Shadow IT

Management and Control of unofficial IT

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Abstract—**Shadow IT describes the supplement of "official" IT by several, autonomous developed IT systems, processes and organizational units, which are located in the business departments. These systems are generally not known, accepted and supported by the official IT department. From the perspective of IT management and control it is necessary to find out, which interrelations exist with shadow IT and what tasks are resultant. So far only little research exists on this topic. To overcome this deficit the presented project targets on a scientifically based definition of shadow IT, the investigation of best practices in several companies and the development and application of instruments for the identification, the assessment and controlling of shadow IT.**

Keywords- Shadow IT; IT Controlling; IT Governance; IT Service Management.

I.   INTRODUCTION

IT management and control focus on the effective, efficient, transparent and compliant organization of information technology to achieve a best possible support of the business objectives [1]. This includes the minimization of risks and the recognition and realization of opportunities for improvements. The "official" IT infrastructure, developed, managed and controlled by the IT department, is supplemented in most companies by an unofficial IT. Business departments have a multiplicity of other hardware, software and IT employees. Generally these exist without the awareness, acceptance and support of the IT department. The resulting, autonomous developed systems, processes and organizational units are usually characterized as "Shadow IT" [2].

From IT management's perspective, some questions arise: What does the existence of shadow IT mean to its implementation? Does IT management have an influence on the growth or reduction of shadow IT? And what continuative tasks result from this subject?

Shadow IT is not a new phenomenon, but due to some current trends its significance is increasing [2]: New and primarily web-based technologies allow an easy access with low initial costs – so, on the first look, it is easy for a business department to select and get admirable IT services by itself. In addition to this the end users themselves play a particular role for growing shadow IT. Especially young employees have a strong bond to the usage of IT, as they grew up with it and use it in their daily private life. Thus, however, the expectation regarding the IT environment in their job is going to increase [3]. If the IT department is not able to satisfy their needs, the "emancipated" users start to take care of their IT devices and applications by themselves [4][5].

In this paper, we present first results of our research project "Shadow IT" [6]. Apart from the theoretical analysis of some detailed questions on this phenomenon and its definition, it is particularly necessary to develop methods for the identification and evaluation of shadow IT. In addition to that best practices have to be collected and the developed approaches have to be assessed in business. Several companies will be analyzed for data collection and for the verification of the methods mentioned above. All these steps are important to build a stable basis for developing an integrated and practical approach to control shadow IT. So far, we have set up the research concept and worked on the definition and the layout of the methods.

For this paper we will give a brief literature review in Section II. Based on this analysis, research questions are derived. In Section III we will present a detailed description of shadow IT and its occurrences. Section IV introduces the first concepts and developed methods for the identification and evaluation. Section V concludes with a brief outlook and next steps of the study.

II.   STATE OF THE ART

This section examines the state of the art on the topic shadow IT. Therefore, an overview of the most considerable literature is given. Based on this, open research questions will be derived.

A. Literature Review

In spite of its rising significance, shadow IT has so far only attracted little attention in science. Some references can be found using the term shadow IT. But mostly, the topic has a tangential-role or it is only mentioned in connection with the main issue of the considered work. Most references are practical reports or blogs, which are based on the author's experience with no scientific foundation. Table 1 shows the central contributions, which are often referred to or which provide a solid investigation of the topic.

TABLE I.   LITERATURE REVIEW

Reference	Main content
Sherman, 2004 [7]	This article focuses on Business Intelligence shadow IT, e.g., Excel- or Access-based systems, used to add information to reports, which are not supplied from the official IT. The systems start small and grow continually over time, which makes them costly to maintain. The data shadow systems can be recognized through user interviews on how reports are created. Sherman terms several reasons for their development: 1) Missing fulfillment of user's needs; 2) Shadow IT is easy to develop and seems to be "cost-free"; 3) A solution is needed, but the realization of official IT projects takes too long. To control shadow IT he suggests an improved communication between business and IT and the creation of data marts to secure consistent databases.
Bayan, 2004 [8]	Bayan describes reasons and effects of shadow IT and an approach how IT can deal with it. As the main reason he mentions the combination of reduced IT budgets and increasing IT demands. This forces business departments to develop their own IT. Furthermore, shadow IT is more focused on the business needs, it seems to be cheaper from business view and it appears to be faster and more dynamic than official IT. He refers primarily to security risks as the main effect of shadow IT. In his approach Bayan suggests to search for shadow IT with technical scanning tools. Afterwards, security gaps in the identified systems should be detected and closed. Finally, the implementation of new shadow IT should be reduced by achieving a better fulfillment of the business needs.
Jones et al., 2004 [9]; Behrens/ Sedera, 2004 [10]; Behrens, 2009 [11]	These publications refer to a study on a single shadow IT system in an Australian university [8]. The study describes an eight-year life cycle of a shadow software system, which was implemented and supported parallel to an official system. The work shows the possible reasons for its implementation and the opportunities and risks shadow IT can have. Furthermore, the work presents a few lessons learnt [10] on how management and the official IT should react on existing shadow IT. It is stressed that contrary to the common opinion shadow IT also has positive sides: It can be a source of innovation.
Raden, 2005 [12]	In his work Raden concentrates on spreadsheets for Business Intelligence. In his opinion this is the most common kind of shadow IT. These spreadsheets occur due to a lack of satisfaction of business requirements, such as reporting. Spreadsheets are an expressive, universally used, autonomous, fast and portable opportunity to fill these gaps. He highlights different problems through the behavior of developing shadow IT spreadsheets, e.g., wasted time, inconsistent business logic and inefficiencies. He concludes that a company-wide supply and integration of databases connected to all official IT systems can reduce the negative effects.
Schaffner, 2007 [13]	Schaffner describes effects and reasons for the development of shadow IT. As effects he lists several risks, such as poor engineering techniques, inefficiencies and compliance problems. His main argument for the existence of shadow IT is an insufficient alignment between business and IT. Typical efforts to reduce shadow IT, like the prohibition of shadow IT or the locking of administrator rights, don't have any effects. Schaffner suggests a closer cooperation between business and IT to increase the IT understanding of business processes and requirements.

