Surveying forecasting: a review and directions for future research

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ABSTRACT

How is forecasting doing in today's world? It's a question researchers have been asking for a long time. For half a century, we have been surveying practitioners, conference attendees, other academics, managers and high-level executives. From the introduction of forecasting in organisations onward, we have questioned technique use and familiarity, accuracy and evaluation methods, the place of forecasting within organisations and the hurdles and barriers that prevent forecasting from evolving as fast in practice as it does in academia. This paper summarizes these findings and concludes with a number of recommendations for future surveys, as we will need to continue tracking the state of the art of forecasting practice. Recommendations includes surveying the analysts rather than the forecasting managers, using an international sample, focussing on process-oriented performance measures and looking into the barriers that prevent a more widespread adoption of sophisticated forecasting techniques.

Keywords: forecasting survey, practitioners, forecast improvement

INTRODUCTION

The world has changed dramatically over the last half century. The technological change is unstoppable and pervades every aspect of personal and business life. In business especially, a number of trends over the past decades have made a significant impact: the globalization of the market, the proliferation of consumer products, e-commerce, fast deliveries and an overall reliance on technology. These trends have had an impact on what is required from business in terms of forecasting. In order to know what exactly is required from forecasting, this paper looks at the best source we have in this respect: the practitioner. More specifically, this paper summarizes over forty years of forecasting surveys, beginning with "Sales forecasting methods and accuracy" (Dalrymple, 1975) and ending with the most recent survey at the time of writing, being "Mind the gap – Assessing maturity of demand planning, a cornerstone of S&OP" (Vereecke et al, 2018).

METHODOLOGY

This study considers surveys aimed at forecasting practitioners, forecast software providers and users, and researchers in the field of forecasting. The topics covered in this review are forecasting in business practice, and more specifically, operational and sales/demand forecasting. Whenever results in this paper cover forecasting methodologies and use of software support systems, these are reported. Papers focusing exclusively on software (e.g., Fildes, Schaer & Sventukov, 2018) and methods are not included (e.g., M competitions; Makridakis et al, 1993). The focus on operational and sales forecasting implies that this review does not cover studies on political forecasting, financial forecasting or economic forecasting. Political, financial and economic forecasting in itself are fields that are more different than they are similar to business forecasting. They are often more concerned with long term trends and cycles, while business forecasting focusses on short to medium term forecasts. The Google Scholar

search engine was used initially. In a first phase, the keywords *forecasting survey, practitioners survey forecasting*, *sales survey forecasting* and *demand survey forecasting* were entered. Only journal articles were selected. A number of older books exist that contain surveys, referenced for instance in Dalrymple (1975). However, these are not considered as they are no longer found in libraries across the world. The conference board surveys, often referenced in older papers, are not considered either as the Conference Board itself no longer hosts these reports on their website. Non-English journals were not considered. The Google Scholar search delivered 38 papers that reported on surveys of practitioners and managers in the field of sales, demand or operational forecasting. An additional search via Web of Science and via Scopus delivered an additional two papers (Mady, 2000; Zotteri & Kalchschmidt, 2007).

The papers that are considered in this manuscript are listed in Table 1, which lists its authors and date, the location of the sample, the sample size (and the response rate), the surveyed profile in the sample and the focus or theme of the survey. The main objective of this paper is to provide a review of the history and lessons learned for the future: Are we focussing on the right questions? Are we asking enough questions, i.e. are academics aware of the current issues in business forecasting and can we make practitioners themselves aware via these surveys? Are we still fighting the same battles in an attempt to improve forecasting accuracy?

This paper starts off in 1975: In the earliest paper of this overview (Dalrymple, 1975), a large number of participants (64%) recognized the importance of forecasting for their success. Simultaneously, over a quarter of respondents indicated that forecasting was *not* critical for their firm. While forecasting nowadays is recognized as a vital part of the everyday success of an organisation, in the seventies, surveys could not simply assume that everyone they contacted in their sample did forecasting. In that time period, the first question was indeed: 'do you forecast'? Dalrymple (1975) found that its importance was recognized more by retailers and by larger organisations. This can, in part, be explained by simple logistics. In that decade, few

companies had access to computers. Some shared a computer with other firms, other managed to get computer calculations by employing consultants. However, forecasting use was already gaining momentum. Dalrymple (1975) compares his results with an earlier study (1967) and finds that more departments than before make use of forecasts. One year later, Wheelwright & Clarke (1976) report that "virtually all" companies in their sample seem to be committed to forecasting. This is therefore the start of this overview.

