

Published in: Martin Quinn and Joao Oliveira (Eds.): Accounting for Alcohol: An Accounting History of Brewing, Distilling and Viniculture, Routledge, 2018, pp. 11-27.

The introduction of accounting machines at Guinness

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Introduction

In contemporary research, the introduction of new technology is viewed as often leading to organisational improvements and advantages. To gain such benefits, it seems essential for organisations to *adapt* such technology and to *adapt to* such technology (Orlikowski, 1993; Szulanski, 2000). Such adaptation processes seem challenging since organisations may have to develop new behaviours and organisational routines to reap the full benefits of new technology. In many cases, organisations have to go through a learning process that allows new technology-related routines to evolve or to change existing routines through an evolutionary process (Nelson and Winter, 1982). In such processes, collective participation of organisational actors is often required (Edmondson et al., 2001).

Historically, the most common goal of the introduction of new technologies has been cost reduction (Wilson, 1989). Since a significant share of management accountants' daily work is described—both in the contemporary and the historical accounting literature (e.g., Granlund and Lukka, 1998; Hiebl et al., 2015; Johnson, 2002)—as being focused on accounting for and reducing costs, we could establish that management accountants would be very open to the introduction of new technologies. However, to an important degree, management accountants' work routines can also be affected by new technologies. For instance, management accountants may benefit from new technology by gaining easier and faster access to data they need to analyse, which may enable them to speed up reporting processes. Besides such direct effects, there can also be indirect effects on management accountants. For example, new technology may lead to a general change in management practices, organisational structure and business processes, which then in turn affects the work of management accountants who have to reflect such broader organisational changes in their accounts and reports (Granlund and Malmi, 2002).

So it may be theorized that technology and technological change are of high importance for management accounting and management accountants. Nevertheless, there is a debate in the contemporary accounting literature on whether or not new technology has strong effects on

management accountants and management accounting routines. In this context, most contemporary studies are focussed on the effects of enterprise resource planning (ERP) systems on management accounting. Two principal positions have emerged from this literature. While some studies conclude that new technology such as ERP systems has only a relatively moderate impact on management accounting (e.g., Granlund and Malmi, 2002), others find more significant changes in the role of management accountants following the introduction of new technology (e.g., Scapens and Jazayeri, 2003). While we do not aim to sort out these opposing positions in this chapter, we argue that the literature on technological change in management accounting has been remarkably singular as to the form of technological change—that is, the introduction of ERP systems.¹ We argue that historically, the rise of ERP systems has not been the only technological innovation that has affected management accountants and that historical accounts offer a rich and more complete source for the study of the effects of new technology on management accounting. This is why in this chapter, we study an early form of technological change—the introduction of typewriters in the first half of the 20th century. We do so by presenting a historical case study on the introduction of Smith Premier accounting machines at Arthur Guinness, Son & Company Limited (hereafter Guinness).

With this study, we aim to provide a historical answer to the question on the effects of new technology on management accounting and the work of management accountants. We also aim to provide a more complete picture on management accounting in the brewing industry during the first half of the 20th century. While a series of studies in this field have been published recently (e.g., Hiebl et al., 2015; Kristandl and Quinn, 2017; Martínez Franco et al., 2017; Quinn, 2014; Quinn and Jackson, 2014), such studies do not yet illuminate the role of technological change. Our chapter, however, shows that technological change was an important driver of management accounting change, even in the early 20th century. More specifically, this chapter paints a picture of the direct and indirect effects of new technology and the implications for the management accounting profession at Guinness. This contributes to the extant historical literature, but also provides some counterbalance to the contemporary literature which—at least in parts—suggests that new technology has only a relatively moderate impact on management accounting. Our findings reveal that the introduction of Smith Premier Accounting machines facilitated and reinforced processes of management accounting change at Guinness.

¹ Only recently, there have been calls for research on the effects of more recent technological change such as digitalization (e.g., Quattrone, 2016) or big data (e.g., Gärtner and Hiebl, 2018) on management accounting

The remainder of this chapter is organised as follows. In the next section, we review the extant literature on new technology and management accounting change, which is the background in which we position this chapter. The following section then describes our historical research methods and afterwards, we detail the introduction of Smith Premier Accounting machines at Guinness. In the final section, we conclude the paper with a discussion of our findings and we provide suggestions for future research.

