The Role of Business Intelligence/Analytics Systems Quality in Translating 'Finance Transformation' Efforts into Higher Management Accounting Information Service Levels

Completed Research Paper

Bernhard WIEDER **Maria-Luise OSSIMITZ**

Abstract

Our research investigates the trending topic 'finance transformation' (FT), how FT projects impact on the quality of business intelligence and analytics (BI/A) systems and to what extent such impacts result in higher internal accounting information service levels. Using survey data collected from accounting and finance executives, the results of our SEM-PLS path model indicate that IT and efficiency centric FT projects lead to higher BI/A systems quality via two mediators: system/data integration and adoption of BA tools in management accounting. We also find that the use of ERP systems in management accounting has a complimentary effect in some of those relationships. Finally, we find that FTP projects actually lead to higher internal accounting information service levels via the above-mentioned indirect relationships, thereby providing first systematic evidence of managerial benefits associated with FT projects.

Keywords: Finance transformation, systems quality, management accounting, business intelligence, analytics

Introduction

In an era in which 'digital transformation' has become a paradigm (Chang et al. 2014), a similar term has (re-)entered the list of priorities of C-level executives, consultants and professional accounting bodies alike: 'finance transformation'[1] (FT). FT is in vogue (Driscoll 2016), as evidenced by search trends in Google, reports published by professional accounting and finance bodies (Lyton and Kops 2014) and the Big Four accounting firms, who all have specialised consulting sections for FT support. In the absence of an academic definition of the term, practitioners offer a wide range of descriptions, such as a process "to align Finance with the overall company strategy in order to become more efficient and provide better service to internal customers" (Lau 2014); or: "aiming at better service and more insight. Second, articulating the role of the function to drive more effective analysis through partnering" (Arnold 2017). Effectively, FT projects (FTP) typically aim at better financial services, delivered more

[1] FT is a practitioner term, and practitioners use the term 'finance' very differently from academia: the former use it to either denote accounting and finance, or sometimes even just management accounting, whereas the latter restrict it to the function in a business which manages capital acquisition etc. To avoid confusion, we stick to the term coined by practice (FT).

efficiently, providing better insights to internal information customers or 'business partners', and becoming more strategic (Arnold 2017; Bhimani and Willcocks 2014; Lau 2014).

But FT is certainly not a new phenomenon: Attempts to reform, improve or re-engineer the accounting and finance (A&F) function have been undertaken frequently over the past decades, either under the same heading Josep or using different labels or project names, such as 'reengineering finance and accounting'(Robbins and Drory 1995), and with varying objectives or approaches. Accounting scandals and large corporate collapses are typical examples of triggers, but also technology innovations, global economic crises or simply internal pressures for higher efficiency and better service quality.

The current rise in FTPs is to a large extent technology-driven, e.g. by the 'digital transformation /revolution' and associated challenges for A&F (Bhimani and Willcocks 2014); the advent of robotics process automation, which increases pressure on core financial management in terms of what it should look like and cost (Driscoll 2016); and the emergence of data scientists as a profession (Davenport and Patil 2012) potentially competing with management accountants. But FTPs are also the result of increased pressure – at least from the professional accounting bodies – to more service orientation and 'business partnering' (Arnold 2017; Civichino 2013; Hagel 2015), also partly as a result of the rapid growth of the international outsourcing market and the corresponding emergence of service level agreements (SLA) between accounting and finance (A&F) and the rest of the organization – similar to the well-established SLAs between IT and 'business'.

'Transformation' is about *fundamental* changes to processes, structures, people, etc., and FTPs are therefore usually very complex, challenging, costly, lengthy, intimidating – and therefore risky and failure-prone. This raises the question as to whether the potential benefits associate with FTPs justify the cost and risks. While there is some case evidence of project successes, no systematic evidence has so far been presented, and academic research in accounting has been completely silent on the phenomenon. In our attempt to reduce this research gap, we first of all focus on the service role of management accountants ('business partners') by asking (RQ1): *Do formal FTPs lead to more detailed and timely management accounting information provision to business managers?*

We also acknowledge that any such effects will not be direct, but rather delivered along indirect effect chains. As today's management accounting information is gathered, stored, processed and often also distributed to managers using computerised information systems, we focus our attention on the mediating effects of those information systems on the delivery of potential FTP-related benefits for managerial decision support. In today's systems architectures of medium to large firms, management accounting data and information is typically processed at two system 'levels':

a) The *core information system* level, which is used to record and maintain actual financial and also non-financial transactions, but which is also used for basic planning (e.g. standard costs), for splitting such costs into variable and fixed components, etc. and to provide standardized reports on such data. Most medium to large organisations use primarily enterprise resource planning systems (ERPS) to cover the core system level requirements.
b) The *ad-hoc information system* level, which largely – but not necessarily exclusively – relies on the data in the core system, to provide ad-hoc support for one-off problem-specific information requirements (e.g. a project budget or an optimisation problem), more advanced issues in budgeting (e.g. scenario analysis) and advanced reporting requirements (e.g. dashboard kind of visualisation tools). Such information processing and reporting requirements may be addressed by – ad hoc or more permanent – spreadsheet models, or more specialized and functionally sophisticated 'business intelligence' (Chaudhuri et al. 2011) and – more recently – business analytics tools or systems (Chen et al. 2012a; Holsapple et al. 2014) (BI/A systems).

