BUSINESS INTELLIGENCE & ANALYTICS COST ACCOUNTING: AN ACTION DESIGN RESEARCH APPROACH

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COST ACCOUNTING:
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Research paper

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Abstract
In order to sustain their competitive advantage, data driven organizations must continue investing in business intelligence and analytics (BI&A) while mitigating inherent cost increases. Research shows that examining outlays by individual BI&A artifact (e.g. reports, analytics) is necessary, but introduction in practice is cumbersome and adoption is slow. BI&A service-oriented cost allocation (BIASOCA) represents an improvement to this situation. This approach enables to render the BI&A cost pool accountable and improves cost transparency, which leads to a higher BI&A penetration of economically viable applications in organizations. Against this background, this paper aims at designing and implementing BIASOCA in a medium-sized company. To record organizational impact and increase customer acceptance, this study is carried out as action design research (ADR). Our findings indicate improvements in BI&A management from working with consumers to locate cost savings and drivers. After invoicing, consumers’ BI&A awareness increased, releasing resources while also making a better understanding of BIASOCA necessary. We detail how to implement BIASOCA in a real-life setting and the challenges attendant in so doing. Our research contributes to theory and practice with a set of design principles highlighting, besides the accuracy of cost accounting, the importance of collaboration, model comprehensibility and strategic alignment.

Keywords: Cost Accounting, Cost Allocation, Cost Transparency, Design Principles.

1 Introduction
In the information age, it is becoming increasingly important for businesses to recognize and harness the full potential of data-driven decision support that business intelligence and analytics (BI&A) promises (Moss and Atre, 2003). Chen et al. (2012) define BI&A as “the techniques, technologies, systems, practices, methodologies, and applications that analyze critical business data to help an enterprise better understand its business and market and make the timely decisions it needs”. The principal purpose of BI&A is to use past experience to support decision making. Many organizations have an internal department for BI&A, in most cases structured as a BI competency center (BICC) (Miller et al., 2006), which provides this information using a company-specific BI&A architecture and organization (Horakh et al., 2008). With the benefits of BI&A now undisputed, the discipline has reached most organizations (Baars et al., 2014), as is also shown in a study by Müller et al. (2018) which identifies the positive effects of BI&A on organizational performance, especially in highly competitive and information technology-intensive industries. Currently, investments in BI&A are increasing (Howson et al., 2018) and it is likely to remain a strong focus for CIOs worldwide over the coming years (Arnott et al., 2017). According to Gartner (Howson et al., 2018), the market for analytics and BI grew by an estimated 10%, with further growth of 8% through 2021 predicted. Furthermore, in order to remain...
competitive in future, BI&A organizations will have to deal with new informational demands created by machine data resulting from new intelligently-networked production processes (Rüßmann et al., 2015; Lasi et al., 2014).

Yet while current discussions in the field of BI&A are dominated by potential benefits of big data and AI (Kaisler et al., 2013; Baars et al., 2014), the costs of establishing and maintaining BI&A systems are often overlooked (Dinter, 2012). Due to its complex architectures (Horakh et al., 2008; Scholz et al., 2010) and the high speed of innovation in technology and methods (Chen et al., 2012) as well as the exponential growth of data (Adler, 2020, p. 96), the costs of BI&A have increased markedly in recent years (Howson et al., 2018). Furthermore, allocating those costs to the level of individual BI&A applications remains challenging (Moss and Atre, 2003; Gansor and Totok, 2015). This difficulty arises because BI&A applications are complex due to both their development process and interdependencies; another issue is the individual nature of a company’s BI&A product portfolio, with customer requirements in continuous flux. As such, if management is to take sound business decisions, the costs associated with this kind of system need to be rendered visible (Grahovac and Devedzic, 2010); this is particularly necessary in times of increased global competition (Lönnqvist and Pirttimäki, 2006).

The lack of cost transparency can be seen as a significant driver for rising BI&A costs. As customers who use BI&A services are not invoiced for the costs occasioned in the BI&A environment, they have little grasp of their impact in availing themselves of BI&A tools; and if they are not paying for BI&A services – or at least aware of the costs for which they are responsible – then there is little or no reason for them to attempt to find savings for the company when procuring them. Moreover, from a customer perspective, there is no incentive to limit their requests to BI&A services with proven profitability. Viewed from the other side, from a BI&A department’s perspective, there is no customer feedback on the basis of which to discontinue unnecessary BI&A applications. Since BI&A outlay cannot be reliably portrayed, there can be no assessment of either a company’s entire BI&A investments or of individual BI&A applications’ cost-effectiveness. From an organizational point of view, this renders it difficult to locate cost savings and cost drivers; furthermore, it is not possible to improve efficiency and productivity, to plan the use of resources, and to justify it to management.