THEMATIC OVERVIEW

Technique familiarity and usage

The studies in the seventies and eighties focus mostly on usage and familiarity of techniques. The two techniques most often cited as popular are jury of executive opinion and sales force composite. Both show that technology was not yet wide spread, or perhaps not yet widely trusted. Companies relied on judgmental methods more than they did quantitative ones. Sales people especially, were seen as a valuable source of information as they are closest to the customer. In 1978, Rothe (1978) dedicated a survey solely focussed on sales forecasting methods. Similar to earlier reports, he found that judgmental methods still reigned supreme. He noted in his conclusion that these methods, based on opinion, seem to be overused, rather than turning to more quantitative methods (something that still sounds familiar nowadays). Many companies at the time did not even attempt trying simple quantitative methods (e.g., moving average, regressions), let alone the more complicated ones at that time (e.g., Box-Jenkins) (Dalrymple, 1975). Rather than a technological exercise, forecasts were a group effort of sales people or managers. Dalrymple (1975; p. 72) even states: "A correlation between the number of persons and the size of the error ($r = -.17$), implies that the more people involved, the better."

Mentzer & Cox (1984a) published a paper that focussed on the use, performance, and satisfaction with sales forecasting techniques. Notably, those who were surveyed in this paper

were sales forecasting managers and not analysts. They focus specifically on managerial experiences, enabling them to dig deeper into the decisions associated with forecasting, evaluation criteria and adoption rates of new techniques. Similar to the studies of the seventies, they found that familiarity with judgmental techniques was still significantly larger than with quantitative techniques, with jury of executive opinion and sales force composite still topping the list, and Box-Jenkins dangling at the end of the familiarity continuum. These results are largely confirmed in a UK study in the same year (Sparkes & McHugh, 1984). While another study of these authors in the same year (Mentzer & Cox, 1984b) cited formal training as the most important factor in increasing accuracy, this paper reports that only half of the respondents had received training in forecasting techniques, of which the largest part had taken a college course in forecasting, a quarter followed forecasting seminar and a quarter attended both. It is therefore perhaps not surprising that familiarity with quantitative techniques is still quite low compared to the qualitative techniques. Of those who used quantitative techniques, most were quite satisfied with them. Yet again, Box-Jenkins appears to be the unwanted player in the field of the forecasting techniques, with 57% of its users reporting dissatisfaction with the technique. Rather surprisingly, between 20 and 30% roughly, reported dissatisfaction with the omnipresent qualitative techniques. An explanation is not provided by the authors. Fildes & Lusk (1984) note that the reports on usage and satisfaction with forecasting techniques in the aforementioned papers may be influenced by the surveyed participants: both Mentzer & Cox (1984a) and Sparkes & McHugh (1984) had a sample that consisted of 85% and 100% managers respectively. Fildes & Lusk (1984) on the other hand, surveyed analysts (90% of the sample) recruited in specialist meetings and conferences. Consequently, their results differ from previous findings: most noticeably, Box-Jenkins, largely ignored by managers, is well-known to the analysts in this sample. This survey paints a more positive overall picture for the usage, satisfaction and familiarity with quantitative techniques. Fildes & Lusk (1984) do note in their

conclusion that some type of favouritism seems to be going on: analysts have their preferred method and do not always consider alternative techniques. Yet, despite this remark and noticeable difference in results, surveys that followed were still oriented towards sales managers and business executives, rather than analysts.