In line with Peters et al. (2016) we expect the functional quality of the ad-hoc system level (hereinafter referred to as BI/A systems quality) to play a major role in conveying FT efforts into the timely provision of relevant MA information to business managers. Accordingly, our second and third research questions are: *Do FTPs improve the accounting BI/A systems quality, and if so, how?*

While we acknowledge that FT in the broader sense has been subject to many previous academic studies, we are not aware of any research which investigated the impact of FT *projects* on accounting information systems (AIS) and managerial decision support provided by accounting. To answer our research

questions, we collected survey responses (Hiebl and Richter 2018) from top financial managers of medium to large size private sector firms, 50% of which had finalised or were in advanced stages for FTP, thereby providing a perfect sample for contrasting FTP and non-FTP organisations. We provide first-time systematic evidence of benefits associated with formal FTPs, and how they can be achieved (i.e. via system and data integration efforts and the adoption of analytic tools). In particular, we provide evidence for the crucial mediating role of BI/A systems in conveying such benefits.

The remainder of this paper is structured as follows: In the next section, we develop the hypotheses out of existing literature and practical observations. That section is followed by a detailed description of the research method, followed by results section and finally conclusions and limitation section.

Theory/Hypotheses Development

Finance transformation projects

As outlined in the introduction, FT-initiatives or projects are not new, but for various reasons, they have moved up substantially in the top-priority list of many chief financial officers (CFOs). Such projects typically aim at better financial services, delivered more efficiently, providing better insights to internal information customers or 'business partners', and becoming more strategic (Arnold 2017; Bhimani and Willcocks 2014; Lau 2014). This requires investments into skills, process engineering and supporting IT/IS platforms and tools, partly aiming at efficiency improvements (e.g. robotic process automation), partly for providing better insights (e.g. through advanced analytics), or both (Gullkvist 2013). Skill investment is about acquiring or improving skills within the A&F function, referring to 'soft' skills in support of better business partnering, and technical skills in support of mastering new methods and technologies (Bhimani and Willcocks 2014). IT/IS related objectives of FTPs are typically two-fold: On the one hand, they pursue IT/IS *infrastructure related objectives*, e.g. the integration of data and systems used within A&F and across the whole organisation, on the other hand, they strive for better IT/IS support for *process automation and 'intelligence' provision* through the use of advanced BI and analytic tools.

System and data integration in support of BI/A system quality

In support of the first IT/IS related objective of FTP, ERP systems (ERPS) have long become the standard integration solution for business and A&F-operations and basic planning activities in both areas. By integrating information from other modules (e.g. production planning and control), they make the operation of large-scale MA systems feasible – even with several thousands of cost centres and other cost objects. Furthermore, ERPS can help develop the role of MA from "data entering (towards) data analysis and consulting" (Endenich et al. 2017, p. 35) and to reach broader acceptance and the desired influence on managerial decision-making (business partnering).

However, ERPS do not 'guarantee' that A&F systems are well integrated with other business functions, because there may be selective use of ERPS modules across business functions, and some organisations even use multiple ERPS. Accordingly, even if organisations use ERPS, they do not necessarily use them for management accounting, either because the system does not provide management accounting functionality at all, or because ERP-users prefer other MA 'solutions' – including 'islands of spreadsheets'. It is therefore not surprising that management accounting functionality embedded in ERPS did not revolutionize MA practices in organizations (Busco et al. 2007; Granlund and Malmi 2002). The mid-1990s saw the 'second wave of digital revolution' (Bhimani and Willcocks 2014, p. 475) and the *data warehouse* emerged as an integration and aggregation infrastructure for increasing amounts of transactional data inside and outside of ERPS using increasingly automated extract-transform-load (ETL) procedures. Data warehouses became the core engines of BI solutions, which were initially primarily reporting tools, e.g. for performance measurement, but were gradually extended with functionality for advanced forecasting and planning, strategy management, and other functions in support of *business partnering* (Acito and Khatri 2014; Elbashir et al. 2013; Peters et al. 2016; Vukšić et al. 2013; Wieder and Ossimitz 2015).

However, data warehouses did not provide an end to the 'quest for integration': With data available rapidly increasing in terms of volume, velocity, variety etc. (Davenport 2014), and the Internet-of-things (IoT) further adding to the data explosion (Moffitt and Vasarhelyi 2013), the integration of systems and data is fully back on the agenda. FTPs are therefore expected to address such disintegration issues, aiming for more integrated architectures in support of their business intelligence and analytics:

H1a: Finance transformation projects with information systems or process-efficiency related objectives lead to increased systems and data integration, which has an indirect positive impact on the quality of business intelligence/analytics systems used in accounting.