To remedy this lack of transparency, a BI&A cost accounting system is needed which can be used as a managerial instrument delivering information about value streams and to plan, audit, and monitor all tasks in the BI&A organization (Hamel et al., 2010) in a fast, efficient, and data-driven way. Especially in the field of BI&A governance, there is demand for research for strategy-driven steering and controlling of BI&A (Schieder and Gluchowski, 2011; Dinter, 2012; Raber et al., 2013; Baars et al., 2014). Additionally, academics are calling on their peers to examine this topic (Kaisler et al., 2017; Espinosa et al., 2019).

Thus far, however, a systematic literature review (Grytz and Krohn-Grimberge, 2018b) shows that little of the research conducted in the field of BI&A cost accounting has addressed the implementation of a BI&A cost accounting system in practice. In particular, no research has been conducted on the organizational impact and experiences of implementing and, later, working with a BI&A cost accounting within an enterprise. Therefore, we pose the following research questions:

- **RQ1**: How can cost transparency related to BI&A be created or increased; and, specifically, how can BI&A costs be charged to internal consumers?
- **RQ2**: What are the improvements and challenges, as well as experiences, of BI&A cost accounting systems in practice once installed?

To answer these questions, we investigate the case of a medium-sized company from the German electrical and electronics industry with a pronounced BI&A landscape. The expected organizational impact on our implementation is considered by carrying out our study as action design research (ADR) (Sein et al., 2011). To build up a BI&A cost accounting system, we use the recent proposal of (Grytz and Krohn-Grimberge, 2017a) which provides guidelines on creating a BI&A service-oriented cost allocation (BIASOCA). This framework is particularly suitable for our purposes, because it relates to BI&A and provides a step by step approach, where at the same time the importance of creating cost transparency up to the definition of single BI&A services is acknowledged and comprehensibility to
the consumer’s perspective is considered. Afterwards, we evaluate the implementation using expert interviews.

The contribution of this study is threefold. First, this paper presents the results of an ADR project that was aimed at designing and implementing the available model for BIASOCA in a medium-sized company. Second, by evaluating the results, we gain valuable feedback about positive and negative effects and improvements to the model. Third, we formulate a set of nascent design principles, that can assist BI&A professionals and other researchers to implement a BI&A cost accounting system in comparable settings.

The rest of this paper is organized as follows. Section 2 discusses the conceptual foundation: first, we emphasize the relevance of BI&A cost accounting and give a brief overview of a state of the art regarding BI&A cost accounting; we then present our research method. In Section 3, the first ADR stage describes the problem and defines the requirements for our implementation. Section 4 introduces the second ADR stage with its design and implementation iterations of the BIASOCA used within the case company. This section ends with an evaluation of our implementation by expert interviews. In Section 5, within the third and fourth ADR stage, besides presenting four proposed design principles, we provide a discussion of our findings. The paper concludes with a short summary and outlook onto further research.

2 Conceptual Foundation

In this section, we give a brief overview about the current state of research on BI&A cost accounting and we present our research method – action design research.

2.1 A brief overview of the current research on BI&A cost accounting

At present, the increasing demands of BI&A continue to challenge existing BI&A landscapes in corporate environments. To stay competitive, BI&A departments have to continuously adapt to new requirements regarding architecture, organization, and technology (Kaisler et al., 2013); yet doing so often results in an increase in costs (Scholz et al., 2010), and the situation for BI&A is all the more challenging because it consists of predominantly fixed and indirect costs (Negash, 2004). To demonstrate efficiency, productivity and cost optimization to management, BI&A departments increasingly find themselves required to render monolithic BI&A cost blocks more transparent (Grahovac and Devedzic, 2010; Schieder and Gluchowski, 2011). Cost allocation systems to mitigate this problem are identified in the literature (Schieder and Gluchowski, 2011; Dinter, 2012; Raber et al., 2013; Baars et al., 2014; Gansor and Totok, 2015; Kaisler et al., 2017; Grytz and Krohn-Grimberghe, 2017a). Although cost allocation systems are well established from the management science perspective with a body of theoretical work in academic literature (Cooper and Kaplan, op. 1999; Horváth et al., 2015), current development of IS research, particularly for BI&A, has not been adequately considered with regard to this discipline (Eppele et al., 2015). Viewed from an IT perspective, (Berghout and Remenyi, 2005; van Maanen and Berghout, 2002) point out that IT costs allocation is necessary to improve cost transparency and that this is a challenging task entailing as yet unresolved problems, and this holds especially true for BI&A (Grytz and Krohn-Grimberghe, 2017a).

However, there is little detail available regarding what a suitable approach in BI&A might resemble. With the goal of providing a comprehensive overview about BI&A cost accounting, an extensive state of the art was previously created (Grytz and Krohn-Grimberghe, 2018b). This research was executed by first, defining the scope (Vom Brocke et al., 2009), which lies on research outcomes as well as the applicability of the literature found on BI&A cost accounting in leading journals. Secondly, the results are presented in a structured way based on the review process described by (Webster and Watson, 2002). Beside existing IS/IT contributions, two research streams are identified.