A small avalanche of surveys, all published by the Journal of Business Forecasting, followed in the late eighties and early nineties, focussed on techniques (Herbig et al, 1993; Kahn & Mentzer, 1994; Keating & Wilson, 1987; Peterson, 1989; 1990; 1993; Wilson & Daubek, 1989). Keating & Wilson (1987) compared 'business professionals' (role not further defined) with those who taught forecasting, in their rating of importance of the different forecasting techniques. As expected, the business professionals preferred qualitative methods, while the faculty placed more importance on quantitative techniques. Wilson & Daubek (1989) looked at marketing managers and found similar ratings of familiarity with qualitative and quantitative techniques as the earlier studies of the eighties. Interestingly, while Mentzer & Cox (1984a) found only 26% of surveyed firms using computer models, Wilson & Daubek (1989) report 'widespread use of computers'. Presumably, distinction must be made here between 'using a computer' (e.g., spreadsheets) and 'using a computer model' for forecasting. Only 13% reported not using a computer in the 1989 study. Peterson (1989; 1990) was the first to focus exclusively on qualitative methods in his surveys. In the first paper, he focussed on sales force composite, frequently cited as the most popular technique in sales forecasting. The method uses estimates from sales peoples, which are generally reviewed and consolidated into a single number by sales managers and/or corporate executives. Amongst other things, he reports on possible issues with the technique, which may provide an explanation for the dissatisfaction reported with qualitative techniques in Mentzer & Cox (1984a): time is often not sufficient to do a good job and submit forecasts in time as a rush job, and are often overly optimistic. In his 1990 paper, Peterson digs deeper into the general role of expert's judgment in sales forecasting.

Nearly 60% of surveyed firms indicated expert judgment to be the primary source for forecasts. Kahn & Mentzer (1994) report on a survey that provides evidence for team-based forecasting over other methods. Other journals followed the survey trend. Sanders (1992) was the first to report on a combination of quantitative and qualitative methods: “The majority.. stated that they always or frequently adjust quantitative forecasts.”. Quantitative methods were becoming more commonplace. Yet, forecasting management did not let go of their judgmental methods. This was confirmed in a later survey by the same author (Sanders & Manrodt, 1994), who found that nearly half respondents always adjusted their quantitative methods. The three most often stated reasons for this were: incorporation of (1) environmental knowledge, (2) product knowledge, and (3) past experiences. This type of information is generally situated under contextual information, which under specific circumstances can contribute to forecasting accuracy (Kerkkänen & Huiskonen, 2014).

Mentzer & Kahn (1995) published a paper which compared familiarity, satisfaction, usage and accuracy, the four big themes of the past decade, with the 1984 study of Mentzer and Cox. They found that familiarity with qualitative techniques appeared to be decreasing, while familiarity with quantitative techniques was increasing. The effects were small but consistent. The most liked qualitative technique (jury of executive opinion) took a nosedive in satisfaction ratings. People were now quite satisfied with quantitative techniques such as exponential smoothing, regression and decomposition, still popular today. While qualitative methods were previously reported to have been used across both short, medium and long term horizons, this now shifted more towards long term forecasts. The majority of the firms made forecasts from 3 months up till two years ahead, using both qualitative and quantitative techniques. This paper was compared with a survey by McCarthy et al (2006). This elaborate paper focusses on technique familiarity, usage, satisfaction and forecasting management. Regarding techniques, they find the following: (1) an overall decrease in familiarity with forecasting techniques, (2)

the most satisfaction with exponential smoothing and regression, and (3) an increase in reliance on quantitative techniques for all horizons.

Fildes & Goodwin (2007) published a survey that focussed on the role of judgment in forecasting. Their survey is based on a subset of principles from an earlier published handbook on the 'principles of forecasting' (Armstrong, 2001). Their study surveyed 144 forecasters attending international forecasting conferences and five forecasters from separate firms who were involved in case studies. Of these, 90% confirms that the main objective of forecasting is to produce forecasts that are as accurately as possible, given the resources at hand. It would therefore be logical that they follow the principles of forecasting, as defined in the handbook (Armstrong, 2001).They find that, contrary to what the principles suggest, firms overuse judgment in their forecasting process, do not record reasons for adjustment (which may improve accuracy) and not evaluate the effectiveness of their judgmental interventions. Judgment was used in itself in one quarter of the companies, or in combination with quantitative methods in half of the companies. There are two ways of looking at this result: one can conclude that judgment is still omnipresent in today's organisations, found in 75% of the cases. Or, in 75% of the cases as well, statistics were used. Depending on your position in life, one can be carefully optimistic about principle 1 and principle 2: use quantitative rather than qualitative methods and limit the number of subjective adjustments. Yet, one can also point out that judgment is still used in the majority of the companies, and was rated as very important (a 4.1 on a 1 to 5 scale of importance). A number of reason were given for this abundant use of judgment, with 'promotional activity' topping the list. However, some of the reasons given could have been integrated in the quantitative model, state Fildes & Goodwin (2007). This could be a symptom of either a gap in knowledge in what quantitative models can do, or a more persistent tendency to adjust even when the reasons are not that clear. Some even indicated that they adjusted to reflect a preference or a decision, rather than the actual forecast number, which leads to a