Analytical tools in support of management accounting

Despite the increased use of data warehouses and business intelligence (BI) solutions in MA, they have rarely evolved beyond what Davenport (2014) refers to as *Analytics 1.0* – the era of BI-reporting (Peters et al. 2018). With the emergence of data science as a discipline and profession, some academics emphasize that MA has used, or has at least proposed the use of advanced business analytics (BA) methods in the past (Amani and Fadlalla 2017; Sutton et al. 2016). Others follow the tradition of Ijiri (1965) and provide new recommendations for the innovative use of such methods in MA (Nielsen 2018; Raval and Greteman 2015; Rikhardsson and Yigitbasioglu 2018). Machine learning/data mining techniques are frequently suggested advanced BA methods, but advanced visualization techniques have also attracted significant attention. In general, many of the recommendations for use of advanced BA methods in MA refer to the use of new non-financial and/or external data sources to support traditional and new tools and methods (e.g. balanced score card (BSC), forecasting, pricing and benchmarking) (Pickard and Cokins 2015; Sutton et al. 2016). In doing so, management accountants are advised to move away from just verifying data, towards modelling, simulation and scenario analysis, "giving a range of answers rather than one single answer" (Russell 2014). A considerable number of publications address new opportunities in inventory management, costing and asset valuation more broadly (e.g. Amani and Fadlalla 2017; Hülle et al. 2011; Moffitt and Vasarhelyi 2013). But the vast majority of advanced BA applications potentially usable in MA are *proposed* rather than empirically *validated*. As for the latter, the actual cases reported in the literature tend to be only very marginally related to MA. We therefore seek to *empirically confirm* that such applications are actually used in MA, and that such use contributes positively to the quality of BI/A systems:

H1b: Finance transformation projects with information systems or process-efficiency related objectives lead to increased use of analytic software tools in accounting, which has an indirect positive impact on the quality of business intelligence/analytics systems used in accounting.

Overall impact of finance transformation projects on BI/A systems quality

It follows from the development of H1a and H1b that we expect an overall positive *indirect* impact of FTPs on BI/A Systems Quality (via higher systems/data integration and the increased adoption of BA tools in MA). We thereby predict as follows:

H1: Finance transformation projects with information systems or process-efficiency related objectives have a positive indirect impact on the quality of business intelligence/analytics systems used in accounting, mediated by the use of analytic tools and system/data integration.

Synergies between ERPS and BI/A systems

ERPS are based on a single-database and single-transaction system paradigm, with an integrated, redundancy free data model and programming architecture. It is therefore well-established (and not hypothesised here) that companies using ERPS achieve higher system/data integration (e.g. by Volkoff et al. 2005). In line with H1a, we therefore expect that the use of ERPS in A&F has a *positive indirect* effect on BI/A systems quality. ERPS also typically contain modules designed for direct functional support of management accounting (e.g. SAP 'Controlling'), and if used properly, these modules can provide MA 'intelligence' in two ways: 1) directly through embedded planning and reporting functionality, and 2) indirectly by providing real-time data as feeder into more specialised and advanced

reporting, planning and analytic (e.g. data mining) tools, thereby leveraging these tools through high quality data provision (Appelbaum et al. 2017; Chou et al. 2005). In fact, there is some evidence that the integration of BI-systems with enterprise/ERPS are necessary for BI success (Işık et al. 2013) and that there are synergies between the core (ERP) and analysis (BI/A) system levels in terms of delivering value for MA (Gullkvist 2013; Rom and Rohde 2006). Considering such direct and indirect effects of ERPS use on BI/A systems, we predict as follows:

H2: The use of ERPS in management accounting has a positive impact on the quality of business intelligence/analytics systems used in management accounting.

BI/A systems and management accounting information service levels

Management accounting (MA) "refers to the processes and techniques that focus on the effective and efficient use of organizational resources to support managers in their task of enhancing both customer value and shareholder value" (Langfield-Smith et al. 2015, p. 7), or more generally, to "fulfil the goals of an organization" (Horngren et al. 2009, p. 5). As a service function, MA is essentially about managerial decision support (Langfield-Smith et al. 2015) – increasingly through 'business partnering' (Arnold 2017; Burns et al. 2014; Hagel 2015; Lawson 2016). This increasing trend towards service provision – rather than control (Burns et al. 2014) – raises questions about MA quality, related metrics and quality/service standards.

Service level agreements (SLAs) have been very commonly used to formalise the services and service quality – including corresponding metrics – expected from internal or outsourced IT service providers, and IS research on SLAs is abundant (Paschke and Bichler 2008). In accounting, SLAs have become prominent especially with outsourcing agreements, but there is also evidence of SLAs specifying the expected service-levels from internal accounting departments, in particular shared-service centres.[2] Irrespective of the existence of formal, semi-formal or no SLAs, the role of management accountants as managerial decision supporters suggests that such support services are subject to – reasonably objective – quality metrics.

MA quality has been conceptualised along three dimensions (Fleischman et al. 2017): Functional quality (based on SERVPERF as proposed by Cronin and Taylor 1992), technical quality and image quality. We focus on technical quality, as it covers the *information* quality aspects of MA, which are the focus of our research. Information quality is a very well established concept in IS research, and MA researchers have largely drawn on IS literature when adopting scales for measuring MA information quality. Fleischman et al. (2017) developed a comprehensive scale of 18 MA information quality items, many of which cover aspects of relevance of information, which is information user specific and therefore relatively subjective. We therefore focus on the 'logistics' aspects of MA information quality, i.e. timeliness, accessibility/delivery and level of detail, and conceptualise those dimensions as 'MA information service level'. BI/A systems can improve such MA information service levels in various ways: BI systems have been found to have a positive impact on annual budgeting by providing faster base line information and enabling monthly rolling budgets (De Leon et al. 2012). It was also found that management support requires structured and unstructured data from BI systems (Baars and Kemper 2008), and that BI tools increase the efficiency of (modern) management accounting (Al-Zubi et al. 2014). BI systems have already been used successfully in performance management (Vukšić et al. 2013) as they improve performance measurement capabilities (Peters et al. 2016). There is also evidence that technological capabilities such as data quality, user access and the integration of BI with other systems improve managerial decision making regardless of the decision environment (Işık et al. 2013; Wieder and Ossimitz 2015). We conclude that fast, up-do-date, flexible and well-integrated BI/A systems assist in providing on-demand, up to date, detailed and timely information to business managers, hence we hypothesise:

