1W1}$	...	$t_{(n+2)A1Wm}$
...	...	...	...	...
$n - 2, n$	$A_p$	$t_{(n-2)ApW1}$	...	$t_{(n-2)ApWm}$
$n - 1$		$t_{(n-1)ApW1}$	...	$t_{(n-1)ApWm}$
$n$		$t_{(n)ApW1}$	...	$t_{(n)ApWm}$
$n + 1$		$t_{(n+1)ApW1}$	...	$t_{(n+1)ApWm}$
$n + 2$		$t_{(n+2)ApW1}$	...	$t_{(n+2)ApWm}$

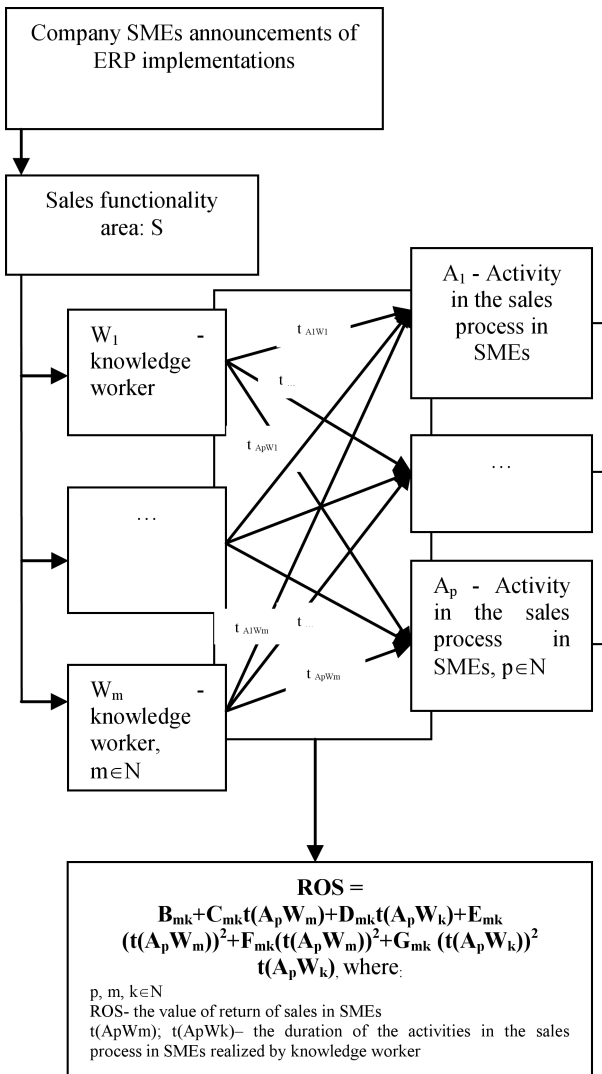


Fig. 1. Research model.

A model for assessing the impact of ERP implementation is built using the Group Method of Data Handling. The multilevel GMDH allows the optimized synthesis of a mathematical model for a given class of regression functions, and it can be used in evaluating criteria and in quality assessment [16, 17].

The following section describes the item measurement and data collection carried out in the research.

### Measures and methods

The indicator matrix is proposed based on the literature and the author's own research. The matrix will help in assessing the impact of ERP implementation in a company. The indicators (values of the duration of the activities in the sales process in SMEs defined for each knowledge worker) include measures to show the value of impact an enterprises system in a company.

A survey was conducted in Poland to test the research model. The data for this study were collected from 40 knowledge workers from sales functionality in 5 SMEs announcements of ERP implementations between April–May 2013 through the use of direct interviews with respondents.

The authors defined the following activities in the sales process in the Polish SMEs:

- A1: Preparing an offer;
- A2: Preparing a order;
- A3: Preparing an invoice;
- A4: Controlling of customer payment;
- A5: Registering a complaint;
- A6: Preparing a warranty.

Table 2  
Indicators matrix.