A contribution by (Grytz and Krohn-Grimberghe, 2018a) which is currently available describes an empirical study of BI&A cost accounting and highlights the urgent need and relevance for BI&A cost accounting approaches and technical assistance. Furthermore, this study strongly recommends that
BI&A managers should explicitly involve BI&A users and developers in the design, implementation, and refinement of BI&A cost accounting initiatives. The same authors (Grytz and Krohn-Grimberge, 2017a, 2017b) created a BI&A service-oriented cost allocation (BIASOCA) which quantifies and subsequently breaks down the cost pool generated by BI&A in an comprehensible and yet efficient way. It proposes four principle elements: service orientation, accounting net, cost model, and service catalog.

Another research stream is about contextual factors (Epple, 2016) and design principles (Epple et al., 2015) regarding the allocation of BI&A costs on a management level. In (Epple, 2016), contextual factors are defined as a result from a focus group in four dimensions: objectives, technology, organization, environment. Depending on company characteristics, this contribution recommends general principles when planning to design a cost accounting for BI&A. In (Epple et al., 2015), design principles are introduced, also based on the findings of a focus group; these principles correlate with the requirements derived from cost accounting literature used as a base in (Grytz and Krohn-Grimberge, 2017a). While these two contributions (Epple, 2016; Epple et al., 2015) offer a first insight into accounting methods for BI&A costs, they are both limited to generalized results and recommended action and do not describe in detail how the design situation identified should be implemented.

Some of the other papers found underscore the importance of our research topic; others apply cost accounting methods to other domains (Grytz and Krohn-Grimberge, 2018b). Other papers justify the need for BI&A cost allocation as a condition to show profitability (Dinter, 2012) or to exercise auditing functions (Baars et al., 2014) for BI&A competence centers in a service-oriented way (Baars et al., 2009). Beside this, cost management is identified as an important success factor of a BI&A organization (Schieder and Gluchowski, 2011) and could be described as strategical instrument (Raber et al., 2013).

During our research we have learned, that implementing a cost allocation for BI&A is heavily company-specific and depends on a range of factors such as strategical alignment, maturity of technology/organization, and consumer acceptance. Therefore, a BI&A cost allocation has to be designed and implemented for the specific situation.

2.2 Research method

The aim of this paper is to improve the overall situation of BI&A in a medium-sized company by introducing a tool for steering and controlling BI&A and later investigating the effects on the organization. To increase the acceptance of the implementation, its organizational impact is considered by carrying out our study as action design research (ADR). ADR is particularly appropriate for our case because it is based on an artifact and emphasizes the interdependence of building, intervention and evaluation within a company by considering also organizational issues. Furthermore, with this research method we are able to follow the requirement of (Grytz and Krohn-Grimberge, 2018a) to involve also BI&A users (consumers) and developers, beside managers, into the implementation process. Beyond that, with ADR we can generalize our results by deriving design principles for how to design and implement BI&A cost accounting for future comparable situations. ADR conceptualizes the research process by building the IT artifact firmly connected with its influence on the organizational impact by evaluating it concurrently (Sein et al., 2011). The ADR method defines four stages: 1) problem formulation, 2) building, intervention and evaluation (BIE), 3) reflecting and learning, and 4) formalization of learning. The resulting effects after implementation are then further investigated by using expert interviews (Bogner et al., 2009). We consider this approach suitable for our case because it allows an in-depth investigation of a contemporary phenomenon in its real-life context (Noor, 2008).

3 First ADR Stage: Problem Formulation

In the next sections, we report from our ADR project of creating a BI&A cost accounting system in the electrical and electronics industry, following the ADR steps suggested by (Sein et al., 2011) in Section 2.2.
Due to the sensitivity of cost data, both the company and the results have been anonymized. In its BI&A strategy, the BI&A department pursues a key goal of dealing with BI&A resources more economically, and to achieve this goal, BI&A requirements need to be recorded in terms of costs and evaluated economically before implementation. Our goal is to improve the cost transparency of BI&A, as well as to create a pricing scheme for the BI&A product portfolio and, at a later stage, to charge BI&A costs to consumers within the company.

Our project began in August 2017 and continued for one year. We identified three stakeholders: the BI&A department, the controlling department and BI&A consumers spread over the case company. The BI&A department is assigned to Controlling because it is responsible for realizing essential controlling functions: reporting, analysis, forecast, and enterprise planning. The ADR team was formed of one researcher, also a data warehouse manager in the BI&A department, and representatives from these three groups. For the first ADR stage (i.e. problem formulation) five semi-structured interviews and two focus group sessions were conducted. A focus group consists of an informal group discussion in which individuals share their views and experiences regarding a specific topic (Litosseliti, 2003). While the primary aim of this stage was to delineate the problem situation, a secondary aim was to define the requirements for implementation.

