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STRATEGIC MANAGEMENT ACCOUNTING IN AUSTRALIAN MANUFACTURING FIRMS - A STUDY OF TOOLS AND TECHNIQUES FOR EFFICIENCY IMPROVEMENT IN THE CURRENT FOURTH INDUSTRIAL REVOLUTION CONTEXT

Abstract*: Much progress has been achieved in research works on SMA and the scope of modern analytical tools in SMA techniques. Although there had been many reviews on SMA techniques and their adoption by firms around the world, research on the application of analytical tools like artificial intelligence (AI), big data analytics (BDA) and cloud computing (CC) in SMA techniques had been fewer. This review aimed at assessing the relative extent of research done on these two aspects and the findings obtained from them. Google Scholar was used to search for papers and the PRISMA flow process was used to screen and select the papers. A total of 41 papers were obtained from these methods for this review. These papers were discussed under three main sections: Papers on the use of advanced analytical tools in SMA by firms, SMA (strategic management accounting) techniques used by Australian manufacturing firms and Use of advanced analytical tools for performance improvement by Australian manufacturing firms.However, since the adoption rate of SMA itself is low, using advanced analytical tools in SMA has been still low. Low levels of (negative) adoption of both SMA techniques and tools are due to a lack of awareness, lack of the required skills, lack of resources and resistance to change. The first two of these barriers could be addressed by training employees about SMA, and its techniques and tools. Incremental implementation of SMA and the tools with increasing availability of resources over time may solve the resource problem. Effective change management strategies and positive organisational culture towards changing to SMA and tools can solve the resistance problem. But the current low levels of adoption do not indicate the possibility of changing the organisational culture.*

Keywords: *Strategic management accounting, efficiency improvement, fourth industrial revolution, literature review*

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1. Introduction

Since the introduction of the term "strategic management accounting" by Simmonds (1981), much progress has been achieved in the theoretical aspects and adoption of strategic management accounting (SMA) by firms in different countries. SMA has been shown to cause a positive direct and/or mediating effect on several aspects of firm performance. SMA techniques have been listed differently by different authors. Tools required for different purposes listed by CGMA (2013) are given in Table 1.

A comprehensive list of SMA techniques proposed by different authors was provided by Petera and Šoljaková (2020) in a review (Fig 1).

Table 1. SMA tools for different purposes

Tool Category	**Examples of Tools/Software**
Spreadsheet Software	Microsoft Excel
Enterprise Resource Planning (ERP)	SAP, Oracle ERP, Microsoft Dynamics 365
Data Visualization Tools	Tableau, Microsoft Power BI
Costing Software	Activity-Based Costing (ABC) Software
Budgeting and Forecasting Software	Adaptive Insights, Anaplan, Hyperion
Variance Analysis Tools	Variance analysis modules in ERP systems
Financial Reporting Software	QuickBooks, Sage Intacct, Xero
Dashboard Tools	Klipfolio, Geckoboard, Google Data Studio
Business Intelligence (BI) Tools	QlikView, MicroStrategy, Sisense
Risk Management Software	Riskalyze, IBM OpenPages
Customer Relationship Management	Salesforce, HubSpot CRM, Zoho CRM

Table 1. SMA techniques used in empirical research.

Technique	Cadez and Guilding (2007; 2008)	Cescon et al. (2019)	Cinquini and Tenucci (2010)	Dmitrović-Šaponja and Suljović (2017)	Guilding et al. (2000)	This study
Activity-based costing	no	no	yes	yes	no	yes
Attribute Costing	yes	yes	no	yes	yes	no
Balanced scorecard	no	yes	no	no	no	no
Benchmarking	yes	no	yes	yes	no	yes
Brand valuation	yes	yes	no	no	no	no
Brand value budgeting	no	no	no	yes	yes	no
Brand value monitoring	no	no	no	yes	yes	no
Competitive position monitoring	yes	yes	yes	yes	yes	no
Competitor accounting	no	no	no	no	no	yes
Competitor appraisal based on FS	yes	yes	yes	yes	yes	no
Competitor cost assessment	yes	yes	yes	yes	yes	no
Customer accounting	no	no	yes	no	no	yes
Customer profitability analysis	yes	no	no	yes	no	no
Environmental management accounting	no	no	no	yes	no	no
Integrated performance measurement (PMS)	yes	no	yes	yes	no	yes
Life-cycle costing	yes	yes	yes	yes	yes	yes
Lifetime customer profitability analysis	yes	no	no	no	no	no
Quality costing	yes	yes	yes	yes	yes	yes
Risk analysis	no	yes	no	no	no	no
Strategic costing (strategic cost management)	yes	no	no	yes	yes	yes
Strategic management accounting	no	no	no	no	yes	no
Strategic planning and budgeting	no	no	no	no	no	yes
Strategic pricing	yes	yes	no	yes	yes	yes
Target costing	yes	yes	yes	yes	yes	yes
Valuation of customers as assets	yes	no	no	no	no	no
Value chain costing	yes	yes	yes	yes	no	no
Number of techniques	16	12	11	17	12	11