SME	Activities in the sales process in SMEs, $p \in N$	Duration of the activity (in Minutes)							
		$W_1$	$W_2$	$W_3$	$W_4$	$W_5$	$W_6$	$W_7$	$W_8$
SME1	$A_1$ : Preparing an offer	12	4	9	7	5	8	7	4
SME2		20	25	30	30	20	15	20	25
SME3		9	7	2	9	10	8	7	9
SME4		35	30	30	40	35	45	45	30
SME5		7	10	8	10	7	10	15	7
SME1	$A_2$ : Preparing a order	5	10	5	8	7	7	10	10
SME2		35	30	35	30	20	20	25	35
SME3		10	8	7	5	10	15	10	8
SME4		40	55	60	35	40	45	40	40
SME5		8	10	12	15	10	8	7	7
SME1	$A_3$ : Preparing an invoice	20	25	20	15	15	20	20	25
SME2		45	50	60	40	40	25	20	30
SME3		15	15	20	27	23	22	18	20
SME4		65	60	58	42	40	55	60	45
SME5		12	9	15	20	25	25	30	32
SME1	$A_4$ : Controlling of customer payment	180	120	0	120	0	60	60	90
SME2		80	90	180	120	120	90	90	120
SME3		150	170	0	190	210	240	0	360
SME4		0	150	240	240	360	0	0	480
SME5		480	360	0	0	520	0	320	120
SME1	$A_5$ : Registering a complaint	2	1	5	3	3	5	4	2
SME2		5	7	8	7	9	10	15	5
SME3		7	6	8	5	7	5	5	7
SME4		2	1	0	0	2	3	3	5
SME5		7	4	7	7	5	5	6	4
SME1	$A_6$ : Preparing a warranty	5	8	9	10	5	0	5	5
SME2		40	25	20	15	20	30	30	45
SME3		5	10	5	4	5	8	7	8
SME4		30	35	40	20	15	0	30	25
SME5		5	0	10	25	0	10	8	5

Table 3  
The output variables.

SME/ROS in %	ROS <sub>2008</sub>	ROS <sub>2009</sub>	ROS <sub>2010</sub>	ROS <sub>2011</sub>	ROS <sub>2012</sub>	<b>ROS average</b>
SME1	12	12.8	12	13	14	<b>12.76</b>
SME2	9	10	10	10	10	<b>9.8</b>
SME3	30	31	31	31	31	<b>30.8</b>
SME4	21	21	20.5	21	22	<b>21.1</b>
SME5	15	15	14	15	16	<b>15</b>

Each employee was required to complete a questionnaire. We defined each employee in the sale department as:  $W_1$  – 0–2 years in a company;  $W_2$  – 2,1–3 years in a company;  $W_3$  – 3,1–5 years in a company,  $W_4$  – 5,1–7 years in a company;  $W_5$  – 7,1–10 years in a company;  $W_6$  – 10,1–14 years in a company;  $W_7$  – 14,1–20 years in a company,  $W_8$  – more than 20,1 years in a company. The authors received the data from each company for 2012 – Table 2 (three years of ERP implementation in a company).

The variables in the research model will be 240 input variables defined as the values of the duration time of the activities realized by knowledge worker in the enterprise:  $t(A_p W_m)(8W_m \times 5SME \times A_p)$ :

If  $t(A_p W_m) \in \langle 0; 10 \rangle$ , it is set to 1, if  $t(A_p W_m) \in \langle 11; 20 \rangle$  it is set to 2, if  $t(A_p W_m) \in \langle 21; 30 \rangle$  it is set to 3, if  $t(A_p W_m) \in \langle 31; 360 \rangle$  it is set to 4, if  $t(A_p W_m) \in \langle 361; \infty \rangle$  it is set to 5.

The output variables (Table 3) in the research model will be the vector of average values of ROS

– an indicator, which would direct result in sales performance: (ROS: return on sales: value: net income/sales).

If  $ROS \in \langle 0; 10\% \rangle$ , it is set to 1, if  $ROS \in \langle 11\%; 20\% \rangle$  it is set to 2, if  $ROS \in \langle 21\%; 30\% \rangle$  it is set to 3, if  $ROS \in \langle 31\%; 40\% \rangle$  it is set to 4, if  $ROS \in \langle 41\%; 100\% \rangle$  it is set to 5.

The authors present the possibility of defining a model for assessing the value of ROS using the GMDH method. This enables values of the duration of the activity (in minutes) realized of each knowledge workers and those of the values of ROS to be determined. The method involves the following assumptions [16]: a precise description of the interdependence between output and input data (selected values of the duration time of the activities realized by knowledge worker with the value of the ROS in the company) and minimum modeling error.

In accordance with the date included in Table 2 and Table 3 all the variations of the GMDH algorithms were investigated in the computer software Consulting IT system.

As a result of the algorithm implementation the best possible polynomial was obtained which was characterized by the lowest value criteria for regularity assigned to the pair object. The algorithm evolution process was completed on the second iteration.

In this way, the best polynomial is chosen, which is the one with the smallest error of modeling:

– for  $A_1$ : Preparing an offer

$$\begin{aligned} ROS(t(A_1W_{1;7})) = & -0.02 + 1.50t(A_1W_1) \\ & - 0.43t(A_1W_7) - 0.34(t(A_1W_1))^2 \\ & - 0.11(t(A_1W_7))^2 + 0.43(t(A_1W_4))(t(A_1W_7)). \end{aligned}$$

It should be noted, that for the first activity in the sales department: Preparing an offer in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_1$  and  $W_7$ .