Reference	Main content
Worthen, 2007 [14]	Worthen focuses on web tools and private devices as shadow IT. He highlights security and compliance violations as central risks. He is not considering the prohibition of shadow IT, because this could cause conflicts between business and IT departments. Also, the potential of user-driven innovations, which represents an opportunity of shadow IT, would be ignored. Instead he underlines, that the IT management has to find a strategy to deal with this subject. Worthen makes some general recommendations on how IT could handle shadow IT.
Shumarova/ Swatman 2008 [15]	In their study the authors focus on shadow collaboration systems, e.g., social software, wikis, etc. They explain the rising usage of these systems due to an easy and cost-free access and the growing merger of private and work life. They deduce and discuss three basic strategies on how to handle these shadow collaboration systems: 1) Rejection and banning; 2) Limitation and regulation; 3) Acceptance.
Dols, 2009 [16]	The topic of this master thesis is the search for causes of compliance defects in companies. In an empirical study, which analysis Dutch and Belgian subsidiaries of PwC, shadow IT is identified as one of two reasons for such defects. The work shows the state of the discussion on the topic shadow IT. Additional effects, causes or recommendations on shadow IT are not compiled.

B. Open Research Questions

The analysis of the articles listed in Table 1 and further existing references indicate a number of relevant open issues. These open research questions are listed in this paragraph.

1) Definition and theoretical framework: The term shadow IT is mostly described in an experience-related way. An academic, cohere and consistent definition of shadow IT and its classification according to a theoretical framework is missing.

2) Methods to deal with shadow IT: There are no specific methods or tools on how to deal with shadow IT. The existing frameworks and best practice approaches, such as ITIL [17] or COBIT [18], do not offer solutions regarding shadow IT. To develop a consistent methodology for this subject, the first steps are to identify shadow IT in practice and to evaluate the collected data. The developed methods need to be empirically tested. Best practices in the examined companies could be collected, to find out how successful companies deal with this topic. The answers to the first two research questions should establish a detailed basis for the following research work.

3) Business view: Most articles focus on shadow IT from IT view. The possibilities and consequences of the topic for the business are only analyzed occasionally.

4) Positive effects: The existing work primarily associates shadow IT only with negative effects. There is barely a focus on the opportunities of shadow IT. Nevertheless, to identify the potentials of user-driven shadow IT, it is necessary to identify positive outcomes of

shadow IT like improved process orientation and faster adoption of technical innovations.

5) Integrated approach: Mainly, the current contributions only focus on partial aspects of shadow IT. To handle the increasing phenomenon in practice and to give organizations an orientation on the controlling of shadow IT a balanced set of instruments and methods is necessary. Therefore, it is useful to collect best practices and develop an integrated, scientific approach including its relation to the different elements and tasks of IT management; IT governance and IT service management.

III. DEFINITION AND OCCURRENCES OF SHADOW IT

In Section I, we defined Shadow IT as a collection of systems developed by business departments without support of the official IT department.