[2] While we found no mentioning of internal A&F SLAs in the academic literature, there is substantial evidence of such internal agreements at least in the public sector (as per Google Search).

H3: The quality of business intelligence/analytics systems used in accounting has a positive impact on management accounting information service levels.

Considering the logic of H1 to H3 and the resulting path model (Figure 1), we predict an overall, indirect impact of FTP on MA information service levels:

H4: Finance transformation projects with information systems or process-efficiency related objectives lead to higher management accounting information service levels.

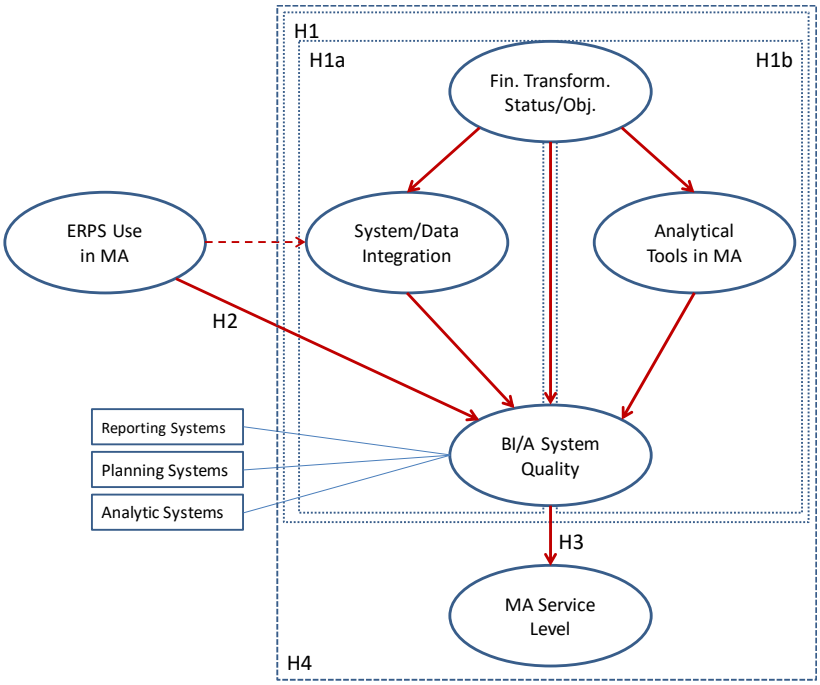

Figure 1: Research Model and Hypotheses Summary

Research Method

The research presented in this paper is based on a cross-sectional survey administered to top level financial managers of 925 Australian-based, medium to large (> 100 employees), private sector firms. The questionnaire relied partly on established (and slightly modified) constructs and measurement instruments, and partly on new measurement scales (for the two new constructs 'finance transformation project' and 'analytical tools used in MA'). The development of the new scales relied heavily on practitioner literature, including vendor promotional materials and status reports (Dodson et al. 2008). Conventional design and administration procedures were used, including pre-testing with four academics and two practitioners (Dillman 2007), to ensure face and content validity (Tourangeau et al. 2000), as well as the appropriateness of Likert-scale endpoints (Netemeyer et al. 2003, p. 100).

The survey invitation email with a link to the online questionnaire was sent to the target respondents based on an email-list purchased from a commercial provider and targeted the following industry segments: Agriculture, mining, manufacturing, construction, retail, wholesale and distribution, transport, utilities and communications. Other industries, such as banking, insurance and business services, were excluded as they were considered too specific in terms of management accounting and information systems requirements and practices. Medium to large size (> 100 employees) companies were targeted to increase the likelihood that MA had been established as a separate sub-function within A&F.

The survey was conducted in three rounds spanning over a two month period and generating 76 responses (9.95% response rate), 64 of which were complete and another 6 close to complete and therefore usable (9.16% 'usable' response rate). As targeted, the respondents were primarily CFOs or equivalents (e.g. 'director of finance') (70.0%), senior finance managers and financial controllers (24.3%), and less than 6% CEOs or commercial managers. In line with Australia's sectoral structure of the target sample, 18.6% were from the primary sector of the economy (7.1% agriculture and 11.4% mining), 37.1% were from manufacturing firms and 44.3% from services firms (18.6% wholesale/retail, 10% transportation, 5.7% communications, 5.7% diversified services, and 4.3% construction).

Main construct measurement

Table 2 in the appendix provides a brief description of the survey measurement items. As for the FTP construct, respondents were asked about their organisation's status regarding such projects (never considered, currently in plan, currently formally undertaking or formally completed in the past).