Source: Authors.

Figure 1. A comprehensive list of SMA techniques

None of the authors used all techniques. Out of 26 SMA techniques listed, a maximum of 17 were used. Survey results of Petera and Šoljaková (2020) showed the three most-used SMA techniques in descending order as strategic planning and budgeting, customer accounting, and target costing. The least-used SMA techniques, in ascending order, were integrated PMS like balanced scorecards, strategic pricing, and activity-based costing. The importance of customer costing and the appearance of target costing as a preferred SMA technique was pointed out. Strategic planning and budgeting are new findings as a high-use SMA technique.

Currently, many modern analytical tools are used on the data obtained from SMA. In the current fourth industrial revolution period, the internet and related information technologies like big data supported by cloud-based analytical tools and access to distributed ledgers (blockchain), and AI combined with web-based business models are rapidly transforming the digital economy and industry by automating decision-making, improving financial visibility and facilitating timely interventions, when there is professional legitimacy among the management accountants (Moll & Yigitbasioglu, 2019).

These technological advancements and disruptions are leading to significant changes in the underlying infrastructure of SMA. The use of these advanced analytical tools facilitates the implementation of SMA techniques to improve the firm performance in the current industry 4.0 revolution.

Thus, the scope of using modern tools in SMA is clear. However, research on the application of these tools in the SMA techniques listed in Fig 1 is rare. Still rare are works specific to (Australian) manufacturing sector.

The above observation prompted an intention to take stock of the status regarding using modern tools in SMA techniques in manufacturing firms in general with an added stress on the Australian manufacturing firms. Thus, this paper is aimed to provide a systematic review of the literature on the status of research on the use of modern tools in SMA techniques in (Australian) manufacturing firms. The remaining part of this paper is organised in the following manner. After a short description of the method used for selecting the literature, the results of the review have been presented in the following manner. First, papers on advanced analytical tools used in SMA have been reviewed.

The main tools were artificial intelligence, big data analytics and cloud computing and combinations of them. Then, the SMA techniques used by Australian manufacturing firms are reviewed. This is followed by a review of the use of advanced analytical tools used by Australian manufacturing firms. These results are discussed with some quantitative analysis in the next section. A concluding section summarising the findings followed by some limitations of this review ends this paper.

2. Methodology

Search terms, “strategic management accounting”, cloud-based tools”, “blockchain” “artificial intelligence”, and “Australian” and “manufacturing firms” were used singly and in combinations to identify the papers on this topic. Google Scholar was used as the search engine. Only papers published in English were selected. Although full texts were preferred, abstracts were also considered if they contained some relevant points. The papers identified were processed through a series of screening and selection stages using the PRISMA framework (Figure 2). The process yielded 41 papers for inclusion in this review. They are discussed in the following sections.

