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USER ACTIVITIES IN BUSINESS PROCESSES - A SYSTEM-BASED ANALYSIS OF SPECIALIST USERS

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ABSTRACT

Empirical data based on actual system use is in very short supply. How many transactions do ERP system users execute? In which business processes do most users still play an active role? Answers to these questions are provided in the analysis of 77 user organizations, the subject of this publication. For the first time, these questions can be answered objectively, based on data collected with system-based analyses of live post-implementation SAP systems. The analyses examined activities of over 253,000 users and the data was extracted using RBE Plus, a reverse business engineering tool. Areas of intense usage and user types have been identified objectively, and the findings pinpoint specific sub-processes that reveal potential for improvement.

KEYWORDS

ERP, SAP, users, usage analysis, business processes, RBE

1. ANALYZING SPECIALIST USERS

Across the world, corporations have implemented enterprise resource planning systems such as SAP ERP to stay competitive and to better respond to and stay abreast of swiftly evolving business strategies (Robey et al., 2002). ERP systems are end-to-end information systems that model business processes in a single integrated database (Wei et al., 2005). They offer a broad spectrum of functionality and business processes, but can be configured specifically to a user organization's requirements (Klaus et al. 2000). ERP systems therefore belong to a type of standard software that is adaptable to the latest market demands, organizational restructuring and users' changing tasks (Davenport, 2000; Shanks et al., 2003).

ERP systems are now used in most organizations. The up-to-the-minute data generated in these systems documents months' worth of activities routinely used. This article draws on system data (a pool encompassing activities of 253,000 users) to answer practical and theoretical questions about activities performed by users in ERP systems. It will also address three central issues (see Section 3.3) concerning scope and types of user activities. The information provided offers valuable insight for ERP software suppliers and organizational designers in user organizations. First, Section 2 features an overview of comparable scientific approaches to analyzing user behavior. Next, Section 3.1 introduces the system-based analysis method (SAP usage analysis) and the tool (RBE Plus) used to extract and process the data sets from 77 user organizations. Section 3.2 describes the user organizations' data pool, which has been statistically qualified and grouped into two clusters according to six criteria. To delve deeper into the data pool, Section 3.3 addresses three fundamental issues, each building on the previous one. In Section 4, the metrics for usage activity and task distribution furnish descriptive statistics concerning the users analyzed, and initial results for deriving user types. Section 5 deals with the central issue of user activity focus in specific sub-processes, based on analysis of entry activity. Section 6 summarizes all findings, and offers insight and actionable ideas for the improvement of processes in user organizations. Section 7 concludes by pointing out limitations and offering perspectives for alternative approaches.

2. LITERATURE REVIEW

Recent literature reviews (Schlichter and Kraemmergaard, 2010; Grabski et al., 2011) show that most existing ERP research focuses on package selection, implementation, training and managerial issues of ERP systems, not on ERP's post-implementation issues. With more and more experiences gained from past two decades, organizations and consultant companies are more confident of implementing and running ERP systems successfully. According to Staehr (Staehr et al., 2002), the ultimate impacts of ERP on the organization – once the system has been implemented and has been "shaken down" – are not as thoroughly researched. Therefore, understanding post-implementation of ERP will help organizations succeed longer after the ERP implementation. Recently, post-implementation issues are getting more attention, such as, optimization of ERP (Schlichter and Kraemmergaard, 2010). ERP optimization includes usefulness of ERP, achievement of competitive advantage though ERP, issues of ERP users and financial benefits of ERP (Grabski et al., 2011).

Effects and efficiency of business processes of ERP is one of the major activities in post-implementation stage of ERP implementation (Grabski et al., 2011). Business process reengineering (BPR) analyzes the process of an organization's business in order to identify the best way of doing things. An ERP system alone cannot improve organizational performance unless an organization restructures its business process (Bingi et al., 1999). To achieve the greatest benefits provided by an ERP system, a large amount of reengineering should occur iteratively to take advantage of the best practices offered by the system (Loh and Koh, 2004; Somers and Nelson, 2004; Thome and Hufgard 1996, 2006). Organizations, who adopted ERP systems, might trust ERP vendors and believe that their systems have the best business processes after the initial implementations of ERP.

Recently, researchers are using business process analysis methods, such as process mining, to investigate real business operations in ERP systems (Song and van der Aalst, 2008). The data mining method is used to extract detailed business process activities in terms of improving the understanding of business processes. Emergent process mining offers promising ideas to address the need to reveal actual process execution (Jansen-Vullers et al., 2006), discover underlying informational facts of daily business processes (Song and van der Aalst, 2008), and expose the impact of ERP configuration on various process activities (Dreiling et al., 2005). However, currently, this method is solely used to identify issues of ERP configuration.