First, we explored which topics potentially exist regarding how to run a BI&A department more efficiently and improve management. Through exploratory interviews with two executives of BI&A and the leader of Controlling, as well as two BI&A architects, this situation was qualitatively documented and discussed in a focus group meeting. The results are described as follows:

- There is no overall (cost) overview and allocation of all BI&A applications, user authorization, nor of development, training, and consulting activities spread across the case company;
- BI&A consumers have no incentive to request only profitable BI&A services;
- Outlay cannot be priced; no cost evaluation of new or running BI&A applications is possible;
- Outsourcing decisions with regard to technical or organizational parts of the BI&A landscape cannot reasonably be pursued;
- According to the interviewees, an accepted solution was required to solve these issues and to improve the current situation.

To explore requirements for the cost accounting system, we arranged an additional focus group meeting with the BI&A department (6 persons), representatives from Controlling (5 persons), and BI&A consumers (7 persons) from other areas of the company. As a starting point, we used of the case company’s BI&A strategy, the main goal of which is to use BI&A in a more economical manner and increase both the availability and uptake of BI&A applications within the company. In addition to this, we considered key constructs, elaborated out of a survey for BI&A cost accounting (Grytz and Krohn-Grimberge, 2018b), and requirements (Grytz and Krohn-Grimberge, 2017a). During the focus group, the following requirements for BI&A cost accounting were defined and accepted:

- Cost overview of the whole BI&A organization to management;
- Fair allocation of BI&A costs for applications used, user authorization, training, and consulting to all service consumers;
- Transparent and comprehensible pricing;
- Understandable overview of BI&A services and applications running within the organization;
- Compatibility with the corporate cost accounting system (SAP CO);
- Efforts for BI&A cost accounting implementation to be economical;
- A certain degree of flexibility due to the changing BI&A environment.
4 Second ADR Stage: Building, Intervention and Evaluation (BIE)

The second stage of ADR uses the problem framing elaborated, requirements derived, and theoretical premises adopted in stage one, carried out as an iterative process in the case company. After reviewing the literature and existing technology, we discovered that, to the best of our knowledge, only one existing research stream providing a guideline for a holistic BI&A cost accounting approach is available. Therefore, the BIE stage was initiated envisioning the BI&A service-oriented cost allocation (BIASOCA) (Grytz and Krohn-Grimberge, 2017b) as the solution (cf. Section 4.1). In view of the fact that the artifact planned is more controlling dominated, at first the alpha version was developed by the BI&A and controlling department. In a second iteration, BI&A consumers were confronted with a prototypical beta implementation; the BIE form (Sein et al., 2011) selected was therefore IT-dominated (cf. Figure 1).

The stakeholders identified in the problem formulation stage, the BI&A department, the controlling department, and BI&A consumers had specific roles. Working with the researcher, the BI&A department was responsible for the development and later operation of BIASOCA. Beside the developers, in the alpha-cycle, the controlling department was in charge of continuously supporting and evaluating the progress of implementation. In the beta-cycle, the prototype was introduced and, in a series of workshops, the idea of BI&A cost accounting was articulated to a set of BI&A consumers and controlling specialists. The concurrency needed in the BIE phase is ensured by this representation of stakeholders working iteratively in collaboration: building to BI&A department, intervention to controlling department and evaluation to BI&A consumers. The BIE stage especially could be also described as a form of agile development (Keijzer-Broers and Reuver, 2016). Our general motivation was to include the consumer as early as possible in order to be able to adapt to new obstacles as soon as they appear.

4.1 BI&A service-oriented cost allocation

In order to create a cost accounting system for BI&A, single BI&A activities or services have to become calculable. That means BI&A artifacts like reports, user access to the reporting system or BI&A development actions have to become obtainable with a price for BI&A consumers. To achieve this aim, we follow the framework of BIASOCA (Grytz and Krohn-Grimberge, 2017b) presented in Figure 2. To get an idea of the process model, Figure 2 already contains documents out of the ADR project within the case company.
The process model is divided first into the current state, where all the input has to be made available, e.g. activity and application portfolio, current cost center structure. With these documents the second step is to define and develop the cost model. A precondition for the cost model is the service orientation, where BI&A services are defined through the activities carried out by a BI&A department (activity portfolio). These BI&A services are the major elements of allocation and communication to the service consumer. Following, the accounting net defines the method of determining price, by defined allocation keys. The aim is to simultaneously achieve both a fair allocation of the costs incurred and a level of practical feasibility. In the cost model, transparency is provided by a total cost investigation (cost elements), while the calculation method defined determines transfer prices for single services. In the third step the cost model then is used in combination with the BI&A services mentioned to create a company-specific, comprehensible service catalog.