Respondents in the latter two categories were classified as FTP-organisations (FTP = 1), the others as non-FTP (0). FTP-organisations were further asked to state the main objectives associated with their respective FTPs by selecting one or more items from a list of objectives typically associated with FTPs (e.g. Lau 2014), including a free text answer option ('other'). The list provided examples from three broad categories of objectives: A&F systems related, A&F processes/efficiency related and A&F skills related objectives. Respondents were classified accordingly (FTP_IT = 1 or 0, FTP_EFFI = 1 or 0, FTP_SKILL = 1 or 0), with most FTP-organisations pursuing multiple objectives. In line with the wording of H1, only the first two indicators were used to – reflectively – measure the FTP-status in our study. A&F System/Data Integration (INTEG) was measured using an established scale developed by Peters et al. (2016). The reflective items were phrased as extreme endpoints (disintegration vs integration) on a 1-5 point scale (see Table 2 in the appendix). For the measurement of 'Analytic Tools used by A&F' (A-TOOL), we relied on empirical studies about the use of accounting information systems in (management) accounting (Al-Zubi et al. 2014; Amani and Fadlalla 2017; Chen et al. 2012b; Gullkvist 2013), but we also incorporated articles which are more predictive in nature (Appelbaum et al. 2017; Rikhardsson and Yigitbasioglu 2018). In addition, we also used practitioner literature, including software vendor marketing sites. Based on these analyses, the following business software categories were identified as 'analytic': Spreadsheets/Excel, BI reporting and visualisation systems/tools, statistical suites, specialised decision support systems, and specialised data mining suites. Respondents were asked to rate on a scale of 1 (never) to 5 (very frequently) how often such tools were used by A&F in their organisation. The spreadsheets/Excel variable was eventually eliminated from the reflective measurement model, as it scored '5' in almost all respondent organisations (4.85 on average), thereby not only showing very little variance, but also not aligning with the other tools which were used relatively infrequently.

The *use of ERPS accounting functionality* in management accounting (ERP-MA) was a simple dummy variable (Y/N) based on the respondents response to one single question. To measure the quality of business intelligence/analytic systems (BI/A QUAL) (2^{nd} order) we primarily relied on a 2^{nd} order scale developed for BI planning and reporting systems functionality (Peters et al. 2018; Peters et al. 2016), but extended it with corresponding questions about business analytics. The resulting variable is a three-dimensional emergent construct, formatively measured by the first order, reflective constructs BI-planning, BI-reporting and BI-analytics functionality. Latent variable scores for each dimension were generated in a separate hierarchical PLS model as per Wetzels et al. (2009). Scores were coded from 1 to 5, with 5 representing high functionality. Finally, the scale for management accounting service level (MA-SERV) was adopted from Abdel-Kader and Luther (2006). Surprisingly, the first of four items in the reference study did not load convincingly on our INTEG construct and was therefore removed. Sensitivity analysis was performed using an alternative model which contained four additional variables for control purposes: an industry dummy (manufacturing vs. others), a dummy for the legal status of the organisation (public vs. private), a dummy for domestic vs. international ownership and a size variable. Firm size was measured with predefined intervals for full-time equivalent employees. All these controls have been used in previous studies, and have occasionally been found to systematically influence organizational practices (such as management accounting) (Baum and Wally 2003) and information systems architectures and usage pattern.

Biases

To mitigate the potential of method bias, following et al. Podsakoff et al. (2012), several procedural remedies were applied. To increase participant's motivations to respond accurately, they were invited to register on a separate web-site for a findings report. Motivational factors, ability factors, and task factors were considered by targeting only top level managers. The survey invitation email and the introduction message in the online questionnaire avoided hints of our research questions and hypotheses, and the ordering of the questions was designed to mitigate the risk of respondents guessing the research relationships. Finally, different anchor labels were used for related constructs (Podsakoff et al. 2012). Non-response bias was assessed by splitting the dataset into two sub-groups that represented the early and late respondents. Independent sample tests (Mann-Whitney U) of all the test indicators showed no significant sub-group differences.

SEM-PLS

To determine the most appropriate analysis and testing techniques (parametric vs. non-parametric), all indicators and latent variables were tested for normality (Bollen and Stine 1990; Ringle et al. 2012). As shown in Table 2 in the appendix, the absolute kurtosis/standard error scores exceed two for many of the data points, evidencing univariate non-normality (Cramer 1997). Consequently non-parametric test methods are required, with factor-analysis being inappropriate (Chin 1998). SEM-PLS is used, because it uses very general, soft distributional assumptions and non-parametric prediction-oriented model evaluation measures (Chin 1998; Wold 1982). PLS is appropriate in exploratory research and when latent variable scores are used in higher order modelling. It is also suitable for indirect effect and moderator-mediator analysis (Gefen and Straub 2005; Hair et al. 2014). The significance of each effect is determined using bootstrapping with 1,000 samples (Chin 1998) analysing both the bootstrapped t-statistic and the (bias corrected) bootstrapped percentiles. SmartPLS Version 3.00 M3 was used, as were recent guidelines about reporting the results (Chin 2010; Ringle et al. 2012).

