Emerging In-memory and Mobile Technologies: a quantum leap in Strategic Management Accounting

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Abstract. Two technologies are currently reshaping Accounting Information Systems: In-Memory Technology and Mobile Technology. It is not only a matter of generic increase of performances, as it usually occurs in the IT field, but a dramatic improvement that is affecting hardware and software architecture and the organization of the actual systems. We are facing a new generation of BI tools that will greatly improve the capabilities of Strategic Management Accounting systems. In fact, the improved tools available will finally deliver capabilities that will enable end users to directly support their decision, as long-promised.

Keywords. Accounting Information System, In-memory Technology, IMT, Mobile Technology, Management, OLTP, Financial Accounting, OLAP, Strategic Management Accounting, Real-time applications.

1 Strategic Management Accounting: several considerations.

1.1 Strategic Management Accounting: an academic prospective.

Strategic Management Accounting (SMA hereafter) is a promising and well-acquainted evolution of Management Accounting [1]. In particular, SMA tries to address all the criticism levelled against Management Accounting (MA). SMA was initially proposed by Simmonds at the beginning of the 1980s [2] and it was not taken seriously until the late 1980s. Simmonds argues that SMA greatly differs from MA because of its focus on the comparison of the business with its competitors. Although there is no agreed definition of SMA in literature [3], it is clear that MA differs from SMA in several aspects, as shown in Table 1 [5]. Bromwich [4] defines SMA as:

"The provision and analysis of financial information on the firm’s product markets and competitors’ costs and cost structures and the monitoring of the enterprise’s strategies and those of its competitors in these markets over a number of periods."

It is not simply the approach, which is oriented towards strategy, but it is a radically different way of re-thinking MA [1].
Table 1. Traditional Management Accounting versus Strategic Management Accounting

<table>
<thead>
<tr>
<th>Traditional MA</th>
<th>Strategic MA</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Historical</td>
<td>Prospective</td>
</tr>
<tr>
<td>2 Single entity</td>
<td>Relative</td>
</tr>
<tr>
<td>3 Introspective</td>
<td>Out-ward looking</td>
</tr>
<tr>
<td>4 Manufacturing focus</td>
<td>Competitive focus</td>
</tr>
<tr>
<td>5 Existing activities</td>
<td>Possibilities</td>
</tr>
<tr>
<td>6 Reactive</td>
<td>Proactive</td>
</tr>
<tr>
<td>7 Programmed</td>
<td>Un-programmed</td>
</tr>
<tr>
<td>8 Data oriented</td>
<td>Information oriented</td>
</tr>
<tr>
<td>9 Based on existing systems</td>
<td>Unconstrained by existing systems</td>
</tr>
<tr>
<td>10 Built on conventions</td>
<td>Ignores conventions</td>
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</tbody>
</table>

In fact, various authors argue that SMA finally bridged the gap that existed between MA and strategic management [6]. SMA moved MA from monetary concerns to a more multi-dimensional approach. According to Lord [7], the functions commonly associated with SMA are:

"1. To collect information related to competitors.
2. To use accounting for strategic decisions.
3. To cut costs on the basis of strategic decisions.
4. And, to gain competitive advantage through it."

1.2 Strategic Management Accounting: an empirical perspective.

A relevant characteristic of the SMA literature is the paucity of empirical research [8]. As a matter of fact most of the literatures regarding SMA were at conceptual level and with a prominent academic emphasis. SMA adoption cannot be measured directly: it is necessary to investigate the adoption of those techniques that can be reconnected to the SMA concept. As a matter of fact this is an alternative way to define SMA. While researching the link between SMA and strategy, some researchers [9], proposed to define the techniques that firm really implement instead of trying to define SMA itself. In other words, SMA can be empirically defined as the implementation of a number of techniques. Cinquini and Tenucci adopted the following list:

- Activity Based Costing/Management (ABC/M)
- Attribute Costing
- Benchmarking
- Competitive Position Monitoring
- Competitor Cost Assessment
- Competitor Performance Appraisal on public financial statements
- Customer Accounting
- Integrated Performance Management Systems
- Life Cycle Costing
- Quality Costing
- Strategic Costing
— Strategic Pricing
— Target Costing
— Value Chain Costing

Organizations hardly understand the meaning of SMA, hence it is easier to ask them if they currently implement some of the above-mentioned techniques and then evaluate if they are de facto applying a SMA approach. Several researchers followed this course: Guilding et al. [10] create a report based on the survey of 12 SMA practices in different countries and thus concluded that the extent of diffusion was not uniform in New Zealand, UK and USA. Fowzia [8] measured the implementation of 14 SMA techniques and in this way measured business strategy and strategic effectiveness of manufacturing organizations in Bangladesh.