New technology and management accounting change

Throughout history, the business environment has been changing constantly. Such change may have various effects on firms. It may increase the pressure to lower total costs, reduce inventories, shorten processing times, provide more reliable delivery dates and better customer services, expand the product range, improve quality and efficiently coordinate global demand, supply, and production. If such pressures materialize, organisations are sometimes forced to reinvent themselves and ignite organisational change. One way to drive change is adopting new technology in order to sustain competitiveness and to adapt to the changing environment (Edmonson et al., 2001; Umble et al., 2003).

Information technologies are thus often conceptualised as drivers of change that are able to transform organisational structures and social contexts. Such transformation can be observed both at the micro and at the macro level and is considered to have significant effects on individual actors and organisational structures (Applegate, 1996; Caglio, 2003; Hiltz and Johnson, 1990). At the same time, the social contexts of actors and organisations are known to be important factors in driving the adoption and use of new information technologies (Davis and Taylor, 1986; Noble, 1984; Perolle, 1986; Wyne, 1988). Since actors' behaviour is significantly shaped by organisational culture (e.g., Allaire and Firsirotu, 1984; Meek, 1988), we can follow that organisational culture plays an important role in the successful implementation of new technology. Schneider (2000) defines organisational culture as the character or the personality of an organisation and the ways things are done in an organisation. There is reason to believe that organisational culture is crucial for employees' general acceptance and understanding of a technological change. Park et al. (2004) suggest some key cultural attributes, which have moderate to high positive correlation with the success of new technology implementation. These attributes include team-oriented work, trust, working closely with others, sharing information freely, fairness and enthusiasm. However, there are

also cultural attributes which are known to hinder successful adoptions of new technology. Such factors include stability, compliance, attention to detail and being calm.

Researchers such as Quinn and Jackson (2014) suggest that organisational change, in general, and management accounting change in particular, should be viewed as a process rather than a static event. Similarly, Scapens and Jazayeri (2003) find the process of introducing new technology to rather be evolutionary than revolutionary. This means that such change occurs slowly and in certain stages over time. Such slow change may be explained by the routine nature of accounting. Changing institutionalized accounting routines may only be possible over time since more abrupt change may face severe resistance. In this connection, new technology may again be an important factor. Edmondson et al. (2001) suggest the introduction of new technology to be a premier trigger for changing routines. In line with this notion, Granlund and Malmi (2002) found that organisational practices such as management accounting are typically changed to fit new technology, not *vice versa*.

As described above, changes in management accounting may be triggered and explained by technological innovation. The literature provides well-developed concepts and a large body of empirical results on the study of the adoption and implementation of technology. For instance, Fichman (1992) defines an innovation as any idea, practice or object that is perceived as new by the adopter. The adoption of such innovations is contingent to factors which determine the ultimate rate and pattern of adoption. Amongst such factors are personal characteristics of adopters (e.g., their level of education, their level of cosmopolitanism), the stages of the adoption decision, and the actions of certain individuals who can influence the adoption (e.g., to accelerate adoption). For technological innovation that affects organisational routines deeply ingrained in organisational structures, as is the case for many management accounting practices, further implementation characteristics are important factors for the adoption and diffusion of innovation. These implementation characteristics are organisational complexity (number of people and functions affected), divisibility (ability to divide implementations by stages or sub-populations), and transferability (communicability and maturity) (Leonard-Barton and Deschamps, 1988).

For centuries, accounting was a manual process. In large organisations, prompt access to financial information was basically impossible due to a need to conduct extensive and time-consuming manual searches through bound ledgers. Starting in the late nineteenth century, a series of technological innovations emerged that not only changed the way accounting processes were conducted but also dramatically changed the information that was provided,

and thus, the accounting profession in its own right. The mechanical era was dominated by devices that were dependent upon the mechanical actions of levers, gears, and wheels to process data. Although hand-operated at first, later mechanical devices were often electric or motor-driven. The mechanical period lasted for two more decades until there emerged a second major innovation in information processing, the computer (Wootton and Kemmerer, 2007).

