Summary and conclusions

Current accounting research and practice is still based on the double entry accounting framework provided by Pacioli about 500 years ago (Pacioli's *Summa de Arithmetica et de Proporcione et Proportionalita* is dated November the 20th 1494). This thesis highlights some important events in accounting history as it has developed from single-entry accounting to double-entry accounting and then to cost accounting, financial accounting, and management accounting and finally to three-dimensional accounting (see chapter 3).

At a time when the 'state of the art' in management accounting is being criticized in literature and practice (see chapter 3) it is legitimate to ask whether the conventional management accounting model is still adequate to capture today's economic events and to provide the information needed to support justified decision making. Theorists suggest that management accounting has lost its relevance because of the financial accounting mentality. Others suggest that this is because too little weight is given to the behavioural aspects of accounting. In chapter 4 both views are discussed in some detail. Whatever may be the case, it is clear that management accounting needs a revival. This could be realized through an adjustment to the old accounting framework of Pacioli, which, it is argued, is not adequate to discharge the accounting function in today's environment.

Some recent developments in management accounting, such as activity based costing and strategic cost accounting, are introduced as new accounting approaches which are needed to recover accountings's relevance. But in fact these new ideas would all be implemented if the traditional accounting framework were to be modified in a certain way. The potential of Ijiri's triple-entry and momentum accounting system to solve the problems that accountants are faced with has been under-appreciated. In fact this system is derived from physics, sometimes called the science of science. For this reason it is necessary to describe the most important happenings in the history of physics so far as these are relevant to accounting.

Historically the study of moving objects (i.e. classical mechanics) has been one of the most discussed topics within physics. Mechanics embraces several subdivisions: kinematics, which analyses motions without examining the causes of motion, and dynamics.

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1 Some authors have found evidence that Pacioli was not the original writer.
2 There is also some evidence that the Indian *Bakh-Khata* system predates the Italian system by many centuries.
3 This is especially true with regard to the sophisticated electronic technology that is available nowadays.
4 This does not necessarily mean that triple-entry and momentum accounting concepts have any meaning in a financial accounting context, but on the other hand these concepts might change financial accounting practice as well.
Dynamics is subdivided into

1) statics and
2) kinetics, which studies motion in relation to its causes.\(^5\)

In brief, there are three main approaches to the study of moving objects: (1) the Aristotelian approach, (2) the Newtonian approach\(^6\) and (3) the new approach (of which Einstein is the best known representative). From an accounting perspective the Newtonian idea is most relevant.

Aristotle (384-322 B.C.) supposed that an object moves only if it is forced to do so. When the impulse is exhausted the object ceases its motion.\(^7\) This means that the Aristotelian approach to motion is discontinuous. Given his historical context, it is not surprising that Pacioli's double-entry framework corresponds to an Aristotelian concept of the physical universe.\(^8\) It was Leonardo Da Vinci (1452-1519), a friend of Lucas Pacioli, who first studied the acceleration of falling objects. Galilei (1564-1642) improved on Da Vinci's ideas by analyzing many experiments.

Newton (1643-1727) abandoned all these models of motion when he introduced his inertia or momentum concept: in the absence of friction an object forced into motion would move indefinitely. Not discontinuity, as in the Aristotelian model, but continuity is the starting point. From an accounting point of view this means, for example, that one would consider the expected increase in annual net income forecast to result from an advertising campaign as a continuous increase. Hence we should discuss the financial impact of this campaign in terms of income per year, which is the income momentum (or the net income capacity) as measured at a given time. It is the rate at which income is earned over time.\(^9\) If a $30,000 computer-maintenance contract is signed in September 199X, the traditional wealth accounting system only captures the $10,000 in expenses that is matched to the 199X financial statements. From a momentum accounting perspective the income power decreases by $30,000 per year and this amount is entered in the system.\(^10\) This information may be very important to predict the 199X+1 income. From a momentum accounting viewpoint and from the standpoint of performance evaluation the payments made under this contract are in fact irrelevant (non-events) because these do not change the company's financial inertia. Within the conventional system a 'status quo' situation would mean that no accounting events have occurred. This means that wealth has remained unchanged. In momentum accounting, 'status quo' means that this year's

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\(^5\) The ABC system is analogous to kinetic studies, as it is designed to detect cost drivers.