This definition of shadow IT includes a variety of different occurrences [2]. One aspect is the usage of "Social Media Software" for business communication and data exchange or other services offered by providers from the internet, e.g., Cloud Computing or Software as a Service [14][19]. Furthermore, shadow IT includes the development and operation of self-built applications. In many cases these applications are Excel or Access based [7] and implemented by employees in the business departments. Moreover, the subject includes purchasing, in-house development and support of business intelligence solutions [12]. In the field of hardware, shadow IT relates to the integration of self-procured notebooks, servers, network routers, printers or other peripherals [13]. These devices are procured directly from a retailer, instead of being ordered via the official IT catalogue. A special case is the own purchasing of mobile devices, such as smartphones or tablets, and the usage of the related applications in the company network [20]. Finally, another occurrence is the development of own IT-support structures inside the business departments [12][13]: In case of IT incidents or problems technology-friendly colleagues are asked for help.

For the definition of shadow IT it is necessary to differentiate the term from end user computing (EUC). In this concept, the development of applications is delegated to the end users [21]. In contrast to shadow IT, EUC is officially initiated and supported. Primarily EUC is applied for the development of very easy IT solutions based on official platforms or for basic, individual configurations concerning specific applications.

The phenomenal description is one way to develop a definition for shadow IT. Another way is to consider existing work on informal organization [22] structures: Unofficial and hidden shadow IT processes are created in parallel with official structures. Similar to informal organization structures shadow IT differs from official policies and establishes own structures and processes. In addition, the emergence of both phenomena is linked with a distinct orientation towards employees' needs and results often from a lack within the formal structures, e.g., the autonomous acting of business departments pictures an irregularity concerning the decision of centralization within the defined IT governance.

Moreover, the emergence of shadow IT can be explained with information asymmetries and conflicts of interest between IT and business departments [23]. Information asymmetries associated with this relation exist as incorrectly understood business requirements by the IT and as a lack of knowledge by the business departments in general IT subjects and offered IT services. This asymmetry can lead to overpromised offers regarding service levels and software functionality and overcharged prices for IT services. The business departments experience these effects and therefore they try to reduce these risks. As a result, they deploy their own (shadow IT) solutions.

IV. IDENTIFICATION AND EVALUATION OF SHADOW IT

This section presents the current level of the research project in identifying and evaluating shadow IT. This refers to research question 2 and includes the collection of best practice data in the analyzed representative companies.

A. Identification Methods

Generally, there are three possible strategies for the collection of shadow IT information: 1) technical analyses [8]; 2) interpretation of help desk requests and 3) direct surveys of employees in the business departments [7].

The first approach is to identify shadow IT hardware or software with technical tools. Existing license management software and a network analysis tool for shadow hardware, which has been already developed in cooperation with this project team, can be used. The second method is based on information retrieved form the company's service desk. Incidents and problems identified there can be investigated on shadow IT as project experience proves that a remarkable number of calls is related to unofficial IT.

The third approach is a process oriented survey. It is based on structured interviews and process monitoring, to find out, which IT tools employees use in their daily business. Based on the experience gained in these interviews, we will try to develop standardized questionnaires to collect more information on user behavior and the usage of shadow IT.

The types of results from this identification phase are, e.g., graphical process descriptions with actual used IT tools and process-oriented IT landscapes with identified shadow
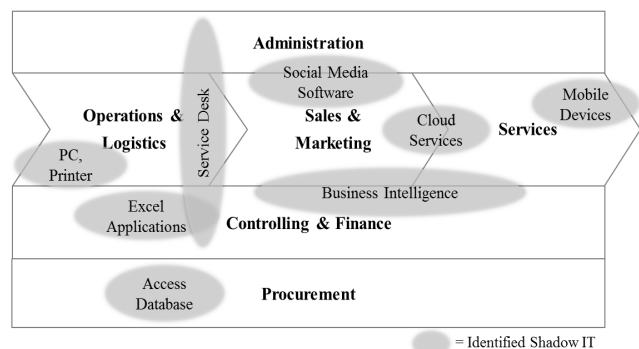

Figure 1. Process-oriented Shadow IT Landscape - Example

IT. Fig. 1 illustrates exemplarily the presentation of shadow IT in a process-oriented landscape on an abstract and high level. The identified shadow IT is assigned to one or several value chain activities [24], such as Operation or Administration. Also, the kind of shadow IT is shown. This type of representation can be refined on a level of departments and business processes to achieve a more detailed view. Thus, the process-oriented IT landscape allows picturing the shadow IT impact on business.

The different methods for shadow IT identification have certain advantages and disadvantages. The technical and help desk analysis enables a direct and quick search for shadow IT within the company's IT architecture. However, it is difficult to find all existing shadow IT occurrences with these techniques and it is not possible to define shadow IT related processes. In contrast to this, the structured interviews are based on the business processes and reveal the process-relation of identified shadow IT. However, this method depends on the knowledge and willingness of the interviewed users, e.g., the users might try to hide shadow IT applications from the interviewer. Furthermore, a lot of work and time is necessary to apply this method. Due to the described facts a combination of the methods is practical: The technical and the help desk analysis should be the foundation for the process survey. Thereby the expenses and disadvantages can be reduced and process-related results can be provided.