User's perspective of ERP systems is another topic that attracts researchers' attentions (Schlichter and Kraemmergaard, 2010). However, most of the current studies focus on system adoption and user satisfactions of the ERP systems (Chang et al., 2008). Limited research reported in the literature are confined to areas such as usefulness of the system from the users' perspective (Amoako-Gyampah, 2007; Jones and Young, 2006), and their conclusions solely rely on users' subjective opinions through survey questionnaires.

Analyzing user behavior with respect to activities in business processes and/or differentiating areas of focus is thought to be helpful, but extremely difficult. Conventional methods for examining user behavior within information systems include distributing questionnaires and, in rare cases, making observations. Even in publications citing usage phases of ERP systems, justification for the creation of entire models is based on surveys of individual users (Gattiker and Goohue, 2005) or even on customer presentations (Seddon and Calvert, 2010).

The problems of a written questionnaire are evident in Jones and Young (Jones and Young, 2006), in which valid responses were received from only 50 of all Fortune 1000 companies. The questionnaire comprised 26 multiple choice questions, including one asking for the number of users and the number of modules deployed in the company. Not only was the low response rate a problem; the questions also lacked sufficient detail. The functional scope could be determined at module level only. Furthermore, the method rendered it virtually impossible to verify if questions were answered truthfully, and whether the questionnaire was indeed completed by the person it claimed to be.

3. METHODOLY

These methods of researching behavior stand in stark contrast to a much more accurate source of information – the trail of activity data users leave behind in enterprise software. There is no more reliable source for an usage analysis and it will be used in the approach outlined in this article. The next section introduces the usage analysis and the data pool of 77 SAP ERP Systems analyzed.

3.1 Usage Analysis

ERP software has penetrated much of the corporate world, and is used more extensively than ever before. Assuming that in the 90's, numerous business processes and data were handled without the help of ERP solutions, the relative degree of coverage in many organizations has greatly increased in the past decade. One reason for this is the ongoing extension of ERP

Suite's scope, and the modeling of an increasing number of user departments and their business processes in the ERP system. This is also apparent in the RBE Plus usage analysis data[1] gathered over the past fourteen years. During this time, the number of users who work with end-to-end solutions from SAP has grown continually in German DAX corporations. Accessing and processing this virtually untapped source poses certain obstacles:

- For analysis, the detailed data must be identified and anonymized to protect corporate data and comply with specific company requirements. Individual users and organizations must be rendered completely anonymous (at least according to European law).
- In order to address the three central issues (see Section 3.3), raw data must also be compiled and structured into logical categories that indicate usage.

For the task of *deriving models from live SAP R/3 systems*, Hufgard and Wenzel-Däfler coined the phrase *Reverse Business Engineering* (RBE) (Hufgard and Wenzel-Däfler 1999). The object of the RBE Plus analysis tool is to leverage organizational and usage data from SAP business software to determine which processes, functions, customization settings, master data and/or transactions are used – by whom, how often and how intensely. This creates an objective fact base that enables assessment of system and process organization as well as of actual usage.

Usage analytics leverage metrics and reference structures to identify the tapped and untapped organizational potential of a customer's SAP system. Furthermore, RBE analyses show which content is included (selected, customized) in the SAP solution scope and where functions must be added. This makes it possible to reconstruct the target concept of organizational structures, business processes and their variants, and compare these with actual usage documented in active master and transaction data. RBE Plus is not used to analyze sales figures, inventory values or any other critical financial data. It examines only system configuration, process metrics and other indicators of usage.

3.2 User Organizations

The data sets shown in Table 1 have been extracted from 77 RBE Plus analyses conducted in 2011/12. Each set consists of about 4,000 separate metrics, primarily from European (mostly German) and American industrial corporations that deploy end-to-end solutions for Financial Accounting and Logistics.

In the interest of confidentiality and because of commitments to the companies examined, all data has been made anonymous two-fold. User data is presented as aggregated key figures only, and all descriptive information has been eliminated, rendering identification of any specific company impossible. Anonymization also makes it impossible to differentiate by industry or country.

In addition, maximum and minimum figures in Table 1 have either been rounded or are depicted as ranges. All other statistics – such as the mean and standard deviations – have been left unchanged.

