SOME IMPLICATIONS OF FEEDBACK SYSTEMS IN THE ACCOUNTING PROCESS

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ABSTRACT

e field of cybernetics and artificial intelli-
nce has exhibited rapid growth since the impetus
ven by Norbert Wiener (9). This paper looks at
e accounting process under three basic view-
ints: linear, cybernetic and intelligence.
ch an examination leads to several insights con-
rning the methods, norms and accuracy of present
counting systems.

INTRODUCTION

e field of accounting has developed throughout
e years based upon the very pragmatic needs of
e business world (Chatfield, 2). These needs
d to today's norms and practices which form the
eleton of an "accounting" science. This practi-
l orientation of accounting also has led to a
ss than adequate examination of the basic prin-
ples of accounting as a science. An exception
uld be the attempts of different accounting
holars to develop basic systems of accounting
tulates and axioms (e.g., Ijiri, 4).

paper attempts to examine accounting under
.ferent "cybernetic" viewpoints. Rather than
tempting an axiomatic development, a wholistic
proach is used. Our approach is based upon an
sumption taken from General Systems Theory, that
, that insight can be gained by considering
alogous (general) system characteristics
'on Bertalansfky, 7). The three basic "systems"
viewpoints considered are: linear, cybernetic
id intelligence.

ie first viewpoint encompasses a sequential view
the process from a static model to two dynamic
odels. The second viewpoint adds the feedback
ature to the dynamic models. Such systems are
lf regulating in nature (i.e., they attempt to
ntrol according to predetermined boundaries).
ie third viewpoint examines accounting as an
telligence process which has dynamic character-
tics, is self regulating in nature and has the
bility to change its own boundaries in response
) changes in its environment.

THE LINEAR VIEWPOINT

ree basic models are considered under the more
eneral classification of linear models: portrait
odel, time-series model and time-series cross-
ection model.

Portrait Model

Accounting can be regarded simply as the portrait of a firm at a definite moment of time. Such reports show an instantaneous close-up of the firm, its assets, liabilities and profits. The argument could be made that this portrait is a distorted one, in which management's objectives, the rigidity of the reporting structure vis-a-vis accounting principles and its static nature impair the validity and usefulness of the portrait.

To circumvent some of the limitations of "financial accounting" portraits many firms have designed management accounting systems which do not conform to standard accounting practices.

Time-Series Model

Securities analysts do not examine firms based upon simple portraits but compare successive accounting reports and, through the analysis of differentials, determine the "trends" in a firm's performance.

For instance, time-series data is a valuable tool in managerial accounting. Indeed, most managerial control schemes are based on the analysis of variances.

Note that the examination of successive static "portraits" representing chronologically different situations begins to depict dynamic characteristics.

Time-Series, Cross-Section Model

The simple analysis of chronological data from a firm would be too simplistic for most buy-and-sell decisions in the stock market. Thus, analysts compare time-series trends among different firms using a cross-section of a specific industry.

This would mean the comparison of successive pictures of a firm which portrayed it in chronologically successive time intervals. This includes comparing these series with other series representing similar firms and finally comparing aggregates of firms of similar risk class.

An example of the utilization of a time-series, cross-section model is the use of accounting data by chartists (financial analysts that base much of their decisions on charts, identifying patterns such as "peaks" and "valleys"). This sequential examination of data (e.g., prices, profits, etc.) is the constant quest of "pattern" search and is based on the belief of general norms governing stock behavior. "Pattern search," or as it is called in artificial intelligence studies pattern recognition (Dreyfus, 3 and Wanatobe, 8), is still performed under very primitive rules. Currently, this process is not easily automated. Thus, human beings are still better pattern recognizers than machines.