In the first half of the twentieth century, the introduction of mechanical technology was led by the strong presence of American companies such as Remington Rand and IBM and the favourable disposition of banks to adopt any technology innovation which would enhance their economies of scale. At this time, banks were particularly open to technological innovation since they had significant numbers of employees engaged in repetitive tasks and wage demands—work that could be largely automated due to the introduction of more sophisticated machines. In the particular case of a medium-sized bank in Lille (Crédit Du Nord), the introduction of 25 accounting machines in 1927 reduced the number of employees by 12 percent (Bonin, 2004). At this time, there also emerged a network of specialists actively involved in the banking sector. This network met regularly at conferences and discussed the best ways of incorporating machines into their organisations and the changes to be implemented in accounting processes (Bonin, 2004). In line with these developments, also requirements for accountants changed. For instance, the original exam syllabus of the Institute of Cost and Works Accountants issued in 1919 included mechanical knowledge and workshop knowledge, including the relations between costs and design (Bhimani and Bromwich, 2009).

Largely disconnected from these historical findings, a considerable amount of contemporary research has been conducted on the implementation processes of ERP systems in the management accounting literature of the 1990s and early 2000s². This literature has mostly sought to analyse the effect of ERP systems such as SAP, Baan and Oracle on management accounting practices. An ERP system comprises a set of integrated application modules, which spans most business functions including accounting. Ideally, such systems also enable users to access real-time from different information bases on all aspect of the business. To enable such benefits, the adoption of ERP systems can require organisations to change their ways of working. This is why ERP systems can be an important driver for business process re-

² Precursors of ERP systems were manufacturing resource planning (MRP) systems, which sought to maximise efficiency in the timing of raw material orders and in the scheduling of machining and assembly in the manufacturing process (Bhimani and Bromwich, 2009). For more detailed information on the development of these systems, please refer to Kumar and Meade (2002) who reviewed contemporary developments in planning systems and how ERP emerged.

engineering (Scapens and Jazayeri, 2003). There are studies which claim ERP systems have had an important impact on management accounting and accountants, while others only find moderate such impacts. Advocates of a significant impact of ERP systems on management accounting (e.g., Anastas, 1997; Edmonson et al., 2001; Fichman, 1992; Scapens and Jazayeri, 2003; Umble et al., 2003; Wilson, 1989) argue that ERP systems can support the integration of financial and management accounting data and processes, fostering a unified enterprise view of the business. Regarding the accounting profession, ERP systems may contribute towards the reduction of accounting personnel, they may enhance the role of management accountants, they may create new requirements for accountants and accounting systems and they can eliminate or change accounting routines. They also offer the possibility of online data access without the need to wait for periodic reports, they can improve and standardize the flow information, they offer more forward-looking information and they can generally decrease the cost of information.

Caglio (2003) suggests that these various impacts of ERP systems on management accounting can be traced back to three structural effects of ERP systems on management: a higher degree of standardization of practices, a stronger need for integration and inter-functional collaboration, and a more prominent role of the accounting department in the management of the information technology system (Caglio, 2003).

Such views of a significant impact of ERP systems on management accounting are contrasted by other studies which conclude that ERP systems have only little (immediate) impact on management accounting. Reasons for such limited impact include the long time needed to implement ERP systems. In consequence, the impacts arising from ERP systems may be slow to emerge. Such introductions of ERP systems may also come with considerable complexity and the need to adapt the ERP systems to different departments, the need to transfer and integrate information from various prior systems and organisational actors' resistance to change. While these issues may all be challenging for management accountants, studies arguing for only limited impacts of ERP systems on management accountants find that such systems do not change, but only reinforce existing management accounting routines. They conclude that ERP systems may facilitate a change in the way management accounting routines are performed, but not in the underlying nature of these routines (Granlund and Malmi, 2002; Maccarone, 2000; Booth et al., 2000).

As indicated above, in this chapter, we do not aim to assess whether the introduction of ERP systems has any material impact on management accounting. However, for the analysis of our

historical study on the introduction of typewriters as an early form of technological innovation in management accounting, we will draw on the above contemporary literature.