[1] Since 2000, IBIS Prof. Thome has examined more than 1,000 SAP systems with its long term proven RBE Plus Usage Analysis. For more details go to: http://www.ibis-thome.com/en/sap-usage-analyses-with-rbe-plus.html. While the tool RBE Plus is limited to SAP ERP systems, the developed method RBE is applicable to ERP systems of other vendors essentially.

Table 1. Descriptive statistics for organizations and clusters examined

Complexity factors	Clusters	N	Min	Mean	Max	Standard derivation
Active dialog users	Normal	46	> 100	727	< 2,500	538
	Complex	31	> 500	7,090	< 27,000	7,044
SAP modules	Normal	46	8	15	< 25	4
	Complex	31	15	22	< 30	4
Enhancements	Normal	46	> 100	1,776	< 4,400	1,468
	Complex	31	> 690	3,985	< 19,000	4,314
Interfaces	Normal	46	> 5	298	< 1,500	359
	Complex	31	> 130	1,585	< 4,900	1,315
Organizations	Normal	46	> 30	401	< 3,300	564
	Complex	31	> 250	7,768	< 31,500	9,237
Countries	Normal	46	1	2.5	< 30	4
	Complex	31	1	22	< 110	28

However, differentiation is achievable when other aspects of the data pool are examined. The available metrics allows the 77 companies shown in Table 1 to be classified in complexity clusters[2]. The six indicators of complexity include the number of active users, the SAP modules used, enhancements deployed, interfaces implemented, the number of active organizational units, and the number of countries where financial statements must be submitted. All international corporations in Table 1 have been classified in the Complex Companies group. These reveal a high degree of individualization, a large number of activities per user and hundreds of disparate organizations. They also have a mean of 7,090 (N=31) active users. The larger midsize companies and corporate subgroups all have upwards of 727 (N=46) users. These comprise the Normal Companies group, whose usage focuses primarily on one country or a division.

3.3 Analysis issues

The core issue addressed by this research is how to quantify and classify user activities in SAP ERP to improve methods of software design and organizational development. Section 4 clarifies the ratio of users to tasks (transactions): **Usage activity** (users 1 : n tasks - Diagram 1) and **Task distribution** (tasks 1 : n users - Diagram 2)

Usage activity shows the scope of transactions a user executes. Distribution of knowledge, an essential aspect of user activity, is quantified by how often specific tasks are performed. Identification of user types and the frequency with which these occur within an organization provide insight into company deficits and uncover extreme cases, such as users who perform only one task.

Section 5 focuses on the entry of data and documents as an indicator of usage. Not included are users who only display information in the ERP system and for whom no data entry is documented. This criterion is not merely technical, but business-related as well. For example, it is relevant for system checks by auditors. In the context of this article, specialist

[2] For this, empirical data were examined in a cluster analysis based on the six characteristics. Two clusters were derived from these six criteria, according to the two-step cluster method and under application of the Bayesian information criterion (BIC).

users in ERP systems are defined as those whose entries are documented in master or document data sets.

Focus of activities is determined by business processes (Document entry; percent of active users - Diagram 3). This metric shows which sub-processes most users are involved in, and those in which only a small group of specialists is active (Number of users as % of total per sub-process in Accounting - Table 3 and number of users as % of total per sub-process in Procurement and Sales and Distribution - Table 4).

These findings provide key information for software suppliers and organizational designers. The real number of users active in sub-processes used to be a great unknown to software suppliers wishing to identify target groups for specific application areas. These figures also help estimate the number of SAP experts to staff user departments. Organizations can derive the greatest benefits by comparing their own figures with the data sets depicted here, checking for any unusual distribution of tasks and remedying these, if identified.

4. USER ACTIVITIES AND DISTRIBUTION OF TASKS

In an SAP solution, the closest approximation to a task – in the broadest sense of the word – is a transaction. Transactions represent a pooling of extensive user interactions that create, change or merely display certain business objects, such as sales orders or accounting records. Transactions are used to create a technical link between the user interface (SAP Dynpro) and the program (SAP Report). They can vary in their scope of content which, in turn, is limited by the software manufacturer's design policies.

User activity can be determined by counting the number of different transactions[3] a user executes. This includes ERP transactions executed by dialog users, such as SAP and customer transactions.

Table 2. Descriptive statistics: user activity

	Clusters	N	Mean	Median
Transactions	Normal	51	20.6	14.6
per user	Complex	36	20.3	12.1

The mean for both clusters equals 20 separate transactions that a user must execute and be familiar with. The median divides the top 50 % from the bottom 50 % of user organizations. It enables identification of distribution of usage intensity among specialist users. When the median deviates significantly from the mean, this indicates a heterogeneous population with certain anomalies. In this case, the median for complex companies is eight transactions lower than the mean. The median for normal companies is at least six transactions below the mean.