blurring of the line between both (Goodwin, 1996). According to the principles (Armstrong, 2001), this could be prevented by asking forecasters to give a reason for adjustment and/or use structured techniques for combining methods. Around 64% claimed to give reasons for using judgment, but the authors express their doubt in the usefulness and comprehensibility of these reasons (shorthand, not codified, ..).

Evaluation and accuracy

How do we evaluate our forecasts? A noticeable trend in the early forecasting surveys, is that forecasting errors were and could be reported. Despite a lack of technology, over 81% of the companies in the 1975 study kept track of their past errors – something that is often missed in companies nowadays, despite the almost limitless on- and offline storage abilities available. Early studies report average errors between 5% and 10% (Dalrymple, 1975; Pan et al, 1977; Rothe, 1978; Wotruba & Thurlow, 1976). Of course, such numbers were highly dependent on the type of business, on the methods used and whether a firm did or did not use consultants and computers. As Kolassa (2008) would later remark, such reported errors cannot really be used as benchmarks, since the processes that lead up to them are so inherently different between firms.

The eighties brought about a range of studies focussing on the role of the methods used in forecasting. In addition to familiarity and usage, measures of satisfaction and accuracy were introduced. Carbone & Armstrong (1982) asked practitioners and academics at the very first International Symposium on Forecasting what they deemed to be the most important evaluation criteria of a forecasting method. Not surprisingly, ease of accuracy was located at the top position, with the Mean Square Error (MSE) being the most popular among both academics and practitioners. The top evaluation criteria for forecasting methods are in order of appearance: accuracy, ease of interpretation, cost time, ease of implementation and adaptive to new conditions. Mentzer & Cox (1984a) have a more or less similar list from practitioners, but add

'credibility' in second place after 'ease of use' but before 'cost'. Other criteria were also mentioned (universality, capturing turning points, robustness and incorporation of judgmental input) but far less frequently by both groups. Academics and practitioners were more similar than they were different in their evaluative criteria, with two exceptions: universality was deemed important by three times more practitioners than academics, while robustness was three times more important to academics than to practitioners. Mentzer & Cox (1984b) focussed further on the determinants of forecasting accuracy. They found that accuracy declined when moving down from high level forecasts (e.g., industry level, corporate level) to the lowest level of individual product forecasts. They further found an effect of dollar sales volume (with higher volumes leading to lower accuracy), industry (wholesale and retail outperformed manufacturing, which could be due to the closer link with the customer), level of preparation of the forecast (improved accuracy with higher level preparers) and formal training (positive effect and the largest impact of all variables). The latter was present in around 60% of surveyed business schools (Hanke, 1984; 1989), although a self-selection effect in responses may have elevated this number. Mentzer & Cox (1984b) note that, while some factors can be controlled (e.g., formal training), the largest explanative factor in accuracy is and remains the quality of the data. Mentzer & Kahn (1995) report MAPE as having become very popular in firms: 52% used this error measure, with the previously popular MSE dropping to third place with a mere 10% using this measure.

A surprising fact was reported in the 2007 survey of Fildes and Goodwin: only 44.3% report that they review their forecasting accuracy. Of those who did, the majority used MAPE. Note that Dalrymple (1975) reported almost double the amount of companies keeping track of their performance. It is surprising to say the least, that in this day and age of unlimited storage space, both online and offline, forecasts would not be tracked and evaluated, while this was the case over forty years ago

Position of forecasting

Where in the company does forecasting occur? Wotruba & Thurlow (1976) focussed on sales force participation in forecasting, being the first to define a specific location for forecasting: the sales department. They questioned managers of the sales departments on the motivation of their sales people to forecast accurately and if bias was present. They found that the type of compensation did not have an effect on the direction of forecast error and that, in disagreement with their initial hypothesis, salespeople did not underestimate more than they overestimated. This was the first survey that positioned forecasting in a specific role and immediately highlighted possible biases that could be associated with this. Around the same period, Wheelwright & Clarke (1976) made a distinction in their survey between the preparers of the forecast (the sales people) and the users (management). Users were much less confident in the ability of the preparers than they themselves were. While 10% error was often acceptable for the preparer, the user was the one who suffered from the real-time consequences. They were critical of the preparer's technical competencies and if forecasts made by these preparers were even useful. In the other direction, preparers felt that users lacked the skills to evaluate their forecasts effectively.