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CYBERNETIC VIEWPOINT

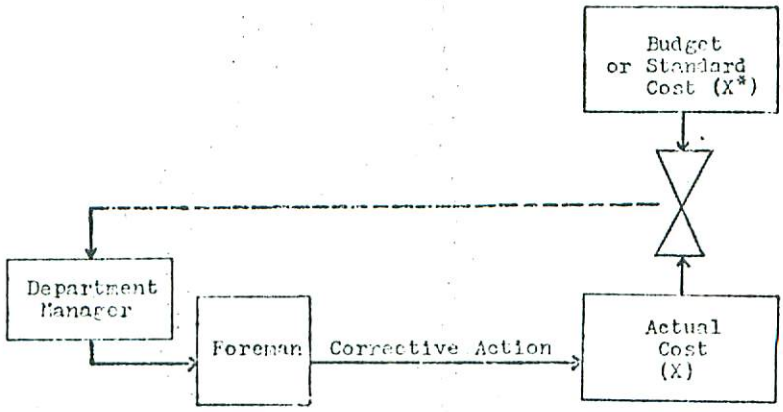
Consider some of the basic concepts in a cybernetic system.

Feedback may be defined as the utilization of the output of a certain process to control or direct this process towards a desired output state. Positive and negative feedbacks can be distinguished according to whether the response to a stimulus is to operate in the same direction or against the direction of the original stimulus.

Control is defined by Pash (6) as "a natural or constructed assembly which interacts with its environment to bring about a particular stability called goal or objective." Also, Anthony (1) describes control as the effort through which "Management attempts to assure itself that the organization is working towards the attainment of the company's objectives..." Both definitions have the main characteristics of an ideal state (goal or objective) and a deliberate trend towards its attainment. Such mechanisms for an accounting system are depicted in Figure I.

FIGURE I

Accounting Budget and Variance Reports:
An Accounting Example of a Control System



The cybernetic viewpoint presents one model which is composed of three basic feedback loops:

(1) Internal feedback loop
(2) Dynamic-temporal loop
(3) Dynamic dispersive loop

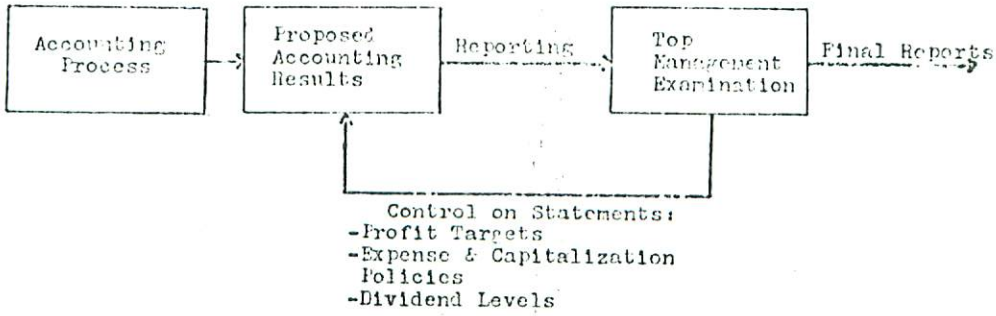
All these loops are part of the same process but for the sake of exposition should be discussed separately.

Internal Feedback Loop (IFL)

The IFL (see Figure II) is an internal process of the firm. Through it, the corporation generates its financial reports.

FIGURE II

Management Reporting as a Control System
(Internal Feedback Loop)



Here, processes of information collecting, coding, classifying and storage are completed and preliminary financial results are prepared. These results are then submitted to management which affects some changes by suggesting dividends to the board and by proposing financial adjustments.

In practice, "earnings" are somewhat controllable and dependent on certain management decisions. For instance, de facto, spending on capitalization procedures are dependent on tax, market and other factors as determined by top management. In fact, some authors have argued that management tends to smooth results.

The IFL cycle is completed with accountants examining these directives, reviewing the financial statements according to GAAPS and resubmitting them to management.