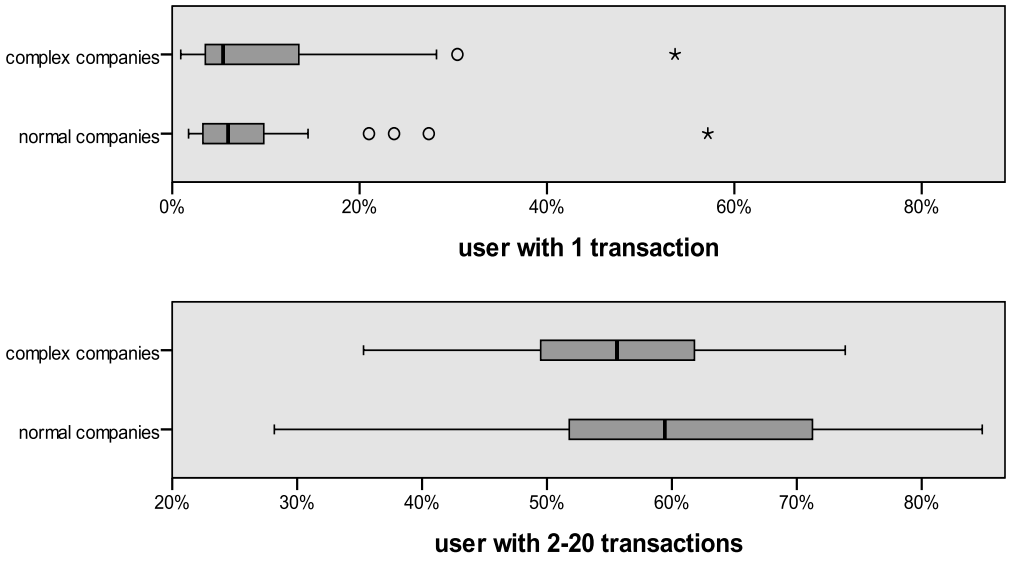
The 'box plots'[4] in Diagram 1 depict user activity in percentages (standard deviation included). The diagram defines four user groups according to the number of separate activities

[3] The number of transaction calls per user, and other attributes can be viewed in depth in individual analyses. Duration and location of users in the system were determined by CPU and database times and other usage parameters. Thresholds and intervals for differentiated evaluation can be used to rule out inadvertent transaction calls.

[4] The boxes show 50% of outcomes and the median. The whiskers make up 25% of the total results. Exceptional figures are shown as outliers (circles at a distance 1.5 times greater than the length of the box) or as extreme figures (asterisks starting at a distance 3 times greater than the length of the box) (SPSS 2012).

performed. Percentages are shown for both clusters. The general mean of 20 transactions used, marks the divide between the second and third groups. The two other groups capture the extremes: users needing to execute only one transaction, and users having to be familiar with more than 50 different transactions.

1. The proportion of users who execute only one transaction is approximately 10 % in both groups. But here the standard deviation is very high and there are a few outliers. It is important to check whether dialog users who have executed only one transaction over a long period are needed. If so, this user type probably has a very specific task assignment. These may be call center employees responding to inquiries or entering feedback.
2. The largest group – with percentages around 60% – are users whose spectrum includes between two and 20 transactions. Either their access is very narrowly defined, or they do not use the transactions to the extent that they could.
3. The third group – approx. 20% – consists of specialist users, who have knowledge of and are familiar with the system along one process chain, or have in-depth knowledge of one user department.
4. The last group – approx. 10% – are super users, who execute more than 50 transactions, and include mainly IT specialists. The primary issue here is whether this type of usage is desirable or efficient.