However, there is no literature regarding SMA implementation difficulties and costs. To evaluate ABC/M, Quality Costing, Customer Accounting or Value Chain Costing, an organization not only needs to have the related management knowledge, but it is also necessary to predispose technical IT-based equipments and procedures. SMA heavily relies on costly IT resources: as we will see, it is necessary to create Data Warehouses, perform extensive elaboration of large data sets, and create and manage complex models. Similarly, Competitive Position Monitoring and Competitor Cost Assessment require the collection of large amount of data. Thus, it is extremely relevant the availability of new technologies that eases the handling and the evaluation of data and the workgroup activities of decision-makers.

2 Emerging technologies.

2.1 In-Memory Technology.

Though the idea of In-Memory Technology (IMT) is not new, it is currently re-emerging owing to multiple factors. Firstly, cheaper and higher performing hardware, in particular affordable 64-bit processors and memory chips. Secondly, newer 64-bit operating systems, with more than 1 Terabyte addressable memory which have made it possible to cache large volumes of data in a computer’s RAM.

The main reason why we look with great interest at In-memory utilisation is because In-memory I/O operations are dramatically faster than traditional HDD-based I/O operations. While an HDD has a typical Time of Response (TR) of 5 ms, a DRAM has a TR of 100 ns, something like 50,000 times faster. This feature is useful in applications where service level agreements require very low and predictable response times, such as telecommunication, real-time financial services trading applications, network equipment, and large web applications. Moreover, it is worthwhile to investigate the new fields of application that have become feasible in this scenario.

Among the various software which have taken advantage of this environment, one of the most important is In Memory Data Base (IMDB) [11, 12]. Many IMDBs are currently available to handle specifically On Line Transaction Processing (OLTP) where a short, consistent response time is relevant and very high throughput. As an example,
Oracle offers TimesTen, which functions as an in-memory cache database in front of the Oracle Database. Another example is SAP HANA, that is SAP AG’s implementation of in-memory database technology. Other IMDBs are available particularly for On Line Analytic Processing (OLAP). The above-mentioned products have analytic capabilities, but it is possible to find more specialized products, such as EXASolution from EXA Sol AG and MonetDB.

2.2 Mobile Technologies.

Communication technology is strictly linked with computer technology, however Mobile Technology is deeply reshaping this interaction. In the past ten years fast, affordable and reliable mobile devices allowed users to interact freely with their corporate computers, both directly and via the Internet. The traditional and institutional approach recognizes mobile devices as an additional kind of device that can be connected to corporate systems.

Actually mobile systems, in particular Smartphone and Tablet, can do much more than this. Thanks to the fact that they can be easily programmed creating the so-called "apps", it is possible to link them directly to corporate databases or datasets to produce personalized views or charts. That is, by means of a Business Intelligence package (as we will see in a short while) a manager can manipulate datasets, analyze data, create models and produce charts and reports that depict her/his findings. When all this is set and done, the same package can directly create an App. The App is a stand-alone procedure: every time the App is launched, it autonomously connects to the appropriate dataset and produce updated charts and reports. Moreover, the App can be sent to other managers, published on corporate servers, and so on. In this way everybody can share and evaluate insights and findings.

Several technology trends will significantly impact the global accounting profession, according to the report “Digital Darwinism: thriving in the face of technology change” [13]. Interviewing several accounting managers, researchers identified ten top technologies, as reported in Table 2.

The first ranked technology is Mobile Technology (MT), that allow people to connect anywhere and anytime utilising a wide range of devices and networks. This high rank demonstrates the perceived relevance to constantly check the situation of the firm and market. In this times of high volatility, managers have to be very quick to take action to fix an emerging problem or to exploit an opportunity.

Besides MT, it is worthwhile to consider the last issue of Table 2, Social Technology (ST). Managers consider relevant to interact with other managers or other people in general. The social approach can be considered the resumption of the "groupware" concept fostered by Keen and Scott Morton in their influential book "Decision Support Systems: An Organizational Perspective" [14]. In fact, in the early days of Decision Support System, the ancestor of Business Intelligence tools [15], one of the main research topic about computer-based systems was related to adequately support not
only the activity of a single manager, but also to ease the interactions within a group of managers.

