Impact of the Quality of ERP Implementations on Business Value

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Abstract: This study compares the financial performance trend of successful and less successful ERP implementers over three years following the implementation. The findings indicate no significant difference in the change in ROA and ROI of the two groups of adopters. Successful ERP adopters however have statistically significant higher efficiency benefits in terms of Asset Turnover and Capital Turnover than the less successful ERP adopters in the first two years after implementation. The findings of this paper reveal no significant contribution of the implementation effort to the success of ERP implementations.

Keywords: ERP implementations, IT investments, Business value, Investment quality

1. Introduction

The degree of success of investments in IT as an explanation for the "productivity paradox" has recently attracted the attention of researchers of business value of information technology investments (Stratopoulos and Dehning 2000). This dimension of the success or quality of the investment appears to be worth investigating in the context of investments in Enterprise Resource Planning Systems. An investigation of the quality aspect is important considering the fact that ERP investments are expensive, and the implementation process is intensive and takes a long time.

Previous research has focused primarily on the relationship between the ERP implementations and the firm profitability. To my knowledge, no research has been done related to the relationship between the quality of ERP implementations and firm profitability.

2. Research objective

This paper investigates if the quality of ERP implementations is correlated with how the business performance of the company develops after implementation. In addition, the relationship between the ERP implementation effort and its success is investigated.

3. Literature review

3.1 The productivity paradox

The exploration of the impact of IT investments on organizational performance has progressed ever since the 1980s. Some results show a significant contribution of IT to productivity, and business performance, whereas others fail to show any positive impact whatsoever (Dehning et al., 2002).

At the outset, studies showed negative correlation between IT investments and productivity. These results were summed up by Robert Solow, who stated "we see computers everywhere except in the productivity statistics". This so-called "productivity paradox" seemed to be the conclusion of the 1980's and early 1990's studies in the area. Brynjolfsson (1993) suggests four explanations for these early findings: the mismeasurement of inputs and outputs, time lags, redistribution and dissipation of profits, and mismanagement of information technology. He goes on to recommend a change in the traditional measurements of productivity.

Brynjolfsson et al. (1994) extend the analysis to the organizational changes that are correlated with IT investments. Their results point to the decrease of the average size of the firm as the most important organizational change. Additionally, the findings indicate that this occurs especially after the first three years of the IT investment.

Hitt and Brynjolfsson's (1996) study is one of the first studies that reveal a positive net return to IT investment by finding a gross marginal product of IT on productivity of approximately 95%. They also investigate the IT effect on firm profitability and the statistical results indicate a slightly negative correlation. Brynjolfsson and Hitt (1996) analyse different econometric models previously employed in research. Using a larger and more recent database, they reveal a significant positive impact of information systems on firm productivity.

The nebulous results led researchers to broaden their outlook on the relationship between IT and business performance. Brynjolfsson et al (2000) and Stratopoulos and Dehning (2000) agreed that the key aspect of the relationship IT investment-business value does not consist in how much the organization invests in IT, but in how the company is capable of managing the IT asset and the organizational changes that accompany the IT investment.

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Continuing the research path started in 1994 about the organizational transformations engendered by IT investments, Brynjolfsson et al. (2000) indicated that there is a correlation between IT investments and the changes in the organizational context engendered by these investments that positively contributes to productivity growth and market value.

Researchers also started analysing the impact on business performance of the organizational changes that complement IT investments. Osei-Bryson et al. (2003) explored the relationship between IT investments and organizational productivity using multivariate adaptive regression splines (MARS). The main result was the discovery of a statistically significant positive impact of the IT asset on productivity only when the value of the investment surpasses a certain threshold value. Dehning et al. (2004) investigated whether the "productivity paradox" claimed until 1991 is explained by organizational slack. The findings were that before 1991, IT investment was followed by an increase in the organizational slack, a situation that was not valid after 1991.

By the late 1990's, the research concerning the IT impact on financial performance broadened with a new research path that focused on the business value of Enterprise Resource Planning (ERP) systems. Once adopted within and across organizations, ERP systems achieve the integration of such business functions as accounting, sales and marketing, operations and logistics, and human resources. ERP systems are built on a single database that enables modules to share data, thus speeding up the information flow within organizations.