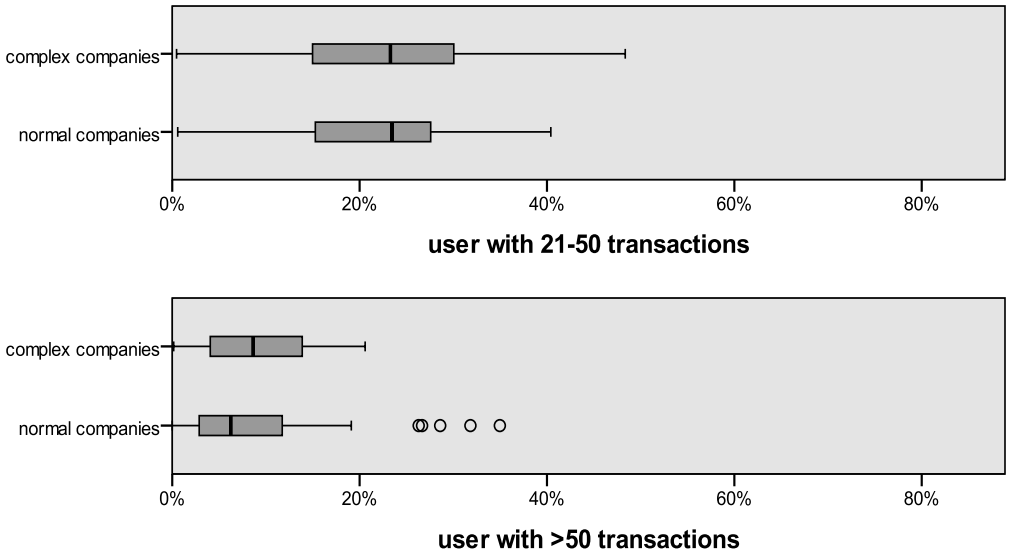


Diagram 1. User activity (box plot)

Assuming these figures are statistically representative, the 70 % of users who execute fewer than 21 transactions require only a simple introduction to the SAP system. The more skilled specialist users, with over 20 transactions, make up no more than 30 % of the population. Since the values are nearly the same for both clusters, these results appear to be independent of system complexity.

Diagram 2 reveals inverted results for distribution of tasks in the organization. It shows how many specialist users execute certain transactions. The mean for both clusters (1,323 transactions used in a normal company with an average 727 employees, as compared to 3,665 transactions used in a complex company with an average of 7,090 employees) shows a vast discrepancy in the transaction spectrum. Also, the standard deviation for complex companies is very high, indicating a high percentage of customer-specific transactions in the ten large user organizations. Based on the means and the box plots of the complex and normal systems, the following statements can be made about the user categories in Diagram 2:

1. 38 % and 32 % of transactions, respectively, are executed by users with a "monopoly on knowledge". Monopolies represent various application areas in the SAP system that are processed by only one user.
2. For half of the transactions there are several (between two and 20) "experts" familiar with the tasks and who can exchange knowledge with one another. This percentage is nearly the same for normal and complex companies.
3. 9 % and 12 % of transactions, respectively, are executed by large groups of 21 to 100 specialist users.
4. Only 2 % and 6 % of transactions, respectively, are executed by a community of more than 100 users.