Measurement and overall model quality

All first-order constructs were measured reflectively and so were tested for convergent and discriminant validities (Chin 1998). For convergent validity, as shown in Table 4 in the appendix, indicator reliability was assessed by examining the significance of the construct loadings, and all were significant at $p <$ .001. For construct reliability and validity, Table 3 indicates high internal consistency in terms of composite reliability (Dillon-Goldstein's *rho* ≥ .6 and Cronbach's α ≥ .7) (Bagozzi and Yi 1991; Chin 1998; Fornell and Larcker 1981; Nunally 1978). Convergent validity is confirmed as all average variances extracted (AVE) clearly exceed .5 (Fornell and Larcker 1981). Discriminant validity of the construct *indicators* was examined by assessing the loading of each indicator on its first-order construct, relative to its loading on other constructs. Table 4 confirms that only one first-order construct-specific loading does not exceed .7 (Chin 1998; Hulland 1999) and that each indicator loading is highest for the relevant latent variable construct (Fornell and Larcker 1981). Discriminant validity of the *constructs* is evidenced by the fact that all square roots of the AVE in the diagonal in Table 5 exceed the correlations with the other constructs (Barclay et al. 1995; Chin 1998). Further to that, all heterotrait-monotrait ratios (HTMT) are < .6, far below the required benchmark of .85 (Henseler et al. 2015). In summary, all the standard measurement model quality requirements are met (Chin 1998). The test results for overall model fit (Henseler et al. 2016) shown in Table 6 show that the SRMR, unweighted least squares discrepancy (d_{ULS}) and geodesic discrepancy (d_G) of the estimated model are all smaller than their 95% bootstrap quantile, indicating satisfactory overall model fit.

Results

Table 1 presents the results of hypotheses testing, whereas Table 7 in the appendix contains all other effects of the structural model tested. H1 was a total effect hypothesis (direct *and* indirect) about the overall effect of *FTP* on *BI/A system quality*, which is confirmed in terms of total effect ($\beta = .175$, $p <$ .05) and total indirect effect ($\beta = .165$, $p < .01$) (see below). However, FTPs impact on *BI/A system quality* only indirectly, as those indirect effects fully mediate the significant univariate correlation between *FTP* and *BI/A system quality* (as shown in Table 5), reducing the direct effect between those constructs to a marginal $\beta = .010$ and $f^2 = .000$ (Table 7). The test results for the strengths of the indirect paths in that overall effect, i.e. the paths via *system and data integration* (H1a: $\beta = .072$, $p < .05$, $f^2 =$ .132) and *analytical tools in MA* (H1b: $\beta = .092$, $p < .05$, $f^2 = .153$), confirm those two sub-hypotheses. In both cases, the effect sizes (f^2) of the mediating variables are significant at $p < .05$, and medium in terms of power. H2, which predicted a positive effect of the *use of ERPS in MA* on *BI/A system quality,* was confirmed in all respects, i.e. as direct effect (H2: $\beta = .313$, $p < .001$, $f^2 = .14$), total effect (H2$_T$: β = .423, $p < .001$), and – not hypothesised – indirect effect ($\beta = .110$, $p < .05$; Table 7). As for H3, which predicated at positive relationship between *BI/A system quality* and *MA information service levels*, we find very strong support for our prediction (H3: $\beta = .499$, $p < .001$, $f^2 = .332$), both in terms of effect sizes and significance. Sensitivity analysis revealed that after adding a path from 'ERPS use in MA' to 'MA service levels' the effect of 'BI/A systems quality' remained strong and significant, while the effect

of 'ERPS use in MA' was even marginally negative. Finally, we could also find a significant total indirect effect of *FTP* on *MA information service levels*, thereby confirming H4 ($\beta = .087$, $p < .05$), but the significance of the predicted effect is borderline, as it is only confirmed by the bootstrap confidence interval method (both regular and bias-corrected), but not by the bootstrapped *t*-statistic.

Table 1: Test Results for Hypotheses

Hypo.	***Path:***	***Effect***[1)]	***Coefficient***	***f Square***
H1 – p/reject.	FTP → BI/A QUAL	D	.010	.000
H1 – conf.	FTP → BI/A QUAL	TI	.165**	
H1 – conf.	FTP → BI/A QUAL	T	.175*	
H1a – conf.	FTP → INTEG → BI/A QUAL	I	.072*	.132*[2)3)]
H1b – conf.	FTP →A-TOOL → BI/A QUAL	I	.092*	.153*[2)3)]
H2 – conf.	ERP-MA →BI/A QUAL	D	.313***	.14
H2 – conf.	ERP-MA → BI/A QUAL	T	.423***	
H3 – conf.	BI/A QUAL → MA-SERV	D/T	.499***	.332*[2)]
H4 – conf.[2)]	FTP → MA-SERV	TI=T	.087*[2)]	
	R squares:			
H1, H2	BI/A QUAL		.417***	
	INTEG		.208**	
H3	MA-SERV		.249**	
	A-TOOL		.087*[2)]	

[1)] D = direct effect, I = indirect effect, TI = total indirect effect, T = total effect; [2)] significant only when applying bias corrected confidence interval method; [3)] refers to impact on BI/A QUAL only. Significance 1-tailed: p < .05; p < .01**; p < .001****

Conclusion and Limitations

The aim of this study was to investigate if and how FTPs impact on the quality of BI/A systems, and whether variations in such quality have an impact on information service levels provided by MA. Our results confirm that formally established FTPs, which have IT/IS and/or accounting efficiency related objectives, have an overall positive effect on the quality of BI/A systems. The results further suggest that this positive effect is fully mediated by the positive effect of FTPs on a) system and data integration and b) the adoption and use of analytic software tools in MA, both of which impact positively to the quality of BI/A systems. However, we also find that diffusion rates of analytic tools in MA are still very low.