**Table 2. Top 10 technologies**

<table>
<thead>
<tr>
<th>Rank</th>
<th>Technologies</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Mobile</td>
<td>Anywhere, anytime access to broadband connectivity from a range of devices, wireless networks, operating systems and applications</td>
</tr>
<tr>
<td>2.</td>
<td>Big Data</td>
<td>The massive quantity and variety of structured and unstructured data from internet-connected systems, devices and physical objects</td>
</tr>
<tr>
<td>3.</td>
<td>Artificial intelligence and robotics</td>
<td>The broad range of machines and computer systems that demonstrate limited characteristics of intelligence</td>
</tr>
<tr>
<td>4.</td>
<td>Cyber-security</td>
<td>Protection from new forms of cyber-risk, attack, crime and terrorism caused by increased reliance on personal and professional digital devices and data</td>
</tr>
<tr>
<td>5.</td>
<td>Educational</td>
<td>Trends and tools that are changing and enhancing educational achievements, developments, techniques and possibilities</td>
</tr>
<tr>
<td>6.</td>
<td>Cloud</td>
<td>Internet-based technology resources – such as software applications, computing power and data storage – provided remotely as a service</td>
</tr>
<tr>
<td>7.</td>
<td>Payment systems</td>
<td>New, evolving and emerging internet-enabled software applications, currencies, payment platforms, devices and services</td>
</tr>
<tr>
<td>8.</td>
<td>Virtual and augmented reality</td>
<td>Technologies that use computer modelling to simulate, overlay and supplement reality and enable people to interact</td>
</tr>
<tr>
<td>9.</td>
<td>Digital service delivery</td>
<td>New technologies used to provide online, interactive, self-service, business processes, software and services</td>
</tr>
<tr>
<td>10.</td>
<td>Social</td>
<td>Technologies that support social interaction and are enabled by communications technology, such as the Internet</td>
</tr>
</tbody>
</table>

2.3 **SMA end user tools.**

We are facing a new generation of BI tools that will greatly improve the system capabilities of SMA. An ongoing trend is clearly perceivable as it shifts the SMA platform from an IT-centric, single end user approach to a new paradigm that depicts SMA activities as still IT-based for data preparation, but freely managed by end users with powerful personal tools. It is extremely easy and intuitive to manipulate data with these tools: users can take advantage of a visual approach in order to analyse and rearrange data. Moreover, these tools enable the end users to work in teams and to exchange information by means of the Internet. All of these new tools include mobile technologies, but some of them can also create Apps, the applications that run on
mobile phones. This is a completely new way to exchange information. A freshly created new report or dashboard can be transformed into an App, that afterwards can be utilized by the creator or that can be shared with other managers.

In February 2013, Gartner Inc. released its "Magic Quadrant for Business Intelligence and Analytics Platforms" [16]. This paper reports the state of the market of those platforms that can be adopted when implementing a SMA.

![Magic Quadrant for Business Intelligence and Analytics Platforms](source: Gartner [16]).

By analysing the report and focusing on the Leaders Group, it is possible to deduce what is summarized in Table 1.

The platforms have been compared on the basis of four dimensions:
1. Is the platform entirely IT-centric or does its end user tool have stand-alone capabilities?
2. Does the end user tool adopt In-Memory Technologies?
3. Does the end user tool have a visual approach?
4. Does the platform app-creation have capabilities?

It appears clear that a new generation of powerful SMA end user tools is emerging.
Table 2. Comparison of Leaders Group offering (source: our elaboration of Gartner [16])

<table>
<thead>
<tr>
<th></th>
<th>IT-centric</th>
<th>IMT adoption</th>
<th>Visual approach</th>
<th>App capabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td>IBM</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Information Builders</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Microsoft</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>MicroStrategy</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Oracle</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>QlikTech</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>SAP</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>SAS</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tableau Software</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Tibco Spotfire</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

3 Strategic Management Accounting revisited.

Accounting Information Systems can be divided into two main fields: Financial Accounting Systems and Strategic Management Accounting Systems [17]. Financial Accounting Systems [18], that rely on OLTP procedures, find a fast and reliable environment to exploit. In-memory computing has become technologically feasible and economically viable, and offers speed, accuracy and performance advantages that no relational database-only system can match. This can lead not only to the rewriting of the current procedures so as to take advantage of the new technology opportunities, but a new wave of real-time applications may be expected, covering relevant areas such as real-time auditing or fraud detection, as an example. In addition, real-time OLTP may provide a relevant flow of data that can be conveniently utilized to feed analytic procedures.