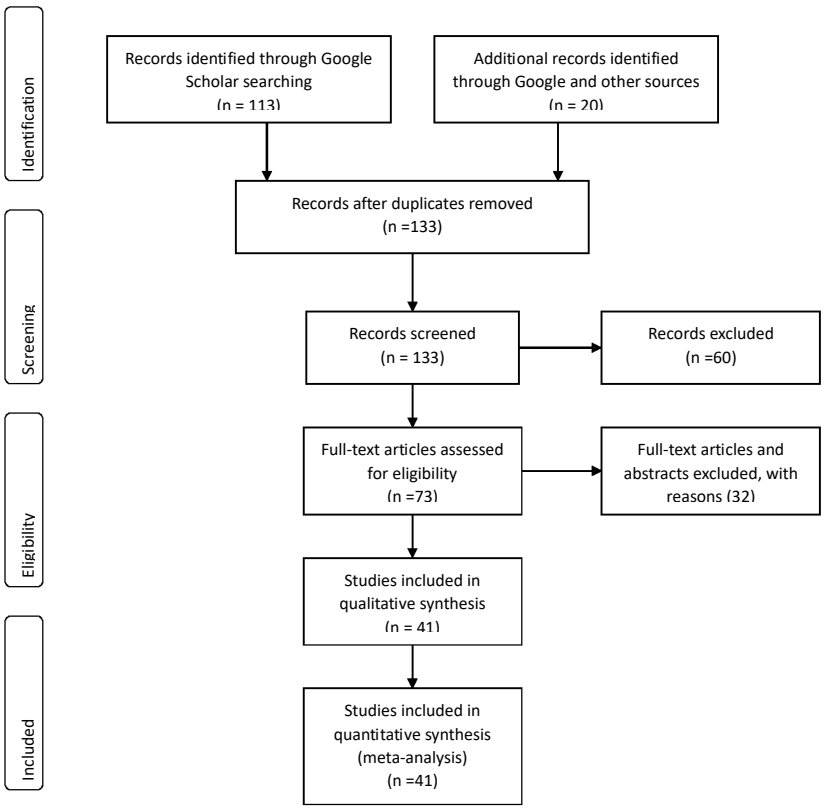


Figure 2. PRISMA flowchart

3. Result

Papers on the use of advanced analytical tools in SMA by firms

3.1 Artificial intelligence

The use of advanced machine learning (ML) methods for textual analysis, to create new types of measurements from unstructured data and algorithms for use in predictive modelling, and the use of artificial intelligence (AI) for interpretation of textual data extracted using ML were identified as some promising SMA tools by Ranta, Ylinen, and Järvenpää (2022).

A conceptual framework to automate the removal of the vulnerability of internal monitoring systems by all types of businesses using AI was suggested by Zhang, Ramanathan, and Maheswari (2021). This is accomplished by AI interacting with the internal control systems to assist SMA practices and minimise risks of data losses using a risk analysis approach.

Greater use of AI leads to transformation from financial accounting to management accounting. However, as was noted by Liu (2022), there is a 97.6% probability of accountants being replaced by AI. About 65% of obstacles to digital transformation are related to data security, 50% of problems of shifting to AI are related to high costs to the business, and 40% of problems arise from relative priorities. The author suggests the use of AI to connect the accounting department with other functional departments to provide relevant accounting information to each department.

Over the period of 2010 to 2019, the popularity of business intelligence declined due to the increasing commoditization of companies and that of machine learning increased due to its relationship with the current and future required skills in firms. Artificial intelligence was well-established at the beginning of the decade. It has benefited from the availability of massive data and cheaper technologies enabling computing power. Hence, AI also showed an increasing trend in its popularity. During the same period, the business implications of AI applications (IoT, resource management) consisted of digital management, process automation, and process mining, for which forecasting, classification and supervised learning are used along with recognition methods (Sestino & De Mauro, 2022).

Based on an analysis of secondary data from the literature, Kar, Kar, and Gupta (2021) observed eight drivers and nine barriers to AI adoption by business firms for SMA. AI solutions' decision-making ability and accuracy were the most important drivers. Lack of an AI adoption strategy, lack of AI talent, and lack of leadership commitment were the most significant barriers. Resistance to change, organizational culture, lack of trust, and the high price of technology are the most critical barriers that interfere with adopting artificial intelligence technology in managerial accounting. The results of a survey obtained by Vărzaru (2022) showed that AI solutions are easy to use and give a high degree of automation and customisation to managerial accounting providing many options to innovate and shorten processes, to improve the use of accounting information.

3.2 Cloud computing

Shi (2021) used edge computing to study the role of asset structure on profitability in the case of express industry. Both financial and non-financial indicators were used. Large total assets, with good asset management, improved profitability, while small total assets reduced revenue and thus, profitability. The edge computing method was better than big data processing methods due to its higher local data processing ability, and the analysis framework for higher performance.

3.3 Big data analytics

AI-assisted machine learning algorithms can process big data faster, more efficiently and meaningfully to sustain business goals in the current multi-sectoral environment according to Arora and Sharma (2023).

Zhang H. (2022) observed that a management accounting system based on big data helped a commercial bank enabled the enhancement of fine and accurate management of the daily operating cost and provided accurate cost data for the profitability analysis of institutions, business lines, products, customers, and account managers as the basis of decisions for performance appraisal, business analysis and product pricing.