\(^6\) The Aristotelian approach and the Newtonian approach together may be called 'the classical approach of physics'.

\(^7\) More generally 'motion' is called 'action'. Hence action is a force integrated over time.

\(^8\) Pacioli refers to Aristotle in his Summa as he calls him 'the Philosopher'.

\(^9\) Income momentum integrated over time gives income.

\(^10\) The momentum accountant is thus much more future-oriented than the wealth accountant.
net income is equal to last year's income. This means that the net wealth increase has remained unchanged.\footnote{In financial management it is becoming more and more usual to value securities from their earnings momentum. See the \textit{Value Line model}. Also within general economics (see the \textit{Fisher equation}) and within \textit{compound interest calculations} it is common to make calculations that account for differences in the velocity of earning money.}

The concept of accounting for momentum as it is discussed in chapter 7 is not really unfamiliar. The speedometer of a car, for instance, accounts for three things. The mileometer records the total number of miles travelled: this is a cumulative figure. There is a separate trip meter that captures the miles covered during a certain drive or day. The speedometer registers the actual speed at which the car is currently driving. If the speedometer indicates 40 miles per hour of constant driving, for 10 hours a day, the trip meter shows 400 miles each day while the mileometer shows 400 miles, 800 miles, 1,200 miles etc. In fact this is the reporting mechanism that is used within the conventional accounting system. It does not report acceleration. Information about these changes in speed, which in an accounting context may be compared to changes in the rate at which net income is earned, refer to the \textit{third dimension} in the triple-entry accounting system. Within this system a different concept of income is used: the discrete concept of income is set aside and the continuous concept is applied.

The momentum accounting system administers data about financial events that are not entered in the conventional system. New wage contracts, new interest rates, changes in investments etc. are all events that are irrelevant from the traditional viewpoint but whose expected financial impacts are recorded systematically within the momentum accounting system. This momentum accounting system is mathematically related to the double-entry accounting system.\footnote{This relationship is based on time derivatives and time integrals.}

\textit{Einstein} (1879-1955) introduced the relative meaning of time and space within the physical measurement of motion. One might say that this approach has been given shape in the strategic accounting strand, in which the traditional accounting boundaries are relaxed so that competitive information can be provided (cross-sectional comparisons).

From a certain point of view, far from the behavioral concept of the firm, a company may be compared to a moving object. The company's goal may be to go from one point

\begin{itemize}
  \item In financial management it is becoming more and more usual to value securities from their earnings momentum. See the \textit{Value Line model}. Also within general economics (see the \textit{Fisher equation}) and within \textit{compound interest calculations} it is common to make calculations that account for differences in the velocity of earning money.
  \item This relationship is based on time derivatives and time integrals.
\end{itemize}
of net profit to another. The central object to be described in a profit accounting system is the position of, and changes in, owner's equity. In the single-entry accounting system the owners' equity position is the central dimension to be measured. In practice this means that all the components of owner's equity need to be recorded. These components are the assets and all the debts and other obligations. Then the owner's equity volume (to be called 'wealth') can be determined by subtracting total debts and obligations from total assets. Hence the volume of owner's equity is found through a stock-taking of its components. From this it is concluded that 'owner's equity composition' is the first accounting dimension. The basic financial statement is the balance sheet, which enumerates all assets, liabilities and - on balance - the owner' equity at a certain point in time.

In order to look for the causes of motion, and to explain changes in position of the owner's equity, it became common to report on profit and loss events about the year 1400 A.D. Revenues and expenses and the net profit explained fully and systematically the increase or decrease in owner's equity from one time to another. By systematically recording revenues and expenses the owner's equity volume at any moment could now be determined directly using this updating mechanism: (1) beginning owner's equity + (2) revenues - (3) expenses = ending owner's equity. The difference between beginning owner's equity and ending equity is earnings per period. Cumulated over time, these earnings must explain the owner's equity volume at any given time. From this point of view owner's equity volume is the second accounting dimension. This second dimension is expressed systematically in the profit and loss statement. Together with the indirect way of ascertaining the owner's equity volume (assets less liabilities), this means that the owner's equity can be determined in two different but related ways. Both approaches must lead to the same equity volume, providing a systematic internal check on the owner's equity volume that is expressed on the balance sheet. This explains the 'double' in the double-entry accounting system.