In the 1992 survey of Sanders, a quarter of the respondents asked for more management support. Drury (1990) found earlier that only one fifth of companies indicated that forecasting is directly related to the response of management. So, who is in fact responsible for forecasting and achieving sufficient accuracy? In the Drury (1990) study, responsibility for forecasting was located mainly with the financial planners (52%). Nearly one fifth of respondents had a designated forecasting and planning staff, and 14% thought the responsibility should be located with management. Peterson (1993) was among those first who questioned the place of forecasting within the organisation. He asked who prepared the forecasts (top management, followed closely by finance, and marketing), asked about bottom up (mostly large retailers)

versus top down forecasting (mostly small retailers) and in which functional area forecasting was used mostly (marketing, followed by top management, and HR). West (1994) published a study which looked at the number of forecasting methods used and who this related to the *context* of forecasting. While earlier studies report on contextual influences, these findings were never the primary focus of the survey (West, 1994). Similar to Peterson (1993), West's study reports on the relationship between number of forecasting methods, accuracy, the organisation and the process of forecasting. Companies report that marketing and sales personnel is strongly represented at the stage of inputting data and drafting the forecasts, while top management is mostly involved in inspecting and approving the forecasts. West (1994) further looked into the relationship between these findings and the number of methods used. He finds a U-shaped relationship between number of methods, such that both low and high levels of accuracies are associated with the usage of more forecasting methods. The number of methods was also related to the involvement of marketing in all stages of the forecasting process, and with increased involvement of top management at the inspection stage. The role of other departments (e.g., finance, production) was smaller.

In 2006, also mentioned above in the techniques section, McCarthy et al (2006) published a longitudinal review of forecasting surveys, and performed their own survey. Their results are more optimistic than the latest reports up until that point: over half of the companies (56%) report employing a cross-functional team for forecasting that consolidates forecasts across departments. Thirty-four percent reports having one department responsible (usually sales and marketing) and 10% uses a decentralized approach, referring back to the islands of analysis found in Moon et al (2003).

Barriers and hurdles

How can we improve forecasting? A very early survey that looked into potential avenues for improvement was the one by Wheelwright & Clarke (1976). They were ahead of their time, in that they formulated a number of obstacles for better forecasting: lack of effective communication between preparers and users, lack of skills required for effective forecasting, disparity in preparer and user perception, and failure of a company to plan its development of the forecasting techniques. Similar to Wheelwright & Clarke (1976), Peterson (1990) includes a section in his questionnaire dedicated to issues associated with (judgment by experts) forecasting. Lack of information, training and inadequate timing are reasons most often cited as barriers for better forecasting.

In 2001, Hughes (2001) published a paper on organisational issues in forecasting practice. He sent out mail surveys to electronics manufacturing firms and firms in the financial services sector in Scotland. He states that the latter is very different in results than the manufacturing firm, which is why these results are not considered in this paper on sales and demand forecasting surveys. Again, this survey was addressed to managing directors and the responses are therefore very similar to previous studies oriented at managers: a strong preference for judgmental techniques, lack of technical knowledge and avoidance of quantitative techniques, insufficient training, limited reported use of computers. Interestingly, Hughes (2001) explicitly asked after the barriers and hurdles found in the company that prevent better forecasting. The most often stated reason was 'insufficient time due to other work' by over 40% of the respondents. This was followed by insufficient resources, limited historical database, insufficient training and lack of computer resources/skills. The latter was confirmed by Sanders & Manrodt (2003). Hughes (2001) concludes that there was not a great deal of support from top management for a separate forecasting function, resulting lack of time, resources and training. Additionally, in a follow-up case study in the same paper, it became