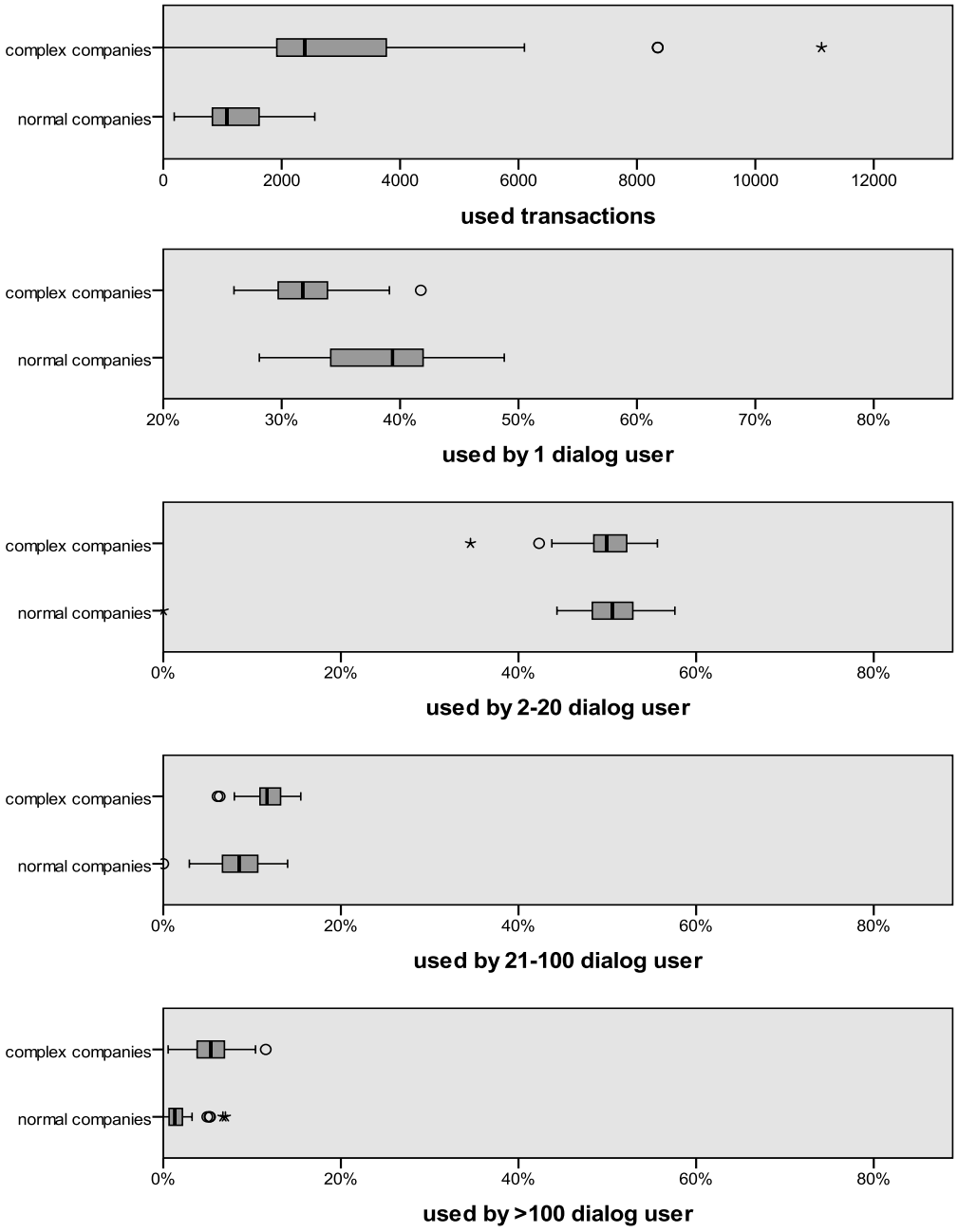


Diagram 2. Task distribution (box plot)

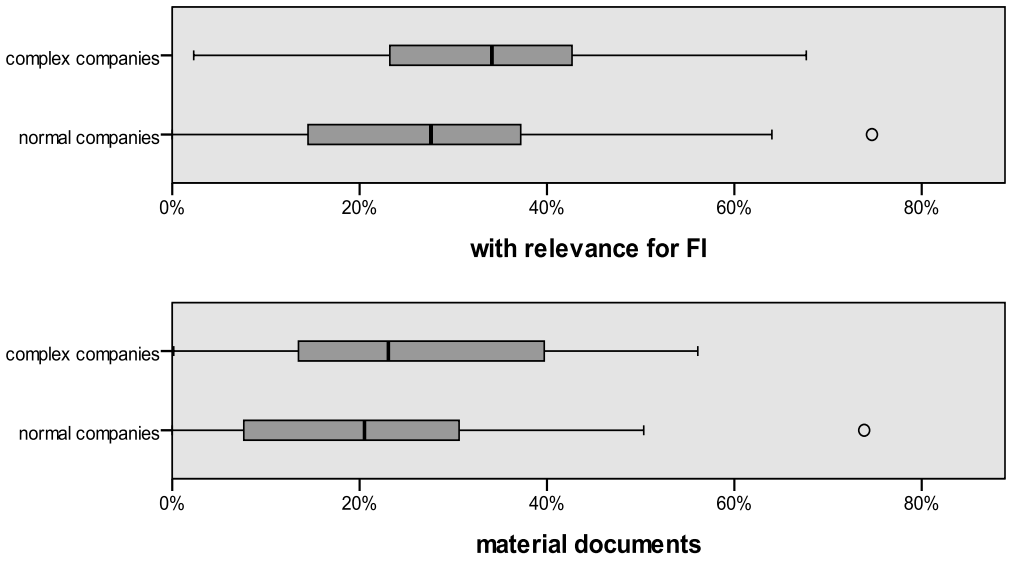
The most striking finding is the high percentage of "knowledge monopolies". These do not include personalized, but rather specialized transactions, such as ones concerning end-of-period closings, etc.

5. AREAS OF FOCUS IN BUSINESS PROCESSES

User activities within business processes are a significant process indicator. There is a vast difference between four and 400 users actively executing transactions in a sub-process. It also makes a difference whether they are editing (entering or changing) data or whether they are only gathering data.

Diagram 3 shows the percentage of specialist users who have entered one of the four most important document types in the ERP system.

- The "FI-relevant" label represents documents that trigger a direct or indirect posting in Financial Accounting.
- Material documents represent transactions that trigger goods movements.
- The percentage of specialist users responsible for Purchasing documents and Sales orders is much lower than that of those responsible for Materials and Accounting documents.