3.2 ERP project success

How to measure the success of ERP projects has been extensively discussed. Wang and Chen (2004) conclude that the success of an ERP project may be analysed from three perspectives that depend on the different stages in the system lifecycle:

- The operational perspective, which means that the system should have the expected functionality.
- The financial perspective, which means that the analysis focuses on establishing whether the ERP system realizes the key performance indicators.
- The project implementation perspective, according to which the success of an ERP project is achieved if the software is installed on time and on budget.

In their study of critical managerial issues in ERP projects, Kumar et al. (2003) attempt to establish what it is meant by success of an ERP project. According to the project managers interviewed, the most used project success criteria are the completion of the implementation process on time and on budget. From the point of view of ERP software users, the success of an ERP project means the ease of use and the enhancement of the daily tasks.

The three above-mentioned perspectives represent a unit, in the sense that in order for an organization to harvest the expected benefits from an ERP software, it is important to start with a successful implementation of the package, then to continue with having a system that functions at the expected parameters and that is used according to the established objectives, and ending with the financial returns of the ERP investment.

4. Hypothesis development

4.1 ERP implementation success and financial performance

Poston and Grabski (2001) examined the impact of ERP systems implementation on firm financial performance during an analysis window of 3 years before and 3 years after implementation. They found no significant improvements in the financial ratios. However, the firms obtained a significant decrease of the Cost of Goods Sold as a percentage of revenue, in the third year after implementation.

In a subsequent study, Hunton et al. (2003) make a comparative analysis of the financial performance of ERP adopters and non-ERP adopters. Firm performance was measured over a 3 year time frame. The results showed that the financial performance of non-adopters declined in time whereas the financial performance of adopters remained at an appreciatively constant level. The results also pointed to some efficiency benefits measured as Asset Turnover.

On the one hand, the empirical studies show little financial gains associated with ERP implementations. On the other hand, the market and the managers perceive value in ERP announcements, and ERP implementations, respectively. (Mabert et al., 2001, Hayes et al., 2001, Hunton et al., 2002).

Thus, the question about the realization of the business value of ERP implementations still remains unanswered. One anecdotal answer lies in Hitt and Brynjolfsson's (1996) suggestion that the ERP financial gains are passed on to consumers

through lower prices. Or, it may be that ERP financial gains are positively associated with successful ERP implementations. Stratopoulos and Dehning (2000) test whether successful IT projects lead to a superior financial performance compared with ineffective IT projects. Their findings reveal that the successful IT investments entail superior financial performance for 3 or 4 years. However, the superior financial performance is short-lived.

The quality of ERP implementations is a variable that could have explanatory power when looking into how ERP systems affect the financial performance of adopters. The financial impact of successful ERP adoptions is expected to exceed that of less successful ERP adopters, because the asset utilization and the efficiency of the business processes are superior for the former group of companies.

Hypothesis 1: Successful ERP adopters have a higher financial performance than less successful ERP adopters.

4.2 ERP implementation effort and ERP implementation success

Francalani (2001) investigates the impact of the technical size and organizational complexity on implementation effort. The project size is measured as number of modules and sub-modules implemented, while the organizational complexity is measured as the number of users involved and the overall company size. The findings show that both the technical size and the organizational complexity are important factors that determine the implementation effort.

Based on the findings of Mabert et al. (2001), there is clear indication that under/on budget firms make a stronger effort for ERP implementation. In this study, we look at the success of ERP implementations from the operational perspective. Implementation success is measured in terms of functionality of modules, system use, and attainment of the business case. The operational perspective is a long-term way of measuring the success of the ERP system implementation. It tries to measure how the ERP system handles the organizational processes once it is up and running.

Hypothesis 2: The implementation effort affects the success of ERP implementations.

5. Methodology

5.1 Sample selection and validation

5.1.1 Sample selection

The sample was selected from the VOITTO database of Finnish companies and their financial statements using the following criteria:

- Parent companies were selected because of the belief that the implementations of different information systems in groups start with the parent company unit.
- The company should be active.
- The number of employees should be greater or equal to 50, thus excluding very small companies. It is very unlikely that small Finnish organizations would have implemented an ERP system.

The initial sample for the postal survey was 676 companies. 152 responses were received, out of which 114 ERP adopters and 38 non-adopters.