Triple-entry accounting theory asks whether the two dimensions in use can be extended

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14 Actually 'time' is a basic measuring unit and dimension as well.
15 To do so all assets and debts and obligations need to be expressed in financial terms. In former days (about 3000 B.C.) this was not common. All the owner's equity components were expressed in physical measures only. Sorter has picked up this aspect when he introduced his 'events approach' to accounting.
16 Capital transactions that influence owner's equity volume but cannot be regarded as income transactions, e.g. private withdrawals, an issue of shares or an asset revaluation, are excluded from this mechanism. Hence the focus is on income transactions.
17 This may be called a 'double-entry bookkeeping system' where the method of recording entries is highlighted more than the valuation activities within the system.
18 Hence the 'double' in 'double-entry accounting system' has nothing to do with the common use of two entry columns (the debit and the credit) within the system. In a single-entry accounting system the use of two columns, debit and credit, is also quite usual. The use of two columns can be explained by the avoidance of negative numbers within the accounting system. This is a matter of form, not of content.
Summary and conclusions

to an accounting trinity. But what would the third dimension in a three-dimensional system be? Since the second dimension explains changes in position, the third dimension should explain change in change in position. This is change in earnings per period, or income acceleration. The third dimension or the third entry is related to changes in the rate of income realization. Under the double-entry accounting system it is supposed implicitly that income is realized within a certain period of time at a constant rate. But information about changes in this rate may be very relevant for predicting future earnings. The conclusion is that the third dimension relates to causal net income mutations. The reasons behind the net income difference are summed up in the so called action statement. The accounts in this statement are in money terms so they can be related to the profit and loss statement, just as the profit and loss statement accounts give reasons for changes in the owner’s equity volume on the balance sheet. As a consequence the company’s financial performance may be expressed in a vector, e.g. (1,500, 2,000). The first amount tells the user about the net income realized within a given period. The second amount indicates the firm’s income momentum: it says the firm’s net income potential is $2,000 per year. Obviously not all the impulses have been realized within the reporting period.

To make up the action statement from the general ledger (‘Quaderno Grande’ as Pacioli called it) it is necessary to design new ledger accounts. These might be called ‘Lowered interest rate’, ‘New wage contract’, ‘New competitors’, ‘General economic growth’ etc. Action, as a difference, is a result of impulse: action is impulse integrated over time. The impulses behind the actions are presented at the impulse statement. The force accounts on this statement are in dollars per month. An impulse which occurs causes a change in income momentum which is expressed on the momentum statement. And because income momentum integrated over time gives net income the impulse indirectly explains the change in net income. When looking for reasons behind net income mutations it may be relevant to relate them to the company’s critical success factors. For profit is not

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19 In this respect the third dimension is related emphatically to the earning power concept as it was introduced by Edwards and Bell.

20 Ijiri calls this system a differential triple-entry accounting system. He also describes a temporal triple-entry accounting system wherein not the causal net income difference but the budget is the third dimension. As Ijiri states himself, this temporal triple-entry accounting system is not a threefold system in essence. In fact the temporal system is a double-entry system which is applied twice. The budget dimension is not the integer to the existing two dimensions. However, because of its possible practical significance the temporal system is elaborated in detail in chapter 7.

21 Or any other relevant reporting period.

22 The only difference that may occur is a timing difference. An impulse that is measured per year and that occurred on October 1st would explain a net income difference of only 25% of the impulse, presuming the accounting period runs from 1 January to 1 January.