clear that communication between different parts of the organisation was a real issue. These findings are found as well in the IBF 2000 survey, reported in a Journal of Business Forecasting editorial (Jain, 2001): very few companies have a separate forecasting department (only 7%). Nearly 70% complained about communication issues between different functions: different conflicts of interest stood in the way of improving accuracy. This survey was more positive about computer use and model usage especially, but this could be due to the audience (being attendees of IBF conferences and tutorials). Moon et al (2003) performed an in-depth audit into 16 companies and found a number of themes associated with forecasting that confirm the findings of Hughes (2001): limited commitment, in the sense that there were insufficient resources allocated to training, data management, software and support and a lack of accountability throughout the organisation: no forecasting 'champion' existed. Communication was again raised as an issue: forecasting systems were not interconnected, resulting in 'islands of analysis'. They also mention a blurring of what a forecast, a plan or a goal is, and limited evaluation of forecasts. The latter is surprising, as earlier papers did report a widespread storing and evaluating of forecasting performance data (Dalrymple, 1975; Pan et al, 1977; Rothe, 1978; Wotruba & Thurlow, 1976).

Fildes & Petropoulos (2015) published a survey with a question that is core to the forecasting literature: what are the issues that arise in forecasting practice? The authors identify several problem areas and asked participants in the survey to rate these issues in terms of importance for improving the quality of the forecasting process. The top four issues were (t1) availability of internal data, (t2) evaluation of accuracy, (t3) organisational issues and (t4) the effective use of judgment. On a positive note, those who relied solely on judgment had dropped from about a quarter to now 15.6%. The majority of the respondents (37.1%) indicated that they manually adjusted statistical forecasts. The bottom four issues, seen as playing less of a role in forecasting accuracy, were (b1) changes by senior managers, (b2) over-reliance on Excel, (b3)

technical support quality and (b4) quality of forecasts received from other companies. As the authors note, b1) changes by senior managers, is a rather surprising factor to find at the bottom of the importance list. It should be noted that it was still deemed 'important' or 'very important' by nearly half of the respondents. It's these adjustments specifically that can lead to biases, as senior managers often mix targets or desires with forecasts. Regarding b2) and b3), we might suspect that this is due to a greater reliance and widespread use of forecast support systems nowadays. Smith & Mentzer (2010) found user's perception of the quality and access to the forecast support system to play an important role in forecast performance. These authors focus on task-technology fit in Forecast Support Systems (further denoted as FSS). They note that, in order to improve performance, features of FSS need to be perceived as being of sufficient quality and easily accessible. Collaboration (b4) is an ambivalent issue. While European studies show positive impact of external collaboration, other studies do not support this hypothesis (Nakano, 2009). The main focus is internal data: it is mostly this type of data that was reported being used in forecasts, while simultaneously also being the largest hurdle (Fildes & Petropoulos, 2015). Surprisingly, a recent audit (Vereecke et al, 2018) found more or less equal scores on the usage of internal and external data. This audit focusses on six domains of forecasting 'maturity': data, method, system, performance, organisation and people. The paper mentions average scores per domain and sub question, but does not provide more information on hypothesis testing of the differences between the different variables. Interestingly, the domain that scores the lowest is that of 'system', which asks specifically about the internal linkage of the forecasting systems and availability of feedback reports. To end on a positive note, the highest scoring dimension is that of 'organisation': it seems that the surveyed participant pool has a clear ownership structure in place for the forecasting process, support from top management and a dedicated forecasting team.

DISCUSSION

Based on this overview, we can draw a number of conclusions about past survey research and how we should proceed in the future. A number of themes have emerged: the technique usage and familiarity, accuracy and evaluation of forecasts, its position within the wider organisation and the potential barriers that exist on the road to achieving forecast accuracy. Ideally, future surveys include every aspect mentioned above. General overview surveys can show us important links between scores on perceived barriers and accuracy, techniques and accuracy and so on. Importantly, looking at possible barriers in forecasting practice allows us to orient ourselves towards providing solutions in close collaboration with the practitioner. In addition to a call for broad surveys, a number of recommendations for forecaster researchers are formulated. First, the sample should be selected carefully, such that is representative of the right people. A trend in the surveys summarized above is that they are often oriented at managers, especially in the early days, which might have skewed the results as they were the users of the forecasts and not the preparers. Wheelwright & Clarke (1976) found noticeable differences in forecast evaluation between both groups. A distinction should be made as well between a sample collected at professional training courses and conventions: a self-selection effect exists here as those who are further along in the forecasting process, are generally those who attend trainings and seminars. Thus, a first guideline for further research is to focus on a sample of *practitioners who are the providers of the forecast*. While the user of the forecast can provide an interesting perspective, the core issues will be identified by the analysts themselves. Second, while this was not yet mentioned above, it is obvious from Table 1 that most studies use north American data. A cultural bias may exist here. A second guideline for further research would thus be to include *an international sample*. Given today's easy access to the internet, this should be feasible. However, a note should be made here. It seems that the number of surveys has gone down the last twenty years, despite the ease of today's online distribution (online