5.1.2 Sample validation

The following performance related aspects were taken into consideration:

- The time frame for comparing the business performance before and after the ERP implementation. It would have been better to have a longer post-implementation period of 4 or 5 years, but the availability of the financial information in the VOITTO database restricted the post implementation period to three years.
- Establishing the implementation period. Out of the 114 ERP adopters were selected the companies that implemented an ERP package between 1997 and 2001. This resulted in a sample size of 49 ERP adopting companies out of which for 6 it was not possible to calculate the performance indicators for the third year after implementation, as they did not publish their annual reports for 2004 yet. Therefore, the sample size was reduced to 43 companies when analysing the financial performance of ERP adopters in the third year after implementation.
- The classification into successful and less successful ERP adopters. The survey contains questions, which attempt to measure the success of ERP implementations from two perspectives: the project perspective and the operational perspective. The success of the implementation project is measured through the time and the budget criteria. The operational success of the ERP software is measured through the system functionality criterion: Once implemented, does the software function at the expected functionality in terms of

modules implemented, and user perception's? Does the ERP software realize the business case?

The tests were conducted based on the classification of the companies into successful and less successful ERP adopters according to the system functionality measure. The companies for which the system functionality measure was smaller than the median were classified as less successful adopters, and the organizations that had a system functionality measure larger or equal to the median were classified as successful adopters. The sample size of the less successful adopters became of 17 companies, and the sample size of the successful adopters was of 32 organizations.

5.2 Measuring financial impact

The financial impact was measured by means of the following financial indicators: ROA, ROI, Profit Margin, Assets Turnover, Capital Turnover, and the ratio Wages/Total Costs. They were calculated based on the consolidated financial statements of the groups to which the respondent companies belong, from 1995 to 2004.

Table 1: Calculation of ratios

Financial impact measure	Calculation
ROA	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by average total assets.
ROI	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by average balance sheet total less period average non-interest bearing liabilities
Profit Margin	Profit before extraordinary items, appropriations and taxes plus financial expenses divided by turnover.
Assets Turnover	Turnover divided by average total assets.
Capital Turnover	Turnover divided by average balance sheet total less average non-interest bearing liabilities.

To test hypothesis 1, a non-parametric test was conducted. The Mann-Whitney U test measures whether there are any significant differences in the mean difference between the performance in the post-implementation period and the performance in the pre-implementation period of the successful ERP adopters and less successful ERP adopters.

Hypothesis 2 was tested with a standard multiple regression, in which the number of modules implemented and the ratio implementation cost to overall company size were regressed on the implementation success as follows:

$$implementationsuccess = a_1 + a_2 \cdot number\,\mathrm{mod}ules + a_3 \cdot \frac{implementation\,\mathrm{cos}t}{Size} + \varepsilon$$

The implementation success variable measures the perception of the respondent of the functionality of their ERP system. The perception of the system functionality is the average of the perceptions of the software functionality, the software usability, and the business case attainment.

6. Reliability and validity analysis

Before testing the hypotheses, it is necessary to assess the reliability and validity of the set of variables that measure the success of an ERP implementation. Some of variables measure how successful the ERP implementation project was in terms of time and budget compliance. Other variables measure how well the ERP software functions after implementation. (Table 2)

Table 2: Variables for measuring success and factor analysis for validity of success measures

Success measure	Variables	Description	Factor loading	Factor component
System functionality	software functionality	On a Likert scale from 1 to 5, the variable measures whether the planned ERP modules were actually implemented and function as expected.	0.839	1
	software usability	On a Likert scale from 1 to 5, the variable measures whether the software users utilize the software as they have been trained to do it.	0.806	1

Success measure	Variables	Description	Factor loading	Factor component
	business case attainment	On a Likert scale from 1 to 5, the variable measures whether the measurement elements established at the outset of the project have been reached, hence predicting whether ERP will be beneficial or not.	0.613	1
Time	initial implementation time	The variable measures what is the forecasted duration for the ERP project.	0.767	3
	lateness	The variables measures how many months the ERP project was late.	0.632	1
Budget	budget compliance	The variables measures whether the ERP implementation project was developed within the budget established at the outset of the project.	0.834	2

The test of reliability attempts to verify how well these three measures quantify the success latent construct. Cronbach's alpha coefficient was computed. The reliability turned out to be low since the alpha value was 0.456. The low Cronbach's alpha coefficient was obtained due to the fact that the data is multidimensional. The factor analysis was conducted in order to check the multidimensionality of data.

The suitability of data for factor analysis was assessed. The results of the correlation matrix revealed the presence of many correlation coefficients of values larger than 0.3. The Barlett's test of Sphericity reached a high statistical significance (p-value=0.000), thus supporting the factorability of the correlation matrix.