To eliminate the well-documented effect of ERPS on system and data integration, we control for the presence of such systems, which does not change the above-mentioned indirect effect between FTP and BI/A systems quality. We also confirm a direct effect of ERPS on BI/A systems quality, which suggests there are synergies between those two types of systems – beyond the integration benefits offered by the former. We also find very strong support for the predicted impact of BI/A systems quality on information service levels provided by MA, which partly confirms the benefits previously associated high quality BI systems – but now extended by BA systems. Finally, the results for our path model also reveal that the indirect effects between FTP and BI/A systems quality also 'translate' into an overall indirect effect of FTP on information service levels provided by MA, suggesting that IT/IS and/or efficiency centric FTPs also have an effect on the timeliness and detail of information delivery or accessibility to/for managers.

Our study has several noteworthy implications for academia and practice: So far, FTPs have been promoted primarily by professional accounting bodies and consulting service providers – usually without strong evidence of real benefits. To the best of our knowledge, this is the first cross-sectional research study which investigates FTPs and which empirically confirms benefits associated with formal FTPs, and how they can be achieved (i.e. via system and data integration efforts and the adoption of analytic tools). We also provide valuable evidence that investments into high quality BI/A systems do actually lead to better provision of management accounting information to managers. In terms of measurement, we extend previously established scales for BI-quality by adding a new dimension for BA-quality, and we introduce the concept of and measurement for accounting information service level.

The finding that there are substantial synergies between the use of ERPS for MA purposes and the quality of BI/A systems may create an incentive for the large portion (60%) of firms in our sample which have an ERPS, but do not use it for MA purposes at all. Finally, we add to the academic ERPS literature by finding that the use of ERPS in MA does not directly improve MA service levels, but only indirect via high quality BI/A systems.

Like with all empirical research, we have to acknowledge several *limitations*: Due to the constraints imposed by the survey method, we were not able to collect MA quality perceptions of information consumers, i.e. business managers outside A&F. This required us to reduce our MA quality concept to only selected aspects of information quality. Another limitation – mentioned and explained earlier – is the small response rate and relatively small sample size. Finally, three of our latent variables are new and further research may be required to increase their robustness (esp. for 'A-tools').

Appendix

Table 2: Descriptive Statistics (Questionnaire Items/Indicators)

Indicator	Question (short version)	Scale	Mean/ Median	Std. Dev.	Kurt/ SE	Skew/ SE
FTP_YES	FTP ongoing or completed	Y/N	50.0%	.50	-3.64	-0.00
FTP_IT	FTP with IT/IS related objectives (out of FTP_YES)	Y/N	48.6%	.50	-3.63	0.20
FTP_Effi	FTP with efficiency related objectives (out of FTP_YES)	Y/N	31.4%	.46	-2.42	2.85
ERP_MA	ERP-system with MA functionality, latter used	Y/N	35.4%	.48	-2.83	2.11
MA_info2	Detailed MA info. available to business managers immediately upon request	Likert 1-5	3.67	1.01	0.17	-2.70
MA_info3	Detailed MA info. can be accessed on a real-time basis	1-5	2.90	1.15	-1.26	0.72
MA_info4	Detailed MA info. is reported directly to line managers	1-5	3.63	1.01	0.02	-2.45
INTEG_1	A&F systems integrated by a common, shared database	1-5	3.39	1.08	-0.23	-2.28
INTEG_2	A&F systems: one single enterprise system (ERPS)	1-5	3.39	1.26	-1.35	-1.48
INTEG_3	A&F systems: all data in a single enterprise database	1-5	3.03	1.16	-1.37	-0.61
Tool_BIRep	A&F use of reporting and visualisation systems/tools	1-5	2.54	1.63	-2.32	1.83
Tool_Stat	A&F frequency of use of: statistical suites	1-5	1.34	.71	8.87	7.84
Tool_DSS	A&F use of specialised decision support systems	1-5	1.40	.86	9.87	8.18
Tool_MIN	A&F use of specialised data mining suites	1-5	1.40	.89	9.36	8.24
Qual_rep1	Sophisticated formats and presentation features	1-5	2.97	1.15	-1.29	-0.63
Qual_rep2	Highly interactive reporting features	1-5	2.72	1.21	-1.97	-0.11
Qual_rep3	Very easy to use and navigate by all users	1-5	3.06	1.04	-0.34	-0.71
Qual_rep4	Rapid response and refresh times	1-5	3.00	1.15	-1.64	-0.00
Qual_plan1	Rapid response and refresh times	1-5	2.69	1.29	-1.88	0.68
Qual_plan2	Very quickly updated with actual and base-level info.	1-5	2.71	1.30	-2.02	0.74
Qual_plan3	Allows forecasts /budgets to be quickly created/revised	1-5	2.66	1.24	-1.75	0.79
Qual_plan4	Sophisticated models: easily implemented/changed	1-5	2.28	1.14	-1.32	1.49
Qual_ba1	Rapid response and refresh times	1-5	2.63	1.25	-1.88	0.36
Qual_ba2	Provide solutions for a broad range of business problems	1-5	2.63	1.13	-1.35	0.42
Qual_ba3	Easy to use	1-5	2.65	1.10	-1.91	-0.10
Qual_ba4	Presents output in an appealing & easy to understand way	1-5	2.54	1.15	-1.74	0.41
Qual_ba5	Sophisticated models: easily implemented/changed	1-5	2.45	.98	-1.73	-0.33
Empl	Full-time equivalent range of employees (median)	Range	100-499	1.14	-0.55	1.52