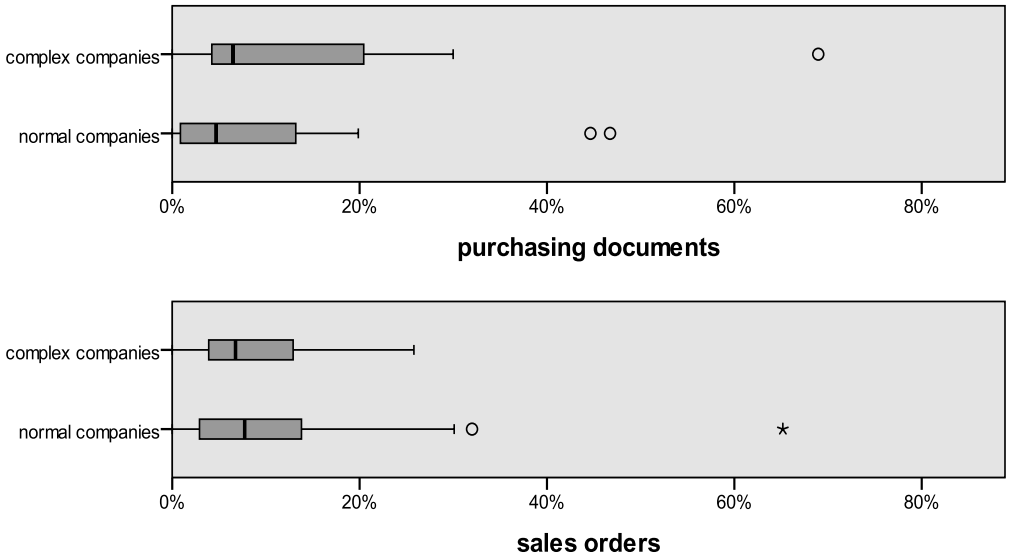


Diagram 3. Document entry – percent of active users

Distribution is very wide, particularly for entry of documents relevant to Accounting and Materials Management, i.e. there are companies in which over 60 % of users enter documents, and there are cases in which almost nobody enters a single document. Overall the findings show that the percentage of specialist users is higher in the complex companies – with the exception of those entering sales orders. The percentages are not disjoint. In other words, users who post Purchasing documents, sales orders or material documents very likely trigger an FI-related transaction further along the process chain. Conversely, the analysis does reveal that on average, between 65 % and 70 % of specialist users execute transactions in the SAP system that do not directly or indirectly generate an FI-relevant posting.

Table 3 depicts user transactions by areas of focus, broken down into transactions with impact on internal and external accounting. Values illustrated include the mean, standard deviation and maximum value (rounded) of the sample.

Table 3. Percentage of users (document entry) in Internal and External Accounting (sorted by mean, descending)

Sub-process	Cluster	N	Mean	Standard deviation	Maximum
Cost object controlling	normal	28	13.3%	10.2%	32%
	complex	26	15.6%	13.3%	45%
Cost element accounting	normal	37	11.9%	9.6%	31%
	complex	28	12.2%	13.2%	64%
Cost center accounting	normal	33	11.2%	9.6%	31%
	complex	27	11.8%	12.9%	62%
Project execution	normal	22	12.4%	16.2%	66%
	complex	22	6.4%	4.8%	20%
G/L accounting	normal	23	8.3%	4.6%	16%
	complex	25	6.8%	4.8%	18%

Product cost planning	normal	19	6.1%	7.6%	28%
	complex	21	5.2%	6.2%	23%
Accounts payable	normal	36	4.5%	3.0%	14%
	complex	28	3.8%	3.6%	15%
Accounts receivable	normal	34	4.5%	3.7%	15%
	complex	30	2.9%	2.1%	8%
Payments	normal	39	2.4%	2.0%	9%
	complex	29	1.6%	1.4%	5%
Internal order accounting	normal	22	1.7%	2.0%	10%
	complex	24	1.2%	1.0%	3,%
Asset accounting	normal	33	0.9%	1.0%	5%
	complex	29	0.8%	0.8%	3%
Profitability analysis	normal	12	0.8%	0.9%	3%
	complex	12	0.4%	0.5%	2%
Budgeting	normal	10	0.4%	0.3%	1%
	complex	16	0.6%	0.5%	2%
Profit center accounting	normal	10	0.5%	0.9%	3%
	complex	10	0.5%	0.5%	2%

"Users" in Table 3 and 4 refer to dialog users who have created a document in the SAP system. Entries made from outside the system via an interface (for instance, because the data comes from a time recording system) either are not included, or are counted as automated.