– for  $A_2$ : Preparing a order

$$\begin{aligned} ROS(t(A_2W_{3;8})) = & 28 - 21.93t(A_2W_3) \\ & + 3.4t(A_2W_8) + 1.8(t(A_2W_3))^2 \\ & - 2.73(t(A_2W_8))^2 + 2.27(t(A_2W_3))(t(A_2W_8)). \end{aligned}$$

It should be noted, that for the second activity in the sales department: Preparing a order in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_3$  and  $W_8$ .

– for  $A_3$ : Preparing an invoice

$$\begin{aligned} ROS(t(A_3W_{7;8})) = & 0.05 - 0.61t(A_3W_7) \\ & + 1.54t(A_3W_8) + 0.24(t(A_3W_7))^2 - 0.45(t(A_3W_8))^2 \\ & + 0.19(t(A_3W_7))(t(A_3W_8)). \end{aligned}$$

It should be noted, that for the third activity in the sales department: Preparing an invoice in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_7$  and  $W_8$ .

– for  $A_4$ : Controlling of customer payment

$$\begin{aligned} ROS(t(A_4W_{2;4})) = & 13.67 + 18.34t(A_4W_2) \\ & - 56.85t(A_4W_4) - 3.35(t(A_4W_2))^2 \\ & + 9.16(t(A_4W_4))^2 + 5.77(t(A_4W_2))(t(A_4W_4)). \end{aligned}$$

It should be noted, that for the fourth activity in the sales department: Controlling of customer payment in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_2$  and  $W_4$ .

– for  $A_5$ : Registering a complaint

$$\begin{aligned} ROS(t(A_5W_{2;3})) = & -0.02 + 1.23t(A_5W_2) \\ & - 0.22t(A_5W_3) - 0.21(t(A_5W_2))^2 \\ & - 0.09(t(A_5W_3))^2 + 0.28(t(A_5W_2))(t(A_5W_3)). \end{aligned}$$

It should be noted, that for the fifth activity in the sales department: Registering a complaint in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_2$  and  $W_3$ .

– for  $A_6$ : Preparing a warranty

$$\begin{aligned} ROS(t(A_6W_{4;7})) = & 0.87 + 2.06t(A_6W_4) \\ & - 0.90t(A_6W_7) + 0.27(t(A_6W_4))^2 \\ & + 0.08(t(A_6W_7))^2 - 0.35(t(A_6W_4))(t(A_6W_7)). \end{aligned}$$

It should be noted, that for the sixth activity in the sales department: Preparing a warranty in the process of selling, the impact on ROS has the duration time realized by knowledge workers defined as  $W_4$  and  $W_7$ .

The models allow the determination of the values of the ROS depending on the duration time of the activity realized by knowledge worker in the sale department.

Our results are encouraging in the sense that we find the business activity that can persistent evidence of sales performance associated with ERP investments: Controlling of customer payment (Fig. 2).

This study does not just testify to the influence of enterprises systems on sales performance, but also explores how this mechanism works.

The next section of the paper summarizes the new findings of this study and discusses the implications.



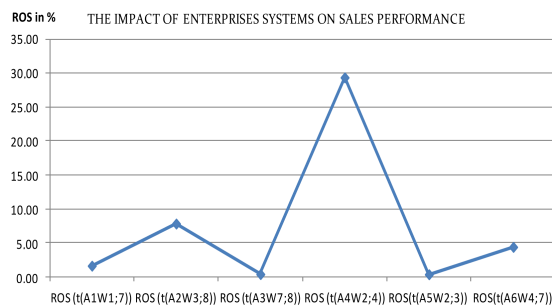


Fig. 2. The impact of ERP on sales performance.

## Conclusions

The summarized finding is that Polish SMEs are increasingly forced to restructure their sales process in a flexible way during operation.

This research analyzes the effects of the impact of ERP on sales performance. By proposing a model which addresses the influence of enterprises systems this study contributes to filling the gap which exists in the literature. The empirical findings of this study confirm the research model. It is therefore clear that among knowledge workers, those with used ERP can create the added value for businesses. It can be stated that some of the activities realized by knowledge workers can enhance the sales performance.

Like all studies, this one has certain limitations that further research should aim to overcome. Firstly, because the intention is to analyze the Polish SMEs, this study focuses on Polish knowledge workers. It would be unwise to generalize the findings too broadly to other countries. Furthermore, the input variables are measured at the same moment in time. So, it would be useful to provide such research over a longer time period and at different stages.

These conclusions and limitations suggest proposals for future research directions, such as exploring additional factors that could improve the effect of the enterprises systems.

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