By setting targets and requirements for the process model based on the BI&A strategy, a strategic alignment towards the business model as well as the corporate strategy is considered. The model is not described as static. After the first initialization, and then during the life cycle of the model, more states are possible. Moreover, objectives and requirements could change over time, so that further development of the model is required. This work improves cost transparency and enables internal processes for invoicing BI&A service purchasers and consumers within the organization in a fairer and more exact way.

### 4.2 Analysis of the current state

This section provides the foundation for the subsequent implementation, elaborated in a series of interviews with the researcher and the BI&A department. The objective is to examine the BI&A department and to prepare the input objects necessary for BIASOCA (Figure 2: current state):

The first step was to determine all existing BI&A activities of the BI&A department within the BI&A activity portfolio. This was necessary in order to prepare comprehensible definitions for the service catalog to follow and to think about a structure for the service orientation. Examples of activities are server administration, monitoring of the data warehouse, and project management.

The case company uses SAP CO as accounting system. For cost documentation, we used the cost center reports available to create an overview of the cost attributes required. By detailing a total cost of ownership (TCO), especially for the BI&A department on planned costs, the overview required was created. We identified personnel costs, costs for software, and hardware as the biggest blocks.
As a next step, all current BI&A applications were documented (application portfolio). The overview obtained was helpful in identifying unnecessary applications and in realizing a more exact cost allocation by evaluation of single applications in the later design concept. The following categories were used: reporting, planning/forecasting, and analysis.

The quantity of all users was ascertained by the authorization component (user directory) of the BI&A system used. This was necessary to allocate the quantity of users with different permission to BI&A applications to consumers (departments) at a later date.

We summarized that no charging of BI&A costs to consumers occurred. Company-wide, BI&A services were perceived as free, so there was no incentive for consumers to use them economically. Along with the constantly increasing need for information, this attitude had led to an overflow of incoming orders and to an increased burden in the BI&A department analyzed. The actions described at the beginning of this section alone were already enough to dramatically improve cost transparency so that cost drivers become identifiable and an overall transparency about the BI&A output (actively used applications and users) was available. In summary, the BI&A department was strongly characterized by fixed costs that are incurred continuously, regardless of system usage. In the next section, we will describe how the BIASOCA was implemented to improve this situation.

### 4.3 Development of the cost model

With the documents obtained from the current state the cost model can be defined and implemented. We follow the process proposed and described in Section 4.1 with service orientation, accounting net and cost model.

#### 4.3.1 Service orientation

The aim of service orientation is to determine which BI&A activities are perceived as an integrated product forming a discrete BI&A service. By defining individual BI&A services, it will be possible to describe and evaluate BI&A applications as units and therefore to provide a more exact and appropriate allocation of BI&A costs. Service orientation was structured by the classic life cycle of BI&A applications (Moss and Atre, 2003) in development, operations, consulting and training. The BI&A services defined are marked in Figure 3 as <<service>>.

![Figure 3. Cost model of BIASOCA in the ADR project.](image-url)
To meet the requirement of minimizing outlay for BI&A cost allocation, it was not possible to respond to every information request and charge it to the corresponding service consumer. As a result, the BI&A department opted to charge efforts requiring more than eight hours of development, consulting, or similar expenditure separately. Consequently, the development of a “simple” report is covered by charging the <<BI&A reporting>> operation to a service consumer, whereas a “complex” report is calculated additionally using the <<BI&A development>> service. We also identified “heavy” or “light” users within the BI&A user’s stage. As services for consulting and training can be assigned directly to a consumer, they too are specified separately.

4.3.2 Accounting net

The accounting net adds distribution keys to service orientation to determine transfer prices for defined BI&A services. It represents the connection between the BI&A department and service consumers. Since most of the monthly costs incurred in a BI&A department are fixed costs (cf. Section 4.2), this gives rise to the question of how these costs should be assigned to the services. To keep the efforts for BIASOCA low, BI&A management suggest using distribution by time recording. This implies an obligatory time recording for the BI&A organization which, in our case company, is in place; continuous time recording allows for a more realistic distribution key by average values over a year – and for adjustments to take account of seasonal/calendar effects.

In view of the fact that there are complex and occasion different resource consumptions in operations, one of the biggest challenges is to design an allocation method for operational costs required to run BI&A applications. Instead of measuring the exact load of each component across the BI&A landscape, which is too costly (indeed downright impossible), we use an approximation method by (Grytz and Krohn-Grimberghe, 2017b). Operational costs are calculated by valuing the complexity for every BI&A application over a meaningful layered architecture like in our case: data warehouse, cube-layer, frontend. The evaluation of the whole BI&A application portfolio was created in collaboration with BI&A management and BI&A business architects. With this overview, resource-intensive applications become identifiable with regards to the defined layered architecture.

4.3.3 Cost model

Lastly, service orientation and the accounting net are put together with the cost view (cf. Section 4.1) to create the cost model (cf. Figure 3). Within this model, the total monthly BI&A costs are distributed as planned costs (Friedl et al., 2010) over the accounting net to single BI&A services.