At 15.6%, the mean for Cost Object Controlling takes first place. Other cost accounting types follow. The relatively high percentage also shows the link to several areas of Logistics. The high standard deviations and the maximum values of the first five sub-processes show evidence that some companies require many users to enter costs locally. Beginning with G/L Accounting, the percentages drop significantly. Sub-processes displaying percentages below 1% are classified in the specialized task category, in sub-processes ranging from Assets Accounting to those listed at the bottom of the table.

The logistical document types shown in Diagram 3 dominate Table 4 for Procurement and Sales and Distribution. These types include material documents, purchase orders and sales orders. Outbound Deliveries and customer invoices occupy second place. The bottom of the table is filled with more strategic tasks (such as outline agreements) and special tasks (such as returns).

Table 4. Percentage of users (document entry) in Procurement and Sales and Distribution (sorted by mean, descending)

Sub-process	Cluster	N	Mean	Standard deviation	Maximum
Material documents	normal	39	13.3%	10.2%	32%
	complex	29	15.6%	13.3%	45%
Purchase orders	normal	35	11.9%	9.6%	31%
	complex	30	12.2%	13.2%	64%
Sales orders	normal	38	11.2%	9.6%	31%
	complex	29	11.8%	12.9%	62%
Outbound deliveries	normal	32	12.4%	16.2%	66%
	complex	29	6.4%	4.8%	20%
Customer invoices	normal	40	8.3%	4.6%	16%
	complex	28	6.8%	4.8%	18%

Presales	normal	22	6.1%	7.6%	28%
	complex	17	5.2%	6.2%	23%
Customer outline agreements	normal	17	4.5%	3.0%	14%
	complex	27	3.8%	3.6%	15%
Invoice verification documents	normal	35	4.5%	3.7%	15%
	complex	30	2.9%	2.1%	8%
Inbound Deliveries	normal	12	2.4%	2.0%	9%
	complex	22	1.6%	1.4%	5%
Vendor inquiries	normal	10	1.7%	2.0%	10%
	complex	3	1.2%	1.0%	3,%
Customer returns	normal	24	0.9%	1.0%	5%
	complex	25	0.8%	0.8%	3%
Vendor outline agreements	normal	7	0.8%	0.9%	3%
	complex	3	0.4%	0.5%	2%

The Logistics process also reveals high standard deviations in the first three sub-processes. All of those hereafter display values above 0.5%, meaning that these sub-processes involve a group of at least four to five employees. Some maximum values indicate exceptional decentralization of task performance (e.g. customer outline agreements entered by 37% of users).

6. PRACTICAL INSIGHTS

The conclusions drawn from these 77 usage analyses reveal a few key concepts that can be put to positive use. In phases of reorganization and in times of economic expansion or recession, IT and user departments are confronted with the issue of how to identify and reduce **operating and systems management costs**. This, in turn, raises the question of whether certain tasks really require individuals to perform them. As established in Section 4, there is a group – 30 % of users – who perform more than 21 tasks. The remaining 70 % perform fewer tasks.

The first approach to intensifying user activity is to pinpoint those who perform few activities. A solution must be found for these users, because they incur costs without using the system in its intended scope and intensity. There are two alternatives:

1. Encourage more intense usage of the SAP system by providing training that enables them to make better use of the system. Or make improvements to the SAP system itself.
2. If it is not a good idea to assign users to the specialist user group, then centralize certain tasks. This enables activities to be limited to specific components, country activities or individual user departments, and saves costs.

When knowledge monopolies are identified in an organization, the process manager should consider distributing this knowledge among a greater number of employees or at least make sure it is adequately documented.

The figures on **areas of focus** in Section 5 immediately pinpoint how many users require advanced training and in which areas. They also show areas in which innovations or organizational changes would have a greater or lesser impact on users. As the maximum values suggest, percentages increase greatly when SAP ERP systems are deployed in production-related user departments and usage focus is illustrated for these less administrative areas. This differentiation, dependent on both organization type and solution scope, must be the subject of a separate study.

7. CONCLUSION, LIMITATIONS AND PERSPECTIVES

The data pool introduced here provides initial insight in response to the subject matter examined. Nearly every one of the aspects illustrated can be enlarged on and linked to further issues. Discussions within the user community should address new issues, and partners in research and industry are encouraged to expand the metrics base. The challenge of usage analytics lies in leveraging the insight gained to promote and secure improvements to the greatest extent possible. The ever growing data pool gathered from live SAP ERP systems and presented in this article will be the source of further publications. But discretion, confidentiality and protection of sensitive data must remain the highest priority.

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