The PCA revealed that there are three components that have an eigenvalue larger than 1, explaining 76.7% of variance. The three components are extracted. Furthermore, the Varimax rotation was performed in order to facilitate the interpretation of the factor analysis results. This rotation solution revealed that the variables software functionality, software usability, business case attainment, and lateness have high loadings on Component 1, and the variable budget compliance has high loading on Component 2. The variable initial implementation time has a high loading factor on Component 3. Considering that the variables in Table 2 have high loading values, this implies that the variables for measuring the success are valid. The data is indeed multidimensional due to the fact that the software functionality, the software usability, the business case attainment, and lateness do not measure the same construct as the budget compliance or the initial implementation time.

Thus, the factor analysis results support the use of time and budget as separate measures of success. Additionally, the system functionality variables and the time variable may be used as either combined measures of success or separate. In order to check what is the best way of using the two success measures, a reliability test was performed for the subset of variables software functionality, software usability, business case attainment, and lateness.

In exploratory studies, a Cronbach's alpha value greater than 0.7 is commonly accepted (Pallant 2004). In this paper, the Cronbach's alpha value for the system functionality and time taken as separate measures of success is of 0.747, which is higher than 0.271 alpha value when the system functionality and the time are taken as a common measure of success. This means that the study can further rely on the system functionality variables as one measure of success, and on the time measure as another measure of success.

In conclusion, the implications of the Cronbach's alpha and PCA are that the system functionality, the budget and the time, can be used as separate scales for measuring the success of ERP implementation. The reliability and validity results are congruent with the theoretical arguments and the previous empirical findings regarding the measurement of the success of ERP implementations. (Kumar et al., 2003)

7. Descriptive regarding the sample

7.1 ERP implementation descriptive

52.2% of the companies belong to the manufacturing sector, 19.6% operate in the services sector, 10.9% of the companies operate in the wholesale sector, and the remaining companies are uniformly distributed in the constructions and transports and logistics sectors. The successful ERP adopters are more uniformly spread throughout the manufacturing, services and wholesale services, whereas the less successful ERP adopters are concentrated mainly in the manufacturing sector. (Table 3)

Table 3: Industry distribution of the sample

Industry sector	Successful ERP adopters	Less successful ERP adopters
Manufacturing	41.9%	73.3%
Services	25.8%	6.7%
Wholesale	12.9%	6.7%
Construction	9.7%	0%
Transport and logistics	6.5%	6.7%
Education and healthcare	0%	6.7%
Radio and television activities	3.2%	0%

Regarding the ERP package implemented, 30% of the sample companies implemented SAP R/3, 8% of them implemented Wintime, a product of the local vendor, TietoEnator, another 8% implemented Sonet, the ERP software of WM-data Novo, a software vendor in the Nordic countries.

The distribution of the sample companies by implementation years is displayed in Table 4. More companies started to adopt an ERP software beginning with 1999. The average implementation duration is of 11 months. The average number of modules implemented is 5, which shows that the companies did not go for a full scale ERP implementation.

Table 4: Implementation years

Implementation year	Number of implementers	Successful implementers	Less successful implementers
2001	13	9	4
2000	11	9	2
1999	14	8	6
1998	6	5	1
1997	5	3	2

7.2 Descriptive statistics concerning the size of the sample

According to the information displayed in Table 5, both in the year before the implementation and in the implementation period, the successful ERP adopters were larger than the less successful ERP adopters in terms of sales and total assets. However, the conduct of an independent samples t test did not show any significant difference in the mean of sales or total assets for the two groups of companies (p-values>0.10).

Table 5: Descriptive statistics for size

Accounting measure	Statistic	ERP adopter	-1	0
Sales	Mean	Successful	292489.7	336132.1
		Less successful	127183.5	145520
	p-value		(0.440)	(0.430)
	Median	Successful	35708.6	42375
		Less successful	29906.7	40620.2
Total Assets	Mean	Successful	357538.4	385170.3
		Less successful	87515.3	161213.6
	p-value		(0.366)	(0.485)
	Median	Successful	27494.2	31833.9
		Less successful	19973.7	29351.8
	N	Successful	32	32
		Less successful	17	17

7.3 Descriptive statistics concerning financial performance trend

Table 6 displays the development in business performance after implementation for the successful and less successful ERP adopters. The general trend was of a worse post implementation performance for both categories of ERP adopters. However, the successful ERP adopters obtained a positive change in efficiency benefits in term of Assets Turnover and Capital Turnover in the first two years after implementation.