The Dynamic-Temporal and
Dynamic Dispersive Loops

In our complete working paper, two more complex cybernetic loops are also examined. The approach is to consider a larger, more dynamic, system including delay, concept-revision and filtering. Some implications of our review are presented in the final section of this summary.

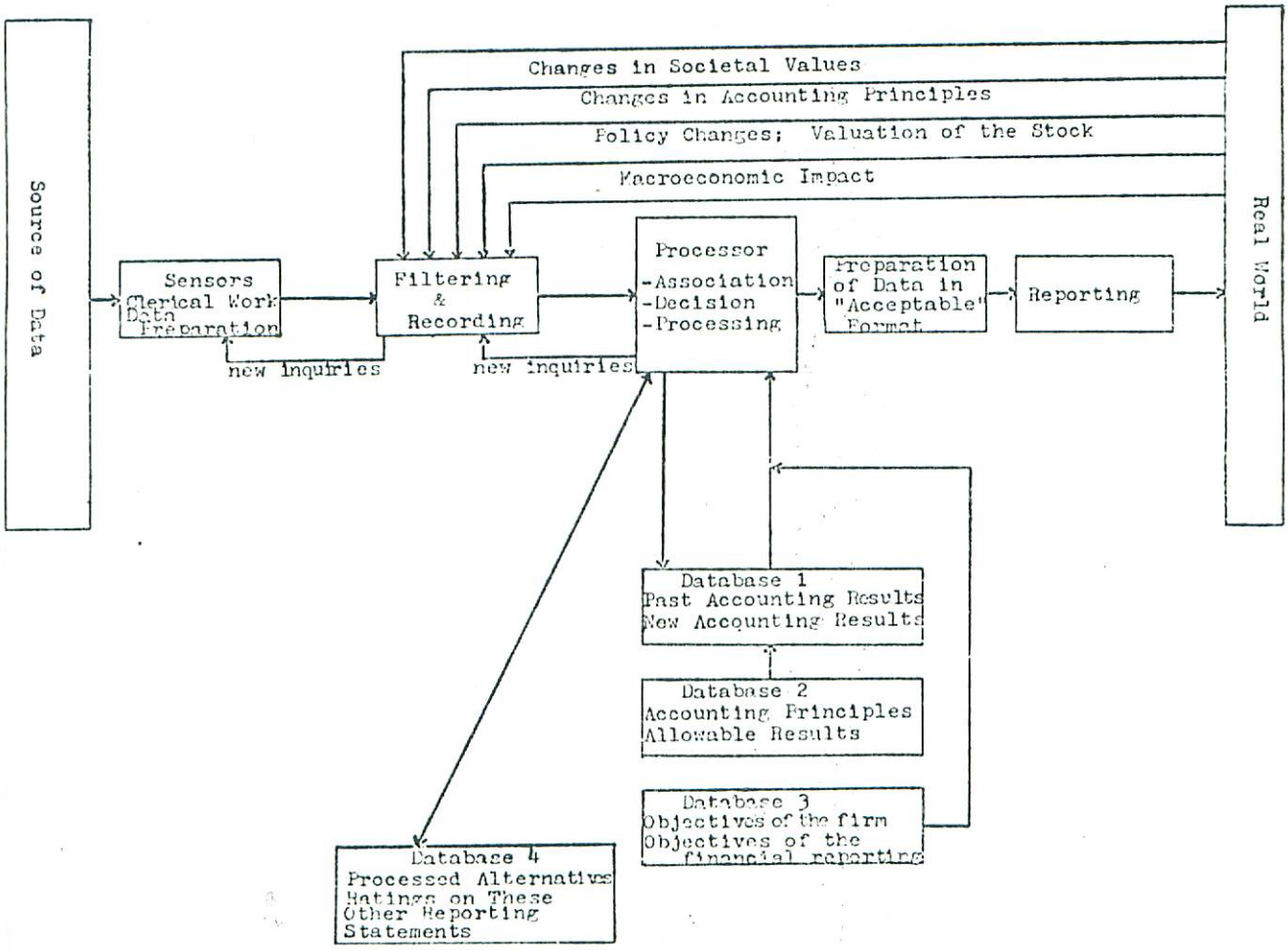
INTELLIGENCE VIEWPOINT

A more complex but more complete model views accounting as an intelligence process (see Figure III). The point where intelligence is linked to the real world is where sensing is performed. Aggregation and filtering also take place: filtering in the sense of decreasing noise, aggregation in the sense of data selection and representation by summary surrogates.