The usefulness of big data analytics for business intelligence was discussed by Sun, Sun, and Strang (2018). A big data analytics service-oriented architecture (BASOA) was proposed by the authors and compared with other models of using big data analytics for business intelligence like SAP’s ESOA.

3.4 AI and Big data analytics

As a cost management strategy, supply chain management is a part of SMA. From a review of the literature, Shah, Gardas, Narwane, and Mehta (2023) found AI and big data analytics help to reduce supply chain risks and make it more resilient, predict risks due to various types of disasters and disruptions, select suppliers and locate the supply chain elements to reduce lead times.

During the Covid pandemic, businesses faced the challenges of supply chain and production disruptions, budget planning,

inventory management, workforce management, and the selection of appropriate business models for the crisis. Many businesses used big data analytics and AI to provide solutions to these challenges. Eight companies, which were used as case studies by Chen and Biswas (2021) showed tremendous business performance during the pandemic due to the use of big data analytics and AI.

Results of a survey by Dubey, et al. (2020) showed that entrepreneurial orientation (EO) is important to enable the organisation to use big data analytics powered by AI (BDA-AI) to achieve improved operational performance. EO was associated to a greater extent with higher order capabilities in BDA-AI and organisational performance due to greater environmental dynamism These results extend dynamic capability and contingency theories.

3.5 Big data analytics and cloud computing

According to Ionescu (2022) it is possible to configure enterprise intelligent accounting systems using data mining algorithms and cloud-based big data analytics. Increased efficiency and improved international trade were two of the several benefits of integrating big data with cloud computing identified by Qi, Sun, and Hosseini (2022).

In SMA, big data analytics can be used for the valuation of data assets, the use of big data for decision-making, and risk management. However, some barriers to its use are the quick decay of the data as fresh data come in rapidly, automation preventing standard internal reporting, cultural barriers to sharing, and correct interpretation of the results. Deep learning and blockchain technology are two important data analytics tools. Similarly, many SMA functions can also be performed by AI (Bose, Dey, & Bhattacharjee, 2022).

The roles of blockchain, Internet of Things (IoT) and AI in cloud computing for various applications were discussed by Gill, et al. (2019), which have implications for SMA. These applications' past, current and future trends were discussed using diagrams.

The key challenges for the accounting profession identified by Gulin, Hladika, and Valenta (2019) were related to the use of big data, cloud computing, AI and blockchain technology in continuous accounting and reporting.

Various applications of big data, machine learning, AI and blockchain in SMA practices were reviewed by Zhang, Xiong, Xie, Fan, and Gu (2020) using case studies of four reputed accounting firms. These technologies have helped the four accounting firms to re-engineer accounting procedures, reduce accounting information errors and distortions, and increase efficiency, and transparency.

Digital transformation of business firms in all sectors using AI, blockchain, cloud computing and data analytics (ABCD) through hybridization, integration, recombination and convergence can provide SMA solutions for improved benchmarking, cost management, supply chain logistics, quality costing, competition strategy, and value management (Akter, Michael, Uddin, McCarthy, & Rahman, 2022).

3.6 SMA techniques used by Australian manufacturing firms

Results related to SMA techniques used by Australian manufacturing firms are presented below. There is no mention of any specific advanced analytical tools in these papers.

A systematic review (Chenhall & Smith, 2011) identified that 69 out of 231 papers on SMA techniques were in the Australian manufacturing sector, from 1980 to 2009.

Companies need not always adopt what academics hail as the best SMA practices. They tend to opt for simple, easy-to-understand systems rather than complex readily available software. A single case

study of a global manufacturing company by Watts, Yapa, and Dellaportas (2014) revealed that the company rolled back its management accounting system. The newly installed SPA R/3 was removed to revert to the old system, as the system was perceived to be too complex. Hence, a rationalised system compatible with the company's operations was considered. Easily understandable systems were more beneficial and thus, a return to consistent information using earlier systems was implemented. This facilitated benchmarking and established the widely used key performance indicators. The authors think that appropriate training of the managers may lead to such companies adopting modern SMA techniques.

Using two examples, Samson, Langfield-Smith, and McBride (1991) suggested that Australian manufacturing firms can achieve high levels of competitiveness by adopting strategic manufacturing and by designing their SMA to directly supporting the manufacturing strategies. The SMA should use the techniques to measure operational performance and investment control. It should be able to identify the factors determining the competitive advantage of the firm and its type.