Table 3: Latent Variables

Latent Variable – 2nd Order Model	Cronbach's Alpha	Composite Reliability	AVE
Finance Transformation Project (FTP)	.821	.912	.839
A&F System/Data Integration (INTEG)	.819	.892	.733
Analytic Tools used by A&F (A-TOOL)	.755	.847	.589
ERP System used for A&F (ERP MA)	1.00	1.00	1.00
Quality of Business Intelligence/Analytic Systems (BI/A QUAL) (2nd order)	.843	.905	.760
Management Accounting Service Level (MA SERV)	.759	.856	.668

All significant at p < .001 (based on 2,000 sample-bootstrap)

Table 4: Discriminant Validity (Indicator Cross-Loadings)

					BI/A QUAL			
	FTP	INTEG	A-TOOL	ERP MA	REP QUAL	PLAN QUAL	ANALY QUAL	MA SERV
FTP_EFFI	***.870***	.228	.130	.148	.118	.097	.216	.023
FTP_IT	***.960***	.301	.356	.184	.230	.138	.327	.219
INTEG_1	.233	***.876***	.117	.359	.392	.404	.310	.173
INTEG_2	.255	***.874***	.168	.416	.436	.366	.357	.209
INTEG_3	.277	***.818***	.114	.219	.409	.275	.323	.101
TOOL_REP	.076	.047	***.549***^	-.058	.357	.059	.217	.114
TOOL_DSS	.291	.070	***.697***	.062	.185	.128	.202	.061
TOOL_MIN	.215	.170	***.857***	.024	.387	.202	.397	.320
TOOL_STAT	.288	.160	***.912***	.095	.310	.169	.333	.249
ERP_MA_Y	.184	.396	.052	1.00	.383	.441	.374	.193
QUAL_REP1	.193	.372	.212	.216	***.748***	.343	.498	.434
QUAL_REP2	.091	.342	.376	.313	***.820***	.456	.556	.394
QUAL_REP3	.174	.352	.285	.266	***.814***	.391	.450	.186
QUAL_REP4	.196	.458	.369	.400	***.811***	.674	.627	.338
QUAL_PLAN1	.125	.416	.170	.412	.608	***.912***	.563	.348
QUAL_PLAN2	.179	.394	.151	.375	.521	***.927***	.593	.341
QUAL_PLAN3	.030	.275	.115	.395	.467	***.922***	.570	.310
QUAL_PLAN4	.146	.408	.262	.427	.592	***.888***	.631	.328
QUAL_BA1	.244	.418	.331	.411	.592	.665	***.879***	.516
QUAL_BA2	.225	.326	.381	.302	.615	.578	***.918***	.574
QUAL_BA3	.342	.352	.279	.377	.603	.588	***.932***	.489
QUAL_BA4	.357	.304	.424	.263	.660	.563	***.925***	.420
QUAL_BA5	.219	.334	.315	.327	.564	.508	***.839***	.284
MA_INFO2	.229	.199	.241	.285	.356	.392	.465	***.869***
MA_INFO3	.129	.221	.264	.159	.390	.302	.500	***.877***
MA_INFO4	-.053	-.038	.075	-.090	.280	.129	.204	***.689***^

All outer loadings significant at p < .001; all outer weights significant at p < .001, except for those marked with ^, where p < .05; all outer VIF scores < 3.00.

Table 5: Discriminant Validity (Latent Variables)

	FTP	INTEG	A-TOOL	ERP MA	BI/A QUAL	MA SERV
FTP	**.916**					
INTEG	.296 .351	**.856**				
A-TOOL	.295 .327	.157^ .185	**.767**			
ERP MA	.185^ .199	.396 .428	.051^ .091	1.00		
BI/A QUAL	.253 .281	.489 .586	.382 .465	.454 .499	**.872**	
MA SERV	.157^ .193	.190^ .230	.259 .343	.189^ .249	.499 .586	**.817**

a) *Fornell-Larcker Criterion: AVE-squared in diagonal (bold) compared with latent variable correlations (first value underneath diagonal);*

b) *Heterotrait-Monotrait Ratio (HTMT) (second value underneath diagonal). All correlations and HTMT values significant at p < .01, except for those marked with ^, which are significant at p < .05.*

Table 6: Model Fit

	Saturated Model	95%	99%	Estimated Model	95%	99%
SRMR	.088	.089	.094	.091	.116	.131
d_{ULS}	1.065	.978	1.203	1.118	1.822	2.351
d_G	.413	.649	.783	.411	.709	.888