questionnaires, e-mails). An electronic survey may be less inviting or elicit less direct commitment, as an e-mail is only one of many. Reaching a sufficiently large sample will require commitment from both the researcher and the practitioner. Third, as Kolassa (2008) notes, it is hard to compare accuracy numbers and form benchmarks. Every survey in this overview has studied a different aspect of forecasting, has a different market, forecasting process, different accuracy measures and different ideas about what constitutes a good forecast. It is therefore not logical to compare across surveys. Rather, companies should focus more on qualitative targets and focus on process improvement. Future surveys should therefore focus more on *process-oriented measures* of performance. One might look at (desired) bias, survey levels or implications for those further down the operational line. Fourth, technique adoption seems to have stalled or at least lags. This may point towards certain barriers in practice. Thus, it makes sense to start asking more general organisation-process questions. How is forecasting organized? Who fulfils the role of forecaster? What hurdles exist in the business world for improved technique adoption and subsequently, improved accuracy? Additionally, with the rise of Forecast Support Systems, more complex techniques are often hidden or seen as being part of the black box of forecasting. An important avenue for future research is thus working on the acceptability of techniques delivered by computer software. Fifth and last, the guidelines above should be part of a survey that focusses on the hindrances to improving forecast accuracy, or more widely, *barriers* to the adoption of more widespread use of modern techniques. Such knowledge is necessary to test out solutions via action research. A number of in-depth case studies have been done over the past few years, giving us unique insights into forecasting practice. However, survey research is and remains relevant to gain a holistic view on practitioners, including those who might not be open to sharing data, but are open to sharing experiences in an anonymous way.

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Table 1: overview of relevant survey papers

Authors & year	Location of sample	Sample size (+ response rate)	Surveyed profile	Focus of survey
Dalrymple (1975)	US - Midwest	175 (35%)	Midwestern businessmen	Techniques (usage and accuracy)
Wotruba & Thurlow (1976)	International	202 (36%)	Members of the Sales and Marketing Executive – International chapters in San Francisco and LA	Sales force participation
Wheelwright & Clarke (1976)	US	127 (25%), of which 67 matched responses	Preparers and users of the forecast in major corporations	Techniques (commitment and results)
Pan et al (1977)	US	139 (55%)	Large industrial firms	Techniques (usage and accuracy)
Rothe (1978)	US (Texas)	52 (17%)	Manufacturing firms in the eleven county Dallas-Ft. Worth from the Texas Directory of Manufacturers	Techniques (usage and accuracy)
Carbone & Armstrong (1982)	International	145 (29%)	Participants of the First International Symposium on Forecasting (academics and practitioners)	Evaluation criteria
Hanke (1984)	US	324 (51.5%)	Member institutions of the American Assembly of Collegiate schools of Business.	Teaching forecasting
Mentzer & Cox (1984b)	US	160 (32%)	Midwestern Business people	Accuracy