A survey of 166 Australian firms (including about 50% manufacturing firms) by Reeve and Warwick (2006) revealed that less than 50% of them used any cost management systems with moderate to high levels of usefulness. Most of them were using cost management systems for one year or more. The most widely used cost management systems were activity-based costing (ABC) and multiple performance measures (MPM) (Balanced Score Card) mainly by managers for accounting decisions and performance evaluation and control. Monthly reporting was the most common. Computers were used for this purpose by most firms. More manufacturing firms than service firms used these cost management techniques. Thus, the extent of use of any cost management system was determined by its usefulness to the company, progressiveness, level of integration with the management accounting system and level of computerisation.

Among 10626 samples of Australian firms analysed by Moran, et al. (2018) many were manufacturing firms. About 60% of all firms did not have any strategic plans (hence no SMA) or monitoring of key performance indicators.

Therefore, Australian manufacturing firms were slow in the uptake of SMA techniques. In the case of about 6% of firms which were practising SMA, firms employing more than 100 people were more likely to practise SMA. Innovation, collaborations, skill and supply chain responsiveness, and labour productivity were the factors of SMA practices. The education of top managers and foreign investments were the key drivers of SMA capabilities.

In the case of Australian manufacturing companies, generally, the adoption level of SMA techniques was low. However, activity-based costing was widely adopted (Chenhall & Langfield-Smith, 1998). The poor adoption rate of SMA was attributed by Tucker and Lowe (2014) to the gap between academic research and practice in management accounting being of limited concern to practitioners. The two most significant barriers to research utilisation by practitioners are identified as difficulties in understanding academic research papers; and limited access to research findings. Wijewardena and De Zoysa (1999) observed that the Australian manufacturing firms focus more on cost control tools at the manufacturing stage as the SMA techniques, compared to the cost planning and reduction at the product design stage of their Japanese counterparts.

In another comparative study, Hyvönen (2005) found that both Australian and Finnish manufacturing firms adopted similar SMA techniques. In the interviews with owners of 11 Australian and 11 Canadian SMEs, questions on the use of many SMA techniques were asked by Armitage, Webb,

and Glynn (2016). The extent of use of 12 out of 19 SMA techniques was similar in both countries. The extent of use of SMA techniques by manufacturing firms (both countries) was higher than that of non-manufacturing firms.

In another comparison between Slovenia and Australia, Cadez and Guilding (2007) observed that costing oriented SMA techniques were used more by Slovenian firms than by Australian firms. Among the competitor accounting elements, Australian firms used competitor position monitoring, benchmarking, and competitor cost assessment elements to a greater extent than Slovenian firms. Competitor performance appraisal and integrated performance assessment were used by Slovenian firms to a greater extent than the Australian firms.

All the strategic decision-making techniques (strategic pricing, strategic costing, and brand evaluation) were used to a greater extent by Slovenian firms than by Australian firms. Out of the three customer accounting techniques, two (customer profitability and lifetime customer profitability analyses) were used by Slovenian firms to a greater extent and the remaining (valuation of customers as assets) was used by Australian firms to a greater extent. From the paper, it is not clear whether any manufacturing firms were included in the samples.

Some SMA techniques for the management of carbon emissions, applicable to many sectors, including the Australian manufacturing sector, were tabulated by Ratnatunga (2008). The strategies cover all aspects of the business from business policies to performance.

3.7 Use of advanced analytical tools for performance improvement by Australian manufacturing firms

3.7.1 Big data analytics

Improved performance due to the use of big data analytics (BDA) from the survey responses of 163 Australian firms was reported by Thirathon, Wieder, Matolcsy, and Ossimitz (2017). Managers could make their decisions using more analytic-based information obtained from BDA. Managers, who were analytical-minded tended to use BDA for their decisions. Although manufacturing firms were not mentioned in the paper, the claim that the sample represented the Australian industry suggests the inclusion of some manufacturing firms also.

The use of BDA in corporate reporting through its websites, social media and other networks by firms located in Australia, Canada, the UK, and the USA were compared by Basuony, Mohamed, Elragal, and Hussainey (2020) using a disclosure index consisting of some items. The disclosures were related to profitability, leverage, liquidity, and firm size as performance indicators. Thus, BDA in corporate disclosure helps to project the performance of the company to assure suppliers, customers, and investors about the firm's good financial health. Out of the 400 Australian firms, 120 were manufacturing firms, as indicated in the paper.