23 From this point of view one could say that the differential triple-entry accounting system refers to profit variance analyses that are performed within the general ledger.
the immediate result of a particular transaction, but rather the result of doing several things well. The most important 'things' can be termed the company's critical success factors.\(^{24}\)

To implement a triple-entry and momentum accounting system, it is necessary for the management accountant to break away from a financial accounting mentality dominated by information characteristics such as neutrality, objectivity and reliability. Other characteristics such as relevance, timeliness and feed forward may be more important. The FASB and (I)ASC conceptual frameworks\(^{25}\) show the trade-offs that exist between these characteristics (this is discussed in chapter 5). One of the hypotheses tested was that the financial accounting framework could also be used in a management accounting context. The only differences would be divergences in the weighting of the distinctive data characteristics. Some 240 inquiry forms were sent out to be filled in by 120 Dutch financial accounting functionaries and 120 Dutch management accounting functionaries and controllers. The results are described in chapter 6. The useful response was 38%. The respondents generally had to answer on a five-point Likert scale (ranging from most important to unimportant). Finally the answers were tested nonparametrically using the two-sample Kolmogorov-Smirnov test. The standard used for significance was 5%. The main conclusion from this research is that the financial accounting framework, as far as information characteristics are concerned, could also be used in a management accounting context (within a 95% confidence range). The distinctive data features were not weighted differently in the financial and management accounting contexts. This finding is rather disappointing, because it would be anticipated that relevance and hence timeliness, feed-forward and feed-back value would be significantly more important in a management accounting perspective. But the research data did not support this hypothesis. Obviously the management accountants and controllers were not able to disengage themselves from a certain financial accounting background. The average score for relevance was 4.44 and for reliability 4.27 and hence the relevance/reliability ratio was 1.04. This ratio was not significantly different for any specific activity (non-profit, auditing, management, government).\(^{26}\) The company's orientation (national/international) was also not decisive for the ratio (1.07 vs. 1.03). The ratio increased for functionaries who had been executing the function for longer, but the difference was not significant.

The average scores for relevance and reliability for the management accountants and controller group were 4.57 and 4.11 respectively. The average scores for these items within the financial accountant group were 4.19 and 4.33 respectively. Looking at the relative frequency, it is noteworthy that 88% of the accountants' answers for the

\(^{24}\) Of course not all of the net income mutation may be explained by forces. It is a matter of materiality and cost-benefit whether the accountant should look for the profit drivers.

\(^{25}\) As far as the information characteristics are concerned.

\(^{26}\) Although the ratio was remarkable high in the non-profit sector, at 1.16.
characteristic 'relevance' fell within the categories 1 and 2 (most and very important). This was 98% for the controllers. For reliability the figures were 92% and 74% respectively. Taking out the management accountants from the accountants cohort, the figures above change remarkably. For the financial accountants (auditors) the relevance/reliability ratio is 0.94, whereas for the management accountants (including controllers) the ratio was 1.28. Almost none of the respondents indicated that they felt any need to extend the choice of criteria. This means that this set of criteria may properly be used within either a financial accounting or a management accounting context.

In general the differences in weights used for the several aspects were not significant. Several correlation tests (Spearman rank order) were executed to trace the associations between the different choices of aspects and to validate the internal consistency of the answers. These tests justified the confidence given to the research results.

In almost all of the responding companies the financial accounting system and the management accounting system coincided (this was a matter of cost and efficiency). But in more than half of the investigated cases a radical change in the management accounting system was expected within the next three years, i.e. in the area of performance measurement. Almost 80% of all respondents believed that current management accounting systems were unsatisfactory. Some 20% of the respondents indicated that the management accounting system should be improved by adding future-oriented data to the system. This is important with reference to triple-entry and momentum accounting. But when implementing such a system the accountant needs to be detached from criteria such as neutrality, verifiability and reliability. In a management accounting context these criteria are not very relevant because the accounts are being prepared for a single user with whom the accountant is in close contact, and there will normally be no conflict of interest between the two about the information to be provided.

To supplement Ijiri's concept of triple-entry and momentum accounting, a general ledger model must be designed to implement the ideas practically (see chapter 8). From a theoretically sound basis, new accounts must be designed to make up the action statement and momentum statement from the general ledger, and new accounting rules have to be designed. Evidently the actual trigger or impulse of any administrative action should not be transactions but (documented) decisions. This could mean that the classical definition of events needs to be modified. But as an event is defined as 'a happening of consequence to an entity' (SFAC 6) this is not necessary. Applying the concept of income realization correctly, a distinction is made between realized and unrealized income forces (or profit drivers) in such a way that the connection with the traditional accounting system is preserved as much as possible.

27 When for example interest rates increase this is 'a happening of consequence to an entity'. It is a curious fact that such happenings are not captured within the traditional system.