Archival sources

Our research is based on records from the Guinness archive. These archival records generally extend from 1759 to date, with a 30-year hold on document release. The archive holds more detailed records from Guinness' listing on the stock market from 1886 on. We chose Guinness as a case example since a series of recent studies (e.g., Hiebl et al., 2015; Martínez Franco et al., 2017; Quinn, 2014; Quinn and Jackson, 2014) shows that the Guinness archive covers detailed internal accounting records. Most importantly here, there is also an array of records covering the period of the introduction of Smith Premier Accounting machines around 1928-1929.

Table 1.1 - Archival records related to the introduction of Smith Premier accounting machines at Guinness.

Archival Classification	Brief description
Ordering of Smith Premier Accounting machines	Records of orders of Smith Premier Accounting machines, letters between Guinness and the Smith Premier company requesting changes in machines and stock count.
Ordering of supplies in connection with accounting machines	Records of orders of steel cabinets, chairs, boxes, envelopes, ledger cards, account forms, etc. in connection with accounting machines, statements examples with different changes and stock count.
Instructions to ledger-keepers	Files of instructions from the Chief Accountant to ledger keepers about the use of the Smith Premier Accounting machines, the established period of accounting information, the information format, statements examples of customers and instructions about the implementation of Smith Premier Accounting machines in new stores of different districts.

After initial contacts with the archivist, we were granted access to the archive and—with the help of the archivist—searched for documents related to the introduction of Smith Premier Accounting machines. In Table 1.1, we present a summary of the archival records that emerged as relevant from this search. We grouped these records into three clusters: (1) documents related to ordering Smith Premier Accounting machines, (2) documents related to ordering

supplies in connection with the accounting machines and (3) documents related to instructions to ledger-keepers. All the archival records were examined in detail and digitally photographed for ease of analysis.

Generally, the quality of archival documents can be assessed by four criteria: authenticity, credibility, representativeness and meaning (Scott, 1990). As argued by Quinn and Jackson (2014), the archival sources at Guinness comply with all these criteria. Also for our study of the introduction of Smith Premier Accounting machines, the archival sources studied conform with these criteria, too. First, all documents were examined locally at the archive, which grants them authenticity. Second, the records seem credible because they consist of written internal reports, orders, instructions, memoranda and other documents from the Accountant's Department. Third, while we cannot be sure that these records are representing the introduction of accounting machines at other firms at this time, we know from related research that the accounting operations at Guinness in the first half of the 20th century can be regarded as typical of this time in history (Hiebl et al., 2015; Quinn and Jackson, 2014). We thus suggest our findings are representative of the introduction of technological innovation in management accounting in the first half of the 20th century. Finally, the documents examined contained cross references to other documents, were clearly filed and typed. They thus carried excellent comprehensibility and comply with Scott's (1990) requirement for meaning.

The introduction of Smith Premier Accounting machines at Guinness

Company and technological background

Arthur Guinness started to brew ale in Dublin in 1759 with £100 he inherited. He then signed a 9000-year lease at the St. James's Gate Brewery (Lynch and Vaizey, 1960). The first export of ale to England occurred in 1769, which marks the start of highly successful exporting activities which today spans most countries worldwide. In 1799, Arthur Guinness ceased to brew ale and instead, he focused on improving the brew of his popular black beer "porter". Guinness continued to grow its global market share and in 1886 was listed on the London Stock Exchange (Quinn and Jackson, 2014).

It was around this time—in 1872—that the first mass-produced typewriter was introduced. It was designed by Christopher Latham Sholes who worked for the Remington Typewriter Company. The typewriter quickly gained popularity and from 1889 onwards, and many

typewriter manufacturers appeared, among them the Smith Premier Company. The Smith Premier typewriter appeared in 1890. Key characteristics of this typewriter were its relief of cattails and flowers and the columns casting into the sides of the machine. Instead of the levers used on earlier machines, this machine was designed with cranks and rods that could be easily adjusted for optimum control (Early Office Museum, 2017). A second model appeared in 1895, without the ornately decorated sides. Starting with the SP3 model in 1901, the machine had a total of 84 keys (the SP1 and 2 had 76 keys each) and was available in different carriage widths on the models 4, 5 and 6. In 1908, Smith Premier launched the SP10, the only full-keyboard front strike typewriter ever built. The SP10 was the last of the “real” Smith Premiers. After the demise of the company, the brand name was bought by the Remington Typewriter Company which continued to launch regular office machines and portables with the name Smith Premier (The Typewriter Database, 2017). Until 1940, when the Smith Premier production ended, four more models were manufactured (models 30, 40, 50 and 60). The last model— the Smith Premier Typewriter No. 60 “C” (see Figure 1.1)—was acquired by Guinness in 1928.