For transfer price generation, the whole output to all service consumers has to be determined, e.g. amount active reports, planning applications, or analytic users. Since development, consulting, and training allow costs to be allocated in a fair way, the transfer prices are calculated on an hourly basis. Here, the monthly total capacity of personnel resources available within the BI&A department has to be considered. The planned working time is estimated as 125 hours (cf. Kargl and Kütz, 2007), which has to be multiplied by the number of employees in the BI&A organization, which is ten, in order to obtain the total capacity of human resources. To communicate the defined BI&A services in the case company, the last step of BIASOCA is to create the BI&A service catalog (cf. Grytz and Krohn-Grimberghe, 2017b for an example).

4.4 Charging to consumers

To evaluate the technical feasibility of the model, the ADR team used test data to simulate charging in the alpha-cycle. To keep implementation efforts low and increase maintainability, BI&A management decided to use Excel: the key benefit of this is that the whole process can be documented, from its current state through the model designed up to the monthly charging. In addition to this, it is possible to carry out sensitivity analyses and what-if scenarios in Excel or even entire simulations for several periods within the BI&A department. By contrast, implementation directly in SAP CO revealed itself
to be too costly and rigid. Within the beta-cycle, the concept model was presented to a class of twenty BI&A consumers and five controlling managers before it was finally moved to production.

An excerpt of results is shown in Figure 4. The rows show the BI&A consumers and their BI&A resource consumption rated with the transfer prices from the cost model (cf. Section 4.3.3). Since the controlling department is responsible for most of the BI&A costs created, it is further subdivided into component areas: Sales, Operations, and Divisions. In addition to the total planned BI&A costs for this period, the columns also show the costs for the individual BI&A services obtained (transfer price of a BI&A service multiplied by the actual quantity consumed). Monthly expenses for the process of BI&A charging are calculated from the BI&A costs to be allocated, meaning that the quantities required per BI&A service and consumer are determined by the BI&A system and made available to the controller responsible for BI&A cost accounting. The next month to be closed is then added to the BI&A allocation in Excel. Afterwards, the data to be allocated (column “Actual Costs” of Figure 4) is imported into SAP CO via an Excel interface. Finally, the BI&A function is further allocated in the case company as secondary costs.

4.5 Concept evaluation

In this section, we evaluate the implementation using six semi-structured interviews in June 2018, i.e. after implementation and then go-live in January 2018. This empirical research method is an effective means of obtaining results at speed (Bogner et al., 2009); the aim is to investigate the effects of the approach implemented within the case company. For this reason, we selected as participants members of staff working directly with BIASOCA and who have pronounced experience of BI&A particularly. The interview guide consists of three parts: introduction, evaluation of BIASOCA, review and outlook. To get a better picture, an overview of the interviewees is given in Table 1 and a summary of our interview results divided into improvements and challenges is shown in Table 2.

Table 1.

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</table>

Table 2.

We can classify our population as experienced both in BI&A and cost accounting, with 7,67 mean average for BI&A and 8,33 years for cost accounting in general. The experts interviewed were two BI&A managers, one BI&A developer and three consumers (Controlling, Division). Almost, all of
them rated the importance of BIASOCA as high and agreed that it improved the overall situation of BI&A in their company.

<table>
<thead>
<tr>
<th>Improvements</th>
<th>Challenges</th>
</tr>
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<tbody>
<tr>
<td>- Method for steering is very important.</td>
<td>- Operating expenses are high because transparency requires investments.</td>
</tr>
<tr>
<td>- BIASOCA also supports project calculations.</td>
<td>- BIASOCA processes could be automated with our BI&amp;A system.</td>
</tr>
<tr>
<td>- Cost transparency is essential on at least a quarterly basis.</td>
<td>- Solution requires more resources.</td>
</tr>
<tr>
<td>- Profitability analysis has become possible; value has to be estimated.</td>
<td>- Consumer understanding of BIASOCA is very important.</td>
</tr>
<tr>
<td>- Cost overview (Figure 4.4) alone represents notable improvement to BI&amp;A transparency</td>
<td>- Consumers need to be convinced of the benefits.</td>
</tr>
<tr>
<td>- Fair allocation is established.</td>
<td>- Potential for conflicts between BI&amp;A department and consumer departments increases.</td>
</tr>
<tr>
<td>- Transparency helps to convince management not to set unfavourably.</td>
<td>- BIA&amp;A value is difficult to estimate.</td>
</tr>
<tr>
<td>- BIASOCA represents the value creation process of BI&amp;A.</td>
<td>- Expenses for BIASOCA should be monitored to increase acceptance.</td>
</tr>
<tr>
<td>- Regular communication increases understanding and collaboration (internal and external)</td>
<td>- BIASOCA may lose acceptance if pricing does not reflect operational reality as closely as possible.</td>
</tr>
<tr>
<td>- BIASOCA improves internal benchmarking against other internal departments and external products.</td>
<td>- Despite BIASOCA, politics still wins the day, i.e. it does not stop uneconomical BI&amp;A requirements from being implemented.</td>
</tr>
<tr>
<td>- Quality of BI&amp;A applications (e.g. reports) will increase.</td>
<td>- BIASOCA provides costs of BI&amp;A requirements to consumers prior to implementation.</td>
</tr>
<tr>
<td>- Solution increases cost awareness.</td>
<td></td>
</tr>
<tr>
<td>- BIASOCA establishes mature cost transparency.</td>
<td></td>
</tr>
<tr>
<td>- BIASOCA provides costs of BI&amp;A requirements to consumers prior to implementation.</td>
<td></td>
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</tbody>
</table>