Table 6: Descriptive statistics regarding the change in financial performance after implementation

Variable	Statistic	ERP adopter	$\Delta_{+1}{}^{1}$	$\Delta_{avg+2}{}^{2}$	$\Delta_{avg+3}{}^{3}$
Δ_{ROA}	Mean	Successful	-0.0390	-0.0535	-0.0850
		Less successful	-0.0684	-0.0824	-0.0511
	Median	Successful	-0.0158	-0.0347	-0.0334
		Less successful	-0.1217	-0.1452	-0.1712
	Std. Dev.	Successful	0.1378	0.1448	0.1481
		Less successful	0.1535	0.1752	0.1223
Δ_{ROI}	Mean	Successful	-0.0732	-0.0745	-0.1361
		Less successful	-0.1042	-0.1179	-0.1024
	Median	Successful	0.4615	0.0945	0.1519
		Less successful	0.4400	0.1252	0.1921

Variable	Statistic	ERP adopter	Δ_{+1} [1]	Δ_{avg+2} [2]	Δ_{avg+3} [3]
	Std. Dev.	Successful	0.2645	0.2020	0.0434
		Less successful	0.2469	0.2883	0.0368
$\Delta_{\mathrm{Pr}ofitM\,\mathrm{arg}in}$	Mean	Successful	-0.0444	-0.0527	-0.0725
		Less successful	-0.0349	-0.0539	-0.0506
	Median	Successful	-0.0255	-0.0202	-0.0206
		Less successful	-0.0088	-0.0290	-0.0278
	Std. Dev.	Successful	0.1328	0.1316	0.1428
		Less successful	0.1313	0.1337	0.1321
$\Delta_{AssetsTurnover}$	Mean	Successful	**0.1073**	**0.1006**	-0.2177
		Less successful	-0.2996	-0.2170	-0.2407
	Median	Successful	0.0640	0.0437	0.0479
		Less successful	-0.2551	-0.1277	-0.0844
	Std. Dev.	Successful	0.6365	0.5854	0.7031
		Less successful	0.4391	0.3949	0.7919
$\Delta_{CapitalTurnover}$	Mean	Successful	**0.2648**	**0.1289**	-0.1817
		Less successful	-0.2472	-0.2087	-0.1256
	Median	Successful	0.1306	0.1376	0.0446
		Less successful	-0.2653	-0.1014	-0.1096
	Std. Dev.	Successful	1.1358	0.5558	0.8676
		Less successful	0.5605	0.9414	0.9548
$\Delta_{Wages/TotalCosts}$	Mean	Successful	-0.0297	-0.0340	-0.0773
		Less successful	-0.0238	-0.0051	-0.0216
	Median	Successful	-0.0389	-0.0435	-0.0483
		Less successful	-0.0277	-0.0172	-0.0110
	Std. Dev.	Successful	0.1661	0.1352	0.1682
		Less successful	0.0757	0.0899	0.1084
	N	Successful	32	32	27
		Less successful	17	17	16

[1]The difference between the performance in the first post-implementation year and the average performance in the three pre-implementation years.
[2]The difference between the average performance in the first two years post-implementation and the average performance in the three pre-implementation years.
[3]The difference between the average performance in the first three years post implementation and the average performance in the three pre implementation years.

8. Results

The results of Mann-Whitney U test[1] for Hypothesis 1 are presented in Table 7. The negative Z values show that the less successful ERP adopters have statistically significant lower efficiency benefits than the successful ERP adopters, in the first two years after implementation. (P-value<0.05, and p-value<0.10). No significant difference was found in the change in ROA, ROI, Profit Margin or Wages/Total Costs between the successful ERP adopters and less successful ERP adopters.

Table 7: Mann-Whitney U Test for differences between less successful and successful ERP adopters regarding the change in financial performance after implementation

Variable	Statistics	Δ_{+1}	Δ_{avg+2}	Δ_{avg+3}
Λ	Z value	-2.878	-2.226	-0.546
	p value	**(0.004)**	**(0.026)**	(0.585)
$\Delta_{CapitalTurnover}$	Z value	-2.753	-1.702	-0.452
	p value	**(0.006)**	**(0.089)**	(0.651)

The regression analysis results for Hypothesis 2 are presented in Table 8. The sample is the 31 implementers that responded to the question regarding the actual implementation cost. The results show that the implementation effort measured as number of modules implemented and ratio implementation cost to size makes no statistically significant contribution to the success of ERP

[1] Additionally, an independent samples t-test and multiple regression analysis were conducted and the results confirmed the non-parametric test results for the first year after implementation.

implementation (p-value>0.10). The coefficients of both independent variables have a negative sign, which implies that the stronger the implementation effort, the more difficult to manage a successful ERP implementation[2].