Archival records findings

The Smith Premier accounting machines were introduced to the Accountant's Department at Guinness in 1929. Our findings indicate that this form of technological change was materially driven by Walter Phillips, the Chief Accountant of the time. According to Hiebl et al. (2015), Phillips was the Chief Accountant of Guinness from 1919 to 1938. There is no evidence that Phillips had any professional training qualification and indeed Martínez Franco et al. (2017) indicate that chief accountants at Guinness fulfilled their roles by “learning on the job” — in particular learning from their predecessors. In the case of Walter Philipps, this was learning from his predecessor J.A. Hayes and serving as Deputy Chief Accountant to Hayes. So while Philipps had little external training, some literature describe him as an “expert accountant” whose technological contribution marked a new stage in the Accountant’s Department of the company (Dennison and MacDonagh, 1998; Hiebl et al., 2015).

From our archival findings, November 13, 1928 marks the first time the Smith Premier company contacted Walter Phillips. The company thanked Phillips for visiting their stand at a business exhibition the same day, and as promised, enclosed a specimen of Ledger and Statement prepared simultaneously on the Smith Premier Ledger Posting Machine. They also indicated to be pleased to call before the end of the week to explain the details of the system as

applied to his own work more fully. Three days later, Phillips granted them a meeting and the same day, received a quotation for a Smith Premier Accounting machine. The cost of the No. 60 “C” Cross Accounting Machine was £212/19/11.³ It was characterised by writing length of 12½ inches and fitted with electrical equipment, quick insertion lever, star proof of clearance, palm tabulator and tabulating keys, and oblique figures. Furthermore, the machine was equipped with 1-8 wheel vertical sterling totalisers with a capacity of printing numbers up to £9,999/19/11 in the debit column; 1-9 wheel vertical sterling totalisers with a capacity of printing numbers up to £9,999/19/11 in the credit column; and, 3 dummy totalisers and 1-9 wheel vertical sterling totalisers with a capacity of printing numbers up to £9,999/19/11 in the debit and credit balances. The Smith Premier company indicated the training of operators would be undertaken by them, until the operators were satisfied that they were fully competent on the machines and the system. According to Smith Premier company letters found in the Guinness archive, this was a usual procedure when these machines were installed at that time. The Smith Premier company also informed Phillips that the machine came with a guarantee for twelve months for full up-keep and repair, and after that period a maintenance contract could be entered for “a small cost per annum”. In November, 1928, Phillips asked for some potential adaptations to the machines and finally, at the end of the next month, Phillips requested permission to borrow one of their accounting machines to give it a thorough trial under normal working conditions. In the archival records, Phillips signalled that he was convinced that the machines would save a good deal of time when the staff had got familiar with them because in particular, no separate staff for the actual writing of accounts would be needed and the balancing of the ledgers would be facilitated. For three months, the accounting staff of Guinness tested and worked with the Smith Premier machine. Finally, on March 21, 1929, Phillips ordered two more machines for trial. He confirmed, judging from their experience, it would be wise to adopt this method of keeping their ledgers and they would require a considerable number of machines. At the same time, he argued that it was expedient to go slowly in the matter since the transition from the old methods to the new could not be effected in a hurry.

³ To put this cost into perspective, the annual salary of Clerks in the Accountant’s Department at Guinness ranged from £170 to £540 around the time investigated in this chapter (Hiebl et al., 2015). So the Smith Premier Accounting machines can be considered as costly since their cost is roughly comparable to an average Clerk’s annual salary at that time.

Table 1.2 – Ordering of Smith Premier Accounting machines at Guinness (1928-1929).