Strategic Management Accounting Systems [19], that rely on OLAP procedure, will be greatly empowered thanks to in-memory and mobile technologies. In particular, real-time analytics promise to finally enable the final user to discover new business opportunities by means of direct utilisation of fast, improved and powerful real-time analytics. Finally, it is worthwhile to mention that in order to take advantage of the above mentioned new opportunities it is necessary to completely revisit AIS’s architecture [20]. Existing structures, such as data base servers, are supposed to change their roles. Also conceptual architectures, such as Data Warehouses and Data Marts, have to assume different roles, and thus organizations have to completely redesign their information systems.

Although the improvement of Financial Accounting Systems will be impressive in terms of performance, probably the major impact of IMT and mobile technologies will be related to Strategic Management Accounting field. The new opportunities offered by IMT completely redefine (1) SMA system architecture; (2) SMA organizational processes; (3) SMA utilization.
3.1 System architecture.

Traditional SMA architecture is based on a three-layer structure (see Fig. 1) [21]. The first tier is a database server that is almost always a relational database system and it is devoted to Data Warehouse (DW) support. The second tier is an OLAP server that is typically implemented using either (1) a relational OLAP (ROLAP) model, that is an extended relational DBMS that maps operations on multidimensional data to standard relational operations; or (2) a multidimensional OLAP (MOLAP) model, that is a special-purpose server that directly implements multidimensional data and operations. The third tier is a front-end client layer, which contains query and reporting tools, analysis tools, and/or data mining tools to support the end users.

This architecture has been developed in the last years and is quite functional, but it is heavy and expensive. The major drawbacks are related not only to the complexity of the scheme itself, but also to the necessary equipment, both hardware and software. Even relatively small projects, such as pilot projects, may often result to be difficult to implement, expensive and prone to failures.

![Diagram of System Architecture](image)

**Fig. 1.** Strategic Management Accounting: traditional architecture.

The enterprise should prepare an appropriate hardware platform to manage the flow of external data, the Data Warehouse, and the Hyper-cubes. Likewise, a software for the Extraction, Transformation and Load (ETL) process should be selected; one for DW management, another one for Hyper-cubes, and finally, a software environment for end users should be chosen.

The aforementioned model can be simplified with the introduction of IMT. Thanks to the improved capabilities of end user software that can manage hyper-cubes directly, it is possible to drop the OLAP servers tier, and then create and manipulate hyper-
cubes at the client level (see Fig. 2). As we will see, this change greatly reduces both costs and the organization of the processes.

Fig. 2. Strategic Management Accounting: IMT-based architecture.

3.2 Organizational processes.

Within organizations, there is a clear separation between SMA data providers and SMA data users. The former are IT professionals that take charge of the processes involved in the first two tiers of the architecture mentioned in Fig. 1. Following the indications of the end users, they find a proper set of data to analyze, perform the Extraction, Transformation and Loading (ETL) phase, predispose detailed data sets in Data-Warehouse servers, and then create and store Hyper-cubes for future use. The whole process is extremely time consuming and therefore should be carefully defined and planned. Typically, more than half of all the development work for data warehousing projects comprises design and implementation of ETL activities [22].

All the processes are driven by end users’ requests. End users should take advantage of SMA to perform sound and useful Business Intelligence (BI). While the general scheme seems to be quite clear, there may be some flaws that can invalidate the whole process.

If there is a poor understanding of the end user’s needs, in terms of analysis that should be performed and of relevant variables to be selected, all the process risks to be badly defined, and therefore everything must be rearranged [23]. For this reason organizations try to learn from small and relatively inexpensive pilot experiences. In fact inexperienced end users tend to forget crucial variables, and if this happens, all the process has to be restarted. Hence, an optimal understanding between IT professionals and end users is a critical issue.
The adoption of IMT-based software may help to solve this problem. IMT boosts the software of the end users and thus enables them to create their own hyper-cubes directly in seconds with intuitive and easy-to-use tools. In this way, IT professionals can focus on pure data issues and end users can "play" alone with the cleaned and corrected datasets following their thoughts and intuitions. Moreover, IMT can improve the ETL process. This process is often complex as well as time and resources consuming. For these reasons it is often performed in a "batch" mode and scheduled on a regular basis, i.e. once a week, once a month, and so on. IMT greatly empowers database software, hence a continuous ETL process has become feasible and can be implemented. The ETL execution in Real Time can really improve organizations' capability to acquire and elaborate operational data in a strategic perspective.[24]

3.3 Utilization.

There are two main approaches that can be followed in implementing SMA systems. The first one is to realize a system by entirely adopting IT-managed tools, both in the back office activities and in end user activities. A second approach, more naive, still relies on IT-centric back office procedures to prepare data, but leaves the end user free to choose a personal tool such as MS Excel for the final phase of data manipulation. Obviously there are pros and cons in both solutions. Centralized SMA systems:

- have high start-up costs;
- require specialized skills;
- have long lead times, even months;
- modifications often become new projects;
- many user needs are unfilled.