Table 8: Estimated coefficients of the regression model and the corresponding significance levels

Dependent variable	Independent variables	Model coefficients
Implementation success	Number of modules	-0.232 (0.218)
	$\frac{implementation\ cost}{Size}$	-0.001 (0.994)

9. Findings discussion and limits

The main objective of this study was to investigate if the quality of ERP implementations is correlated with how the business performance of the company develops after implementation. To reach this objective, a comparative analysis of the change in financial performance after implementation between 17 less successful ERP adopters and 32 successful ERP adopters was performed. There were used the following financial impact indicators: ROA, ROI, Profit Margin, Assets Turnover, Capital Turnover and Wages / Total Costs.

It was expected that the successful ERP adopters would have a higher financial performance than the less successful ERP adopters because the less successful adoption would hinder the efficiency of assets utilization and business processes. The findings revealed no significant difference in the financial performance change after implementation between the two groups of ERP adopters in terms of ROA and ROI. However, the further decomposition of ROA and ROI indicated that the successful ERP adopters do have significantly better efficiency benefits than the less successful ERP adopters, in terms of Assets Turnover and Capital Turnover, in the first two years after implementation. The post implementation trend in Profit Margin did not differ significantly between the two groups of companies, although it continued to decline over the three years for both groups.

These findings are similar to those obtained by Stratopoulos and Dehning (2000) in that the successful implementation ERP systems lead to a significantly superior efficiency in utilizing assets and capital. However, the efficiency benefits turn out to be short-lived.

The second interesting finding is related to the second hypothesis regarding the relationship between the ERP implementation effort and its success. In this paper there was found no explanatory power of the ERP implementation effort variables on the success variable. In Mabert et al., (2001) it was found clear evidence of stronger ERP implementation effort for the companies that completed the ERP project on budget. The contradictory results may be explained by the fact that in this paper a different construct to measure success was used, that is the system functionality construct. Still, further analysis of the impact of ERP implementation effort on the success of ERP implementations measured as on/over budget projects, revealed also no significant evidence that the successful ERP firms would make a stronger implementation effort. The potential explanation for the two different findings may reside in the fact that the companies in the present study went for partial ERP implementations. The average number of modules implemented is 5 therefore the project size may not constitute a strong enough driver of implementation effort to have any explanatory power on the success of ERP implementation.

The main limitation of this study consists in the fact that it could not capture additional initiatives or industry events that could have had an impact on the financial performance at the same time with the ERP implementation.

The second limitation of the study is related to the macroeconomic influences that were not controlled for to better isolate the business value of ERP implementation. This should be done in a future study in which a control sample of firms should be used for both the successful and less successful ERP adopters. The control companies should be matched on industry code and size, and they should not be ERP adopters.

The third limitation of the paper consists in the small sample size, which combined with the fact that the sample companies went for partial ERP implementations, may hamper the observance of any significant difference in the financial performance trend in the post implementation period between the successful and less successful ERP adopters. Additionally, considering that the findings of this paper are based on data from mid-sized Finnish companies, they can't necessarily be extended to companies in countries characterized by different business practices.

[2] Additionally, the results of Mann-Whitney U test and independent samples t-test support the multiple regression results in that the number of modules implemented is higher for the less successful ERP adopters than for the successful ERP adopters. However, the difference in the implementation effort between the two groups of companies is not significant.

The present findings lead to further research opportunities. One research opportunity that will be carried on by the researcher comes from one weakness of this study. The Mann-Whitney test shows that there is a correlation between the degrees of ERP implementation success and the efficiency measures but it does not provide the answer to the question "Why does the ERP implementation impact the firm's efficiency?". A second research opportunity consists in analysing the redistribution of profits. As Brynjolfsson (1993) suggested, the explanation for not observing any significant impact of IT investments on profitability may be due to the fact that the profits are not retained within the adopting company but distributed up the supply chain to customers. It is worthwhile to explore this issue within the context of ERP investments.

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