Date	Newly ordered machines	Total machines in operation
December 21, 1928	1	1
March 6, 1929	2	3
April 16, 1929	2	5
May 13, 1929	3	8
June 20, 1929	4	12
June 25, 1929	20	32
October 17, 1929	4	36
November 14, 1929	1	37

In the initial trial runs, there were three loaned machines at the Accountant’s Department for a total of almost four months. By April, 1929, Phillips seemed to be fully convinced with the machines. On April 16 1929, Phillips got Board permission to pay for the trial machines and he also ordered two more machines. In that order, he informed the Smith Premier company that it would be necessary to purchase a good many more of these machines before the installation could be regarded at complete. And so it was: in less than a year, the Accountant’s Department of Guinness had installed a total of 37 machines. Table 1.2 details this ramp-up of Smith Premier accounting machines in operation at Guinness’ Accountant’s Department. We found a large order of twenty machines in June 1929. This exceptionally large order can be explained by a 10% discount offer by the Smith Premier company. At the same time, the archival records suggest that it seemed hard for Philipps to accurately estimate the quantity of work each machine would be capable of doing. This may explain—besides aiming for a smooth transition as indicated above—why Phillips did not order all the machines at once, but approached the eventual number of machines needed step-by-step over 1929.

While the introduction of Smith Premier accounting machines spanned all of 1929, there were quite immediate effects. While the number of machines introduced in the Accountant’s Department increased, the Accountant’s Department staff numbers decreased. This decline was also noted by Hiebl et al. (2015) who hinted that the decrease by 11 people (from 61 to 50) at the Accountant’s Department from 1929 to 1931 may be due to the introduction of Smith Premier Accounting machines. This relatively large reduction in headcount can also be explained by the large amount of paper to be printed by the Accountant’s Department. In 1929, all Guinness departments required 1,152 bound ledgers from the Printing Department for the

coming year, of which 972 were for direct use by the Accountant's Department. So it seems as if the largest impact by the introduction of typewriters could be observed at the Accountant's Department since this department accounted for the vast majority of ledgers to be printed.

Besides orders for Smith Premier machines, orders were also made for the purchase of accessories such as steel cabinets, chairs, boxes, envelopes, ledger cards and account forms. From the archival records, it becomes obvious how tests were carried out and changes were requested to adapt the format to the needs of the work procedures, the required information and the accounting machines. Characteristics such as texture, font size and letters were adapted to the ledger cards, envelopes and account forms. Also, different colours were set to differentiate accounting information for different districts. Boxes were supplied for holding ledger cards of different measures and steel cabinets were installed to save the machines with locks or keys. These changes following the introduction of Smith Premier Accounting machines signal that this form of technological innovation in management accounting not just had an effect on the staff members (in terms of reduced staff members), but also on the further materials which were part of the accounting routines at Guinness of that time.

These changes in routines and procedures in the Accountant Department in order to adapt to the use of new technologies and take advantage of them also directly materialized in the archival records analyzed. We found letters, memos and reports that contained numerous instructions from Phillips to the ledger keepers. The ledger keepers were given instructions on how to calculate the basis for discounts on customer purchases with the help of the Smith Premier machines. It was recommended to rather rely on standard rates than on the cash value of beer, as the difference between the two hardly affected the final results; so customers would not appreciate the extra detail of information.

The accounting clerks also received instructions on the frequency of sending accounting information to customers. In this case, we can directly see the effect of the machines on the outputs of the Accountant's Department. In March 1929, Phillips proposed sending out the balances to customers on a *monthly* basis, regardless whether the level of activity with each customer was high or low. Before this time, customer balances were sent out only when a minimum activity level with the customer was surpassed and if not, were sent out only every three months. Since the machines now allowed for an automatic calculation of the customer balances with little effort by the Accountant's Department, the new monthly frequency of sending out customer balances was adopted—although this action resulted in some increased costs for envelopes and postage. The majority of the departments expected that the customers

would appreciate the receipt of such information on a monthly basis. In addition, the availability of monthly balances would also provide better and more recent information in cases of customer doubts regarding the correctness of the numbers. So at the end of March, 1929, a total of 770 accounts of customer balances were sent out and from this date, the balances were sent out every month. The individual balances were accompanied by some introductory text which indicates the automatic nature of the production of these letters:

“The balance of your account at the end of the period for which this Statement is furnished is the last item shown in the Balance column. If shown in black, the amount is due by you (debit); if in red the amount is due to you (credit). Any beer ordered but not dispatched before the end of the period will be charged in the next Statement”.