3.7.2 Artificial intelligence

From the survey responses of 208 Australian firms (13 manufacturing firms) Alsheibani, Messom, and Cheung (2020) identified relative advantage, compatibility, top management support, organisational size and readiness, managerial obstacles, competitive pressure, and government regulations as the factors promoting AI adoption by these firms.

3.7.3 Cloud computing

Based on the results of a survey of Australian SMEs (including some manufacturing SMEs also), Senarathna, Wilkin, Warren, Yeoh, and Salzman (2018) observed that for the adoption of cloud computing, SMEs were influenced by factors

which were advantageous to their organizational capabilities like relative advantage, quality of service and awareness. They were not influenced by risk-related factors like security, privacy, and flexibility.

In the survey studies of Yigitbasioglu (2015), 20 out of 120 Australian firms were manufacturing firms (17%), it was found that mimetic and coercive pressures influenced the beliefs of top management team (TMT) in the benefits of cloud computing. The TMT's beliefs drive TMT's participation and their intention to increase the adoption of cloud computing solutions. But this does not mean a top-down approach.

A survey study on 302 foreign firms operating in Korea (34 from Australia, including a few manufacturing firms) by Garrison, Wakefield, and Kim (2015) showed that the most important factor for cloud computing success of these firms was the relational IT capability compared to technical or managerial IT capabilities. Relational IT capability also determined the public and hybrid cloud delivery models. Flexibility and agility of the firm's internal IT (technical IT capability) facilitated the public cloud.

Results of 16 interviews with forensic accountants and IT experts from eight auditing firms by Yigitbasioglu (2015) showed that medium to large Australian firms opted for private clouds due to concerns on data security, especially if the data were to be moved out of Australia. Many firms also used public clouds. Lack of knowledge about cloud technology or its requirements for them had led some Australian firms to poorly negotiated contracts and agreements.

Results of a survey of 120 Australian firms (20 of them manufacturing) by Yigitbasioglu O. (2014) showed that the perceived vendor opportunism and perceived legislative uncertainty around cloud computing were related with perceived cloud computing security risk. A negative relationship between perceived cloud computing security risk and the intention to adopt cloud services was also noted. Firms already using cloud computing reported that the service met their expectations, and they were satisfied with it. About 71% of the firms had adopted one form or another of cloud computing.

The most frequently used cloud computing systems were email, CRM and collaboration. More than one system was used by many firms. However, many non-adopters did not have any intention to use cloud computing in future. Perceived security risk explained more than half of the variations in increasing intentions to use cloud computing. Perceived security risk together with perceived vendor opportunism accounted for over 30% variation in the intention to use cloud computing continuously.

Out of 228 Australian firms surveyed by Prasad and Green (2015), 31 were others, which might have included some manufacturing firms. From the results of this survey, it was observed that the firms' cloud computing services as attractive opportunities, even if they do not possess the required capabilities. When they acquire new types of resources, the capability profile may change leading to better use of cloud computing to improve SMA-based decision-making. Such an approach will reduce the risks associated with cloud computing.

Cloud accounting involves some specific risks to the accounting process of Australian firms. Added to these risks are the risks involved in other cloud applications. Some risk mitigation strategies include selection of vendor using relatively risk-free criteria, contractual arrangements with clear terms, internal policy development and training of the staff (Yau-Yeung, Yigitbasioglu, & Green, 2020)

4. Discussion

Overall, the above review showed that analytical tools like AI, big data analytics, cloud computing and blockchain can be used in SMA for various purposes. Use of such

tools provide many opportunities for performance improvement through SMA. Many companies, all over the world, are already using these tools not necessarily as an SMA technique.

There is some evidence of Australian firms, including some manufacturing firms using these advanced tools, even if the level of adoption of SMA techniques is low. Some barriers and challenges have been identified to be the reasons for this low level of adoption. When SMA adoption itself is low, the scope of using advanced analytical tools for SMA is limited. However, companies had been using advanced analytical tools for purposes other SMA.

Although numerous papers project many advantages of using the SMA techniques and tools, enthusiasm to accept these claims is low among companies leading to their low adoption. Lack of awareness, skills, resources, and resistance to change are cited as the reasons for low adoption level of SMA techniques and use of advanced tools in SMA.