Worthy of notice is the concept of executive unit and the breakdown of the database (memory) into four sub-bases of different access-times (from immediate access to very slow access). Note also that environmental changes and feedback effects are only accepted into the system through the normal input channels of filtering and recording.

FIGURE III

The Accounting Process as an "Intelligence" Process



A key intelligence notion in this model is the concept of the executive unit which (1) receives coded input, (2) stores, filters, classifies and processes input, (3) learns and takes action, and (4) initiates output. Such a model is appropriate for all sorts of intelligence behavior including chess playing computers and pattern recognizing artifacts.

Pattern recognition and learning models are based upon the association of objects and events according to various classification criteria. Recall that the human mind is still a much better "pattern recognizer" than artificial intelligence artifacts. If developments in these areas continue, particularly for learning models, they will surely impact accounting systems if only in the data recording stage, or more significantly in the data analysis stage of financial and variance analysis or audit analysis.

A related area of research into gaming has focused to a large extent on game playing systems (e.g., chess), which would seem to exhibit very slight potential impact on accounting. However, underlying this research is the search for improved models of heuristic decision rules and of learning. Progress in such research will improve our knowledge of the role of information in decision. Such knowledge is needed for a better understanding of the relevance and value of accounting information.

Also, theorem demonstration has reached a significant level of sophistication in artificial intelligence. The eventual application of such techniques to axiomatic accounting systems such as those proposed by Ijiri (4) and Mattesich (5) could extend the logical results of the systems.

Concepts and techniques developed for machine based language translation, while only moderately successful for foreign language translation, also have potential implications for accounting. For instance, the technical language of financial statements and auditors' reports might be analysed for information content and reformed or "translated" for the general user.

CONCLUSION

In summary, accounting has been examined under several different viewpoints. Given this approach the following points should be stressed:

(1) There seems to be significant similarities between the models, notions, etc., in cybernetics and feedback processes and accounting systems worthy of further pursuit.

(2) Both in theory and in practice the cybernetic approach is relevant and particularly relevant to understanding the process of reporting systems.

(3) Finally, an important characteristic of a management system is its dynamics. An understanding of the dynamics of reporting systems is necessary to meaningful and representative business reports.

REFERENCES

(1) Anthony, R. N., Management Accounting (Homewood, Ill., Richard D. Irwin, Inc., 1960).

(2) Chatfield, M., "The First Fifty Years," The Accounting Review, Vol. L, No. 1 (January 1975), pp. 1-7.

(3) Dreyfus, Hubert L., Alchemy and Artificial Intelligence, The Rand Corporation.

(4) Ijiri, Y., The Foundations of Accounting Measurement, (New Jersey, Prentice Hall, 1967).

(5) Mattesich, R., Accounting and Analytical Methods, (Homewood: Illinois, Richard D. Irwin, Inc., 1964).

(6) Pash, Gordon, An Approach to Cybernetics, (New York, Harper and Bros., 1961).

(7) Von Bertalansfky, Ludwig, General Systems Theory, Reprinted in the General Systems Yearbook, Vol. 1, 1956.

(8) Wanatobe, S. (Ed.), Methodologies of Pattern Recognition, (New York, Academic Press, Inc., 1969).

(9) Wiener, Norbert, Cybernetics or Control and Communication in the Animal and the Machine, (The M.I.T. Press, Cambridge, Mass., 1961).