In this context, a requirement that was agreed to ensure the correct functioning of the machines, was that accountants must have all the documentation available at the end of the first business day of the month. This should ensure that they could check the records in the different accounting books that the stock of beer was not fictitious. To do this, following the introduction of the Smith Premier machines, they established that the days of the month included in Table 1.3 must be respected to update the quantities in the respective books

Table 1.3 – Deadlines for sending out accounting information at Guinness in 1929

Department	Deadline
Secretary Department Journal	12 noon penultimate working day of the month
Cask Department	12 noon penultimate working day of the month
Cash Books	First day of the month
Emergency Journal	The day before penultimate working day of the month
Charges Keeper	Last two days of the month

The archival records show that this new procedure resulted in complaints from some other departments who argued that they could not meet the deadlines as they were working with customers from fifty different countries, with half of them having credits granted, and that they needed to wait until the last day of the month to make the records. The Chief Accountant became aware of the situation and consequently allowed the records to be made no later than between the 1st and 2nd day of the subsequent month. Besides these automated monthly

balances, checks of discount allowances could be automated thanks to the Smith Premier accounting machines. This automation enabled the Audit Department to omit their manual checking of the discount allowances. The machines gave them a check of the total discount allowed. The records indicate that both the auditor and the Chief Accountant agreed and recognized the advantage of the extra hours saved with this change. During the implementation period of the machines, the archival records also indicate that not only the accountants at Guinness headquarters, but also the stores in the different districts incorporated the machines, albeit only in a gradual process. They, too, received detailed instructions on the changes of procedures and routines by the Accountant's Department. Although we could observe from the archival records how some work in the Accountant's Department was automated due to the use of new technology, there were cases in which errors were discovered in the calculation of customer balances. Consequently, the Chief Accountant gave instructions on how to inform the customers when an error was discovered beyond the monthly deadlines and how their balance would be corrected in the next statement.

To summarize, we can identify various effects on the accountants' work at Guinness following the introduction of Smith Premier Accounting machines. There were mainly time savings and staff and cost reductions due to the automation of accounting tasks. In addition, thanks to automation, there also arose an opportunity to provide customers with periodic information on their balances on a more regular basis. The Smith Premier Accounting machines also provided some benefits for other actors such as auditors since they could rely the automated calculation of total discounts allowed to customers instead of performing manual checks. Of course, these benefits did not come without a cost. Besides the costs for the machines, there arose also the need to adapt various other working material to the needs of the new machines. In addition, the accountants needed additional training by external experts on the functioning of the accounting machines. This applied not just the Accountant's Department, but also to store clerks who received detailed instructions on how to operate the new machines from the Accountant's Department.

Discussion and concluding comments

This chapter sought to analyze the effects of technological change on management accounting in the brewing industry from a historical perspective. From archival records of Guinness, we can conclude that the introduction of the Smith Premier Accounting machines in 1929 had different effects on the Accountant's Department of Guinness. When comparing our historical

case with findings from the contemporary literature—which is mainly focused on the effects of ERP systems on management accounting—we can observe various similarities, but also some differences.

First, similar to the introduction of ERP systems (Anastas, 1997; Edmonson et al., 2001; Fichman, 1992; Scapens and Jazayeri, 2003; Umble et al., 2003; Wilson, 1989), the introduction of Smith Premier Accounting machines at Guinness resulted in quite substantial changes to the work of accountants. There were routines which were eliminated such as the audit control on discounts. We can also identify that customers could now get information on a monthly, standardized and automatic basis, which was an important step forward in that time. This automation seemed to lead to a reduction of staff and to lower information costs. This reduction in staff numbers seems to be different to ERP adoptions discussed in the more contemporary literature. This contemporary literature rather finds that automation and time savings thanks to ERP systems leads accountants to free up time for more “value-adding” tasks such as advising management (e.g., Gärtner et al., 2013). Thus, despite the important role of the Chief Accountant (see below), we can theorize that some of the accounting clerks in the 1920s performed more repetitive tasks that could be replaced by machines. Our evidence suggests that freeing up their time using Smith Premier machines did not result in them changing to other tasks. Instead, they were dismissed. Thus, it seems as if accountants nowadays are better equipped to master technological change since they can revert to other, and potentially more value-adding tasks than accountants in the 1920s.