Table 2. Summary of improvements and challenges.

From the management perspective, the dramatic improvement of cost transparency dominated the interviews — before implementation there was “nothing”. In addition, management noticed a “clean up” of the BI&A environment by a decrease of reports and users in general. Furthermore, the developer faced an increased need to estimate expenditure for consumers, then prior to implementation. From the consumer perspective, increased transparency of individual BI&A services was overall positively rated. This was achieved by an comprehensive overview with the BI&A service catalog, documenting all obtainable BI&A services, with additional details like price, including activities and preconditions (e.g. base training). Furthermore, existing and future consumer demands become calculable, whereas at the same time cost awareness increased. Additionally, consumers wanted more involvement in the design of the BI&A accounting processes to get better understanding.

Besides the predominantly positive assessment, however, conflicts also arose. Although a group of BI&A consumers were involved in the design process of BIASOCA, some management staff, especially from product divisions (payment depends directly on costs related to their area), did not agree with the results of BIASOCA; but this situation was clarified by explaining to them their cost block.

5 Third and Fourth ADR stage: Reflection, Learning, and Formalization

The use of ADR in this project helped us to create a more feasible and accepted solution for BI&A cost accounting. Furthermore, this artifact can be used as a template to develop similar artifacts in comparable BI&A environments. Therefore, we abstracted the solution from the medium-sized company in the electrical and electronics industry to the higher class of BI&A cost accounting solutions (Sein et al., 2011). For this reason, we analysed the changes made during multiple BIE cycles together with the feedback received from the practitioners. The aim in this section is to discuss our experiences and learnings, abstracting them from the specific problems and solutions made during the ADR project. Our learnings are then formalized into general knowledge for designing and implementing a BI&A cost accounting system in the form of design principles as proposed by (Chandra et al., 2015) and exemplified by (Thiess and Müller, 2018). The contributions we made during this process are documented for each participant group of the ADR team in Figure 1.

DP 1: Importance of collaboration - Involve all parties affected by a BI&A cost accounting system and present results iteratively in order to establish an accepted solution.

In our project, we noted that during the problem formulation stage and further in the implementation cycles (alpha, beta), different stakeholder types (BI&A department, controlling department, consumers) already had different expectations (Grytz and Krohn-Grinbergh, 2018a), which made implement-
tation challenging. Implementation is broadly accepted as long as the focus during the early stage is on cost transparency; this is especially true of manager perspective. Based on what we learned about our prototypes, we revised the design; for instance, we had to revise the implementation technology from SAP to Excel as the former would have been too costly. This also transpired to have some positive effects inasmuch as simulation for several periods, what-if scenarios, and sensitive analysis became easily possible. In general, we recommend using a transparent/ understandable process showing prototypical results during implementation (e.g. ADR approach) in the organization in question by involving all parties affected by a BI&A cost accounting system to support overall acceptance.

**DP 2: Accuracy of cost accounting** - Limit the complexity for cost accounting when creating cost transparency and a fair allocation in order to increase benefit for all parties.

Another challenge was the accuracy of allocation. To keep outlay low, the resource consumption of applications was approximated. There were also several legal issues in terms of accounting processes across the group worldwide; for the first life cycle of our implementation, we decided to keep costs unallocated for these kinds of consumers (cf. BI&A group companies in Figure 4). The grade of detail to which accounting is carried out is a matter for the company concerned as a function of the outlay occasioned (Horváth et al., 2015), a factor which, we suggest, will lead in most cases to an approximated allocation. We assume that the degree of approximation strongly correlates with the size of the BI&A application portfolio. For those cases with a pronounced BI&A landscape an approximation could be more economic.

Beside the calculation of costs, other organizational questions which also have to be clarified on a company-specific level remain open. When, for instance, a request for an ad-hoc report is made by a consumer who might only need it for a presentation to top management, a rule of thumb is that this first requester (consumer) should be charged for this BI&A service task. The justification for this allocation is that the first requester needs this ad-hoc report to complete his or her work. How to deal with parts of previous BI&A requests reused in other requests, however, such as tables using predefined measures, is another question. Here, the second consumer will benefit from reduced development time for this second request, meaning that the first requester is represented as a kind of sponsor.