B. Evaluation Methods

After the identification of shadow IT, each specific system has to be evaluated. This validation is important to assess first needs of action due to risks. The evaluation results build the basic input for the development of guidelines and strategies. The following section briefly presents an evaluation model developed in the study.

For the evaluation, it is necessary to collect comprehensive information on the company and the IT, its policies and strategies. The general aim is to define aggregated characteristics to evaluate located shadow IT. Based on shadow IT examples in literature and discussions with companies and due to existing interactions of shadow IT with risk management, IT governance and IT service management topics, several parameters can be derived as mayor evaluation criteria.

The mayor criterion relevance describes the significance and importance of a located shadow IT instance for the investigated organization. Therefore, the analysis of the strategic relevance and the shadow IT criticality concerning the business processes, the IT security, the compliance and the IT service management is necessary. The mayor criterion quality refers to the system, the service and the information quality of the located shadow IT. Furthermore, the effects of shadow IT on the quality of business processing is of interest. The size of shadow IT is evaluated with regard to its use of resources and professionalism, its distribution in the company and its penetration with components and IT service processes.

TABLE II.   SHADOW IT EVALUTAION CRITERIA

Shadow IT evaluation criteria		
Mayor criteria	*Sub-criteria level I*	*Sub-criteria level II*
Relevance	Strategic relevance	
	Criticality	Business process
		IT security
		Compliance
		IT service management
Quality	System quality	Hard-/Software
		Engineering process
	Service quality	
	Information quality	
	Quality of business processing	
Size	Use of resources and professionalism	
	Number of users	
	Shadow IT components	
	Shadow IT service processes	
Innovative potential		
Parallelism		

Apart from these criteria, it is essential to evaluate the innovative potential of the shadow IT instance. Finally, it is of interest to judge, if shadow IT is operated parallel to an existing, official IT-System or if it is complementary. Table II summarizes the different major and sub-criteria of this shadow IT evaluation model.

All sub-criteria on the different levels need to be weighted individually for the regarded company and rated for each located shadow IT instance. For the specific criteria evaluation different procedures and models, such as maturity models, can be applied. The total ratings of the major criteria are based on the weighted ratings of their sub-criteria. With these results each shadow IT instance is transferred into a
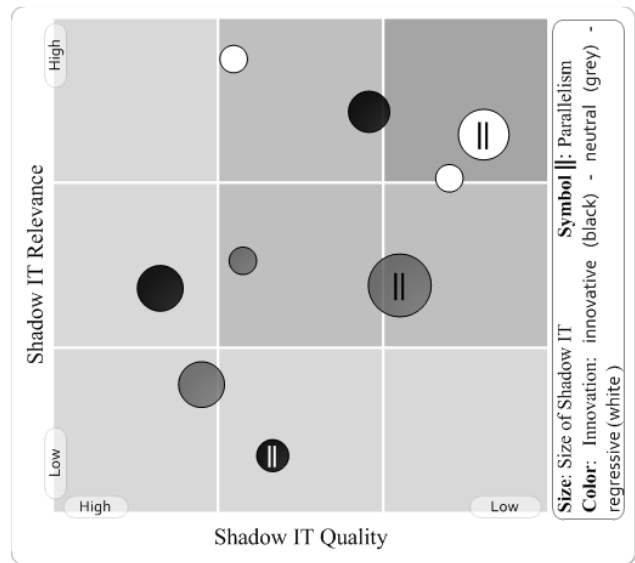

Figure 2.   Shadow IT Evaluation Portfolio - Example

portfolio as exemplarily shown in Fig. 2. The portfolio consists of the two axes relevance and quality, the size for an instance and the color for the innovative potential. A parallel existing instance is marked with two parallel lines. The portfolio indicates which shadow IT instances have to be addressed with a high priority and establishes a basis for further management approaches to control shadow IT.

Furthermore, the development of shadow IT-related key performance indicators is an intended aim of the project. Based on this, it is possible to realize relevant benchmarks.

V. CONCLUSION AND FUTURE WORK

This paper introduced our research on shadow IT. The importance for IT management is shown and existing references are analyzed. As a result of this analysis, several open research questions could be pointed out. We have shown the initial steps and ideas of the research project with the focus on the definition, the identification and evaluation of shadow IT.

For the next steps, the theoretical questions on the definition of shadow IT and its relation to IT management disciplines have to be compiled. Besides, a detailed development of the discussed methods and their empirical appliance in practice will be carried out. Best practices for the handling of shadow IT will be investigated in the companies involved. Based on the results of data collection, the research project aims at the development of an integrated and practical approach to control shadow IT. This enables the revelation of its innovative potentials and the further development to a "User-driven IT".

ACKNOWLEDGMENT

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