On the other side, to let users create and manage their own SMA systems freely using spreadsheets:

- is highly labour intensive;
- may be error-prone;
- is non-secure.

The 2013 version of MS Excel, empowered by IMT, features a new tool called PowerPivot that seems to resolve the aforementioned dilemma. While IMT removes the old 64K rows limitation, PowerPivot adds some relevant innovations. In fact, with PowerPivot it is possible to load a very large amount of data choosing the opportune dataset, to create on-the-fly hyper-cubes dragging and dropping variables, and then to manipulate the hyper-cubes to obtain the desired reports. Also the number and typology of reports has been improved, and now it is possible to obtain impressive dashboards that show together numbers, charts and other indicators. Finally, by means of another MS software, SharePoint, managers can publish and diffuse their thoughts.
Still maintaining the ease of use of Excel, PowerPivot provides those capabilities that enable end users to manage their tasks directly, no matter how large the data set is. This solution has low maintenance costs, data can be auto-refreshed on a timely base and it is robust.

4 Conclusions.

As we said, academic researches focused mainly on theoretical issues related to SMA. Only few researches tried to understand the adoption of SMA in the real world. The new generation of BI tools finally delivers the long-awaited and long-promised end user capability to manage directly SMA systems. Managers appear to be very interested in gaining control of the final stage of SMA processes. The request to have easy and intuitive, yet powerful, end user tools seems to be definitively fulfilled. While IT managers can overlook the core activities related to data handling, data cleaning and, generally speaking, ETL and Data Warehouse activities, managers can focus on extracting meaningful insights from that data. In other words, the work of IT people is aimed at preparing all the datasets, whereas decision makers can focus on strategy and can take advantage of those datasets to make better-informed decisions. It is our intention to perform an empirical research on the real utilization of new tools in the SMA field, but it is necessary to wait somewhat since these tools have become available only recently. As an example, PowerPivot’s capabilities became integral part of Microsoft Office suite only in the 2013 releases.

References

Panconsciousness: A Quantum Leap To Ancestor-Simulation-Program. Monday, March 22, 2021 19:49. % of readers think this story is Fact. Add your two cents. Panpsychism holds that the universe is a web of consciousness an empty stage in which everything that exists has somehow come into being in order to act out the great drama of life. Read more. Section Intel® QuickPath Technology and an integrated memory controller speed traffic between processors and other components to reduce latency and optimize the use of system bandwidth, delivering better application responsiveness and Intel® Xeon® Processors for Each Business Need Enterprise Computing Business-Critical Applications Intel Xeon Processor 5600 Series Intel® Xeon® Processor 7500 Series Intel® Xeon® Processor 6500. For example, all power management settings in Windows Server 2008 R2 support Group Policy, which allows administrators to define and deploy specific configurations for groups of users and computers. Improvements to service accounts, smart cards, UAC, and auditing A Quantum Leap in Accounting’s future is bright, with a projected 10% increase in accountant and auditor employment between 2016 and 2026, according to the U.S. Bureau of Labor Statistics (BLS). Not only does the future of the accounting profession look promising, but the industry is also rapidly evolving with the rise of technology. Intelligent technology may seem new, but many companies are already using basic automated accounting processes. Here are just a few of the accounting tasks and processes that machines can do or streamline, according to Forbes: supplier onboarding, accounts payable, audits, procurement, purchasing, expense management, close processing, and customer queries. Several quantum technologies are racing to reach useful qubit thresholds. Two have made sufficient progress for commercial application to be in sight: trapped ion and superconductor. How Should Companies Prepare for a Quantum Leap? Quantum computing won’t be for everybody. But if your company is in a data-intensive field or an industry in which the ability to run simulations of complex real-world functions and interactions in a practical amount of time advances R&D, you’ll want to start engaging with this advanced technology. Already, BASF, VW, Airbus, and other companies are investing in building quantum computing capabilities.