A TECHNOLOGICAL INNOVATION AUDIT METHODOLOGY

4 Audit Methodologies

Auditing is a method for measuring and validating data from various business processes. Most business processes may be audited if data is available for comparison with a certified or known standard. One of the best-established audit disciplines is financial auditing, while others include technology audits, core competence audits, business process audits and many others.