**DP 3: Model comprehensibility** - Document and visualize in a simplified way, give trainings and make a BI&A cost accounting system available to the organization in order to increase model comprehensibility to all parties.

A further design principle we found deals with the importance of model comprehensibility. BI&A costs have to be made visible and manageable for the consumers. As we described for DP 1, consumer involvement is an import factor which we recommend considering since further training was required; there was also an increased need to convince staff of the necessity of the system. Comprehensibility has to be realized through a service catalog which describes every obtainable BI&A service by detailed descriptions as well as service level agreements. This catalog could be also used as “marketing tool”, which helps to communicate the value of the BI&A department to consumers.

**DP 4: Strategic alignment** - Consider the existing cost accounting system and the BI&A strategy, and then create a flexible, economical approach in order to increase acceptance towards management.

Besides a guarantee of compatibility with the costs accounting system used and the flexibility and customization required, the actual goal of implementation needs to be included in and supported by strategic orientation. An economical approach is further considered by DP 2, but must also be monitored in an understandable way in order to convince management.

As another result of our qualitative analysis, we were able to pinpoint positive and negative effects in the organization. Improvements to costs transparency and the ability to invoice for BI&A were confirmed by all those interviewed. We can also confirm that the benefits of implementing BI&A cost accounting outweighed the comparatively low outlay for said implementation; moreover, the principal idea of creating a BI&A management tool was fulfilled.
Our results show an improvement in customer understanding and cost awareness; for BI&A management especially, we were able to create three-tier cost transparency (1. TCO; 2. BI&A cost model; 3. active charging of BI&A costs). With overall cost transparency it becomes possible to them to identify cost drivers or cost savings. Furthermore, the feedback-loop identifying BI&A applications/users no longer required was rated as huge improvement. Previously, there was a radical approach which first locked and later deleted unused applications or users after six months. Another point we noticed from the developer’s perspective was the increased pressure of delivering qualitatively good BI&A applications due to the fact that consumers were now ‘paying for services’. Obviously, there is improvement potential in including an introduction or training period for all BI&A consumers to enhance comprehensibility and uptake before activating the BIASOCA. Some departments where surprised about the amount of BI&A costs they generate – and when this occurred, they wanted to know exactly how BI&A services are priced and what they could do to reduce the costs.

From our analysis, we can conclude that there was a great deal of potential for BI&A cost accounting in our case company. As part of our implementation project, BI&A as a resource was reinterpreted – i.e. it was no longer for free. We found evidence that dealing with this topic changes user behaviour – with both anticipated and unanticipated consequences. Furthermore, besides an overall improvement in the underlying BI&A department, we expect an increasing penetration of economically viable BI&A applications resulting in higher maturity levels (Dinter, 2012).

6 Conclusion and future work

BI&A takes on an important role in today’s enterprises, directly influencing business development and firm performance. Yet positive expectations alone do not justify BI&A in companies, especially in view of rising BI&A costs. BI&A cost accounting addresses this problem situation and is a new area of study; as such, there has not yet been extensive research exploring this space.

The main challenge of this paper was to improve the BI&A department of a case company by introducing a BI&A service-oriented cost allocation (BIASOCA). This was carried out as action design research (ADR). The ADR method enabled us to manage the complexity of the design process in which multiple stakeholders with different expectations were involved. Beginning with the description of the problem situation, the requirements where then defined. In the building, intervention, and evaluation (BIE) stage, BIASOCA was implemented iteratively in collaboration with the BI&A and controlling department as well as BI&A consumers to consider organizational impact. With this implementation, we can both confirm the suitability of the approach available for a BI&A cost accounting system and show that it represents an improvement of BI&A management and use. Within the reflection, learning and formalization stage we generate knowledge by abstracting the artifact from our specific implementation in a medium-sized company in the electrical and electronics industry to the higher class of BI&A cost accounting solutions. This results in design principles which can support other researchers and practitioners to develop BI&A cost accounting solutions in comparable environments. Besides the accuracy of cost accounting, our design principles highlight the importance of collaboration, model comprehensibility and strategic alignment.

Furthermore, by evaluating this implementation in expert interviews, we gain valuable feedback about the positive and negative effects within the case company. Beside the improvement potential, there is a need of increased understanding vis-à-vis the consumers’ perspective. The future aim is to examine how BIASOCA might be adapted for different kinds of organizations in the long term and to deliver a better toolset for such situations. Moreover, as we predict continued growth of BI&A and increasing demand for such a tool in companies, a better software tool for the whole topic of BI&A cost accounting is a potential future avenue of development with e.g. increased usability, automation and advanced reporting/dashboard.

With this research, we recommend considering the defined design principles as well as effects and challenges observed when implementing BI&A cost accounting in order to ensure higher acceptance and project success.
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