Mentzer & Cox (1984a)	US	160 (32%)	Forecasting managers in U.S. companies	Techniques (usage and management)
Fildes & Lusk (1984)	UK & US	Not reported (31%)	UK: Operational Research Society, US: First International Symposium on Forecasting + Wharton workshop attendees	Techniques (familiarity and accuracy)
Sparkes & McHugh (1984)	UK	76 (25.3%)	Members of the Institute of Cost and Management Accountants	Techniques (awareness and usage)
Dalrymple (1987)	US	134 (16%)	Executives of US companies	Techniques and practices
Keating & Wilson (1987)	US	150 + 153 (not reported)	Teaching members of the American Economic Association	Techniques in teaching and practice
Mahmoud et al (1988)	US	67 (33.5%)	Firms on the Fortune 500 list	Techniques (usage)
Hanke (1989)	US	194 (34%)	Member institutions of the American Assembly of Collegiate Schools of Business	Teaching forecasting
Wilson & Daubek (1989)	US	168 (11.2%)	Members of the American Marketing Association	Techniques (usage and accuracy)
Peterson (1989)	US	35 (38.8%)	Sales managers of firms on the Fortune 500 list	Sales force composite forecasting
Peterson (1990)	US	37 (14.1%)	Sales managers of firms on the Fortune 500 list	Expert opinion methods

Sanders (1992)	US	82 (16.4%)	Managers responsible for forecasting of US companies	Techniques (usage), problems and needs
Peterson (1993)	US	247 (35.3%)	Large and small retailers in the US	Techniques, bottom-up vs top-down, who forecasts and who uses the forecasts, accuracy
Herbig et al (1993)	US	150 (15%)	Small and large US businesses from business lists	Comparisons on type of firms
Sanders & Manrodt (1994)	US	96 (19.2%)	US companies	Techniques and management practices
Kahn & Mentzer (1994)	Not mentioned	208 (43.5%)	Forecasting executives	Forecasting teams, accuracy and satisfaction
Herbig et al (1994)	US	150 (15%)	Forecasting/Marketing manager samples from Fortune, Forbes and Business week)	Comparison between Industrial and Consumer product firms
Hanke & Weigand (1994)	US	317 (42.7%)	Member institutions of the American Assembly of Collegiate Schools of Business	Teaching forecasting
West (1994)	Canada	310 (37%)	Sample of Canada's Micromedia's ltd. Profile data bank	Techniques (number and type) and management (organisation and processes)

Mentzer & Kahn (1995)	US	207 (43%)	Forecasting executives from the list of Mentzer and Cox (1984a)	Replication study of Mentzer and Cox (1984a)
Mady (2000)	Egypt	30 (not mentioned)	Sample of state-owned manufacturing enterprises	Techniques, location and computer use
Hughes (2001)	Scotland	81 (32%)	Electronic (and Financial) companies listed in the report by the Scottish Development Agency	Techniques and barriers
Jain (2001)	US	Not mentioned (not mentioned)	Participants of the IBF conferences and tutorials in 2000.	Forecasting function and accuracy
Kahn (2002)	US	168 (PDMA: 11%, George Tech lab: 20%, IBF: 34%)	PDMA practitioner members, sales forecasting managers associated with Georgia Tech's Marketing analysis laboratory, & executives attending IBF 1999 Tutorial Conference	Techniques, differences between consumer and industrial firms
Sanders & Manrodt (2003)	US	240 (10.3%)	Heads of marketing of US corporations	Forecasting software (usage, performance and satisfaction)
McCarthy et al (2006)	US	86 (18%)	Forecasting executives	Forecasting management, techniques (usage, familiarity, satisfaction, accuracy)

Zotteri & Kalchschmidt (2007)	Italy	60 (6.4%)	Global Manufacturing Research Group questionnaire developed in Italian non-fashion textile and machine tooling companies	Forecast process, usage, supply chain cooperation, organisation
Fildes & Goodwin (2007)	Not mentioned	149 (not mentioned)	Attendees of five international forecasting conferences (US) + five forecasters in other companies	Adherence to the forecasting principles defined by Armstrong (2001)
Smith & Offodile (2007)	US	118 (not mentioned)	Project managers of manufacturing companies in the Pittsburgh, PA metropolitan region	Forecasting as a predictor for supply chain management
Nakano (2009)	Japan	65 (25.4%)	Members of the Japan Institute of Logistics Society	Collaborative forecasting
Smith & Mentzer (2010)	Not mentioned	216 (78.54%)	Individuals responsible for forecasting at the samples companies	Predictors of forecast accuracy
Fildes & Petropoulos (2015)	Not mentioned	47 (not mentioned)	Demand planners and forecasters	Issues for improving forecasting accuracy
Vereecke et al (2018)	Western Europe	128 (not mentioned)	Western European companies	Maturity of the forecasting process