Similar to contemporary studies on ERP system adoptions, we can identify problems or disadvantages that come with technological change in accounting (Booth et al., 2000; Granlund and Malmi, 2002; Maccarone, 2000). For instance, this chapter underpins the complexity of the implementation and adaptation of different staff members and departments to new technologies, the need to educate users and initial technical problems associated with technological change. However, our findings suggest that Guinness dealt successfully with these challenges. It is not entirely clear from the archival records what was the driver of this successful change. The brewing sector potentially was a good place to use such technology due to the large numbers of comparable customers and transactions, and thus the inherent opportunity for standardization and automation. Moreover, the context of the Economic War in Ireland and the Great Depression gave rise to the need for cost reductions. Finally, the enthusiasm of Phillips and his active role involved in ensuring that the implementation of these

machines turned out successful, and that all operators received adequate training, could be another key success factor.

We also observed that the process of implementation was not ad-hoc, but rather gradual and spread over more than one year. From our findings, it seems as if the department needed time to adapt to the machines for an effective use and first of all, they needed to take an initial trial to check the suitability of the new technology for their requirements. During this implementation process, the machines were also adapted to the working procedures so that they could be used as effectively as possible. In a contemporary study on the adoption of ERP systems, Granlund and Malmi (2002) argued that it is rather organisational practices that are changed to fit new technology, not *vice versa*. In Guinness, we can observe that both the practices were changed to fit the new machines, but also the machines were somewhat adapted to fit the needs of the Accountant's Department. So our case suggests that this relationship is not necessarily one-directional.

When further comparing our work here with the contemporary literature on ERP systems and accounting, the gradual implementation of the accounting machines at Guinness happened over time, and thus not in a “big-bang” way sometimes suggested for the introduction of ERP systems (e.g., Gargeya and Brady, 2005; O’Leary, 2000). The gradual process at Guinness can thus be much better compared to so-called “gradual phase-in” ERP system adoptions (e.g., Abdinnour-Helm et al., 2003; Hiebl et al., 2017). The chapter highlights that this technological change was very much driven by the Chief Accountant at Guinness. This indicates that it is not only nowadays, that Chief Financial Officers and other accounting leadership personnel—who can well be compared to the position of the Chief Accountant at Guinness in the 1920s (cf. Martínez Franco et al., 2017)—exert decisive influence on technological choices (Hiebl et al., 2017). This reinforces some recent findings in the literature that in the earlier parts of the 20th century, leading accountants were not just “bean counting”, but were very much engaged in matters of value-adding activities and organisational change more generally (Hiebl et al., 2015; Martínez Franco et al., 2017).

Our study has some limitations and points to some future research needs. First, the Guinness archive represents a single case study and our results may not be readily generalizable to other firms of that time. Second, we focussed on a time frame which is devoid of accounting regulation in comparison with today. Third, we could not observe accounting practices in real time—we “just” analysed artefacts from an archive which could possibly not represent a complete picture of the accounting practices at that time. It would thus be advisable to study a

longer timeframe to complete our findings and the evolution of the process over time. It would of course be very interesting to compare this study here with the introduction of the same or a similar technology in other companies at the same time in history.

To finish, we believe that much can be learned from historical studies on technological change in accounting as our work highlights that the challenges and obstacles to be overcome were similar to those faced in contemporary accounting-related technological change. The benefit of historical accounts, however, is that the underlying change can likely be analysed more holistically as the aftermath of such change should already be well known and/or recorded. We therefore argue that the analysis of historical technological accounting change is not only of value to a more complete understanding of accounting phenomena, but may also provide valuable hints for technological change in contemporary organizations' accounting processes.

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