Awareness and skills can be improved through training of employees in these tools and techniques. To be effective, such training needs to be practice oriented. Initially, a few SMA techniques and advanced tools matching the current resources for essential requirements of the firm can be implemented. Further implementation can be done as resources become increasingly available. To address the resistance to change, a sound change management strategy, along with change in the organisational culture, is required.

A few cases of companies revert to earlier systems as they perceive the new techniques and tools as too complicated, difficult to understand and incompatible with the current strategies. Training may change their perceptions to adopt the new SMA techniques and tools.

Environmental accounting for sustainable business is one of the SMA techniques. However, papers linking these two, especially applied to Australian manufacturing firms, are quite few. This indicates the need for more research in this direction in future.

4.1 Some quantitative analyses

4.1.1 Aim of papers

The aims given in the reviewed papers are presented in Fig 3.

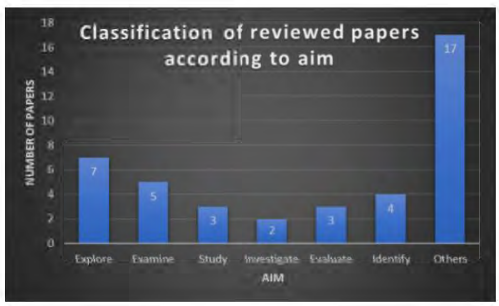


Figure 3. Number of papers according to the aim

If the "Others" category is excluded, most papers (7) were exploratory or examining (5) nature. Hence their intentions were only superficial, and the studies did not go to sufficient depth.

4.1.2 Method of study

Classification of reviewed papers according to methods of study is given in Fig 4.

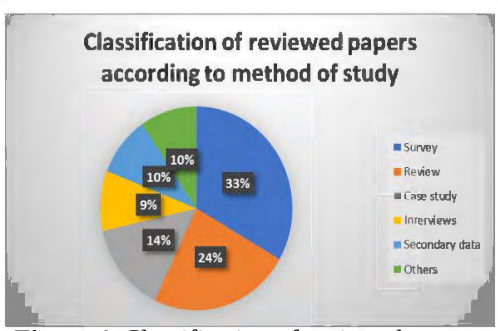


Figure 4. Classification of reviewed papers according to method of study

Survey dominated accounting for about one-third of the reviewed papers. Reviews accounted for about 24% of the papers. About 14% were case studies. Interviews, secondary data and others were about 10% each.

4.1.3 Findings

Classification of papers according to the topic of findings is presented in Fig 5.

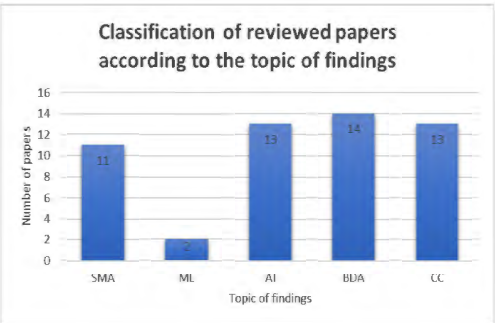


Figure 5. Classification of reviewed papers according to the topic of findings.

The total number exceeds 41 because more than one analytical tool were studied in many papers. BDA attracted maximum research (14 papers) followed by AI and CC equally. Since this review focused more on the analytical tools than SMA, number of papers on SMA were fewer than the tools.

Thus, most of the reviewed papers explored or examined analytical tools of AI, BDA and CC using surveys or review of literature. Some papers used interviews and case studies also for exploration or evaluation of AI, BDA, and CC for their usefulness in SMA techniques. Most papers dealing with SMA used surveys or secondary data to evaluate adoption of SMA techniques and factors related to their low adoption levels.

5. Conclusion

The above review demonstrated the possibility of using advanced analytical tools like AI, blockchain, cloud computing and big data analytics in SMA techniques.

Even if not for the same purpose, firms are using these techniques for other purposes.

Low adoption levels of SMA techniques also affect the use of advanced analytical tools in them. The general observation is that most firms, including Australian (manufacturing firms) have adopted only very few of the SMA techniques. The barriers and challenges to them could be addressed by training the employees and adopting incremental implementation as resources increase.

5.1 Limitations

There were very few papers on SMA techniques and use of advanced tools in SMA by Australian manufacturing firms. More research in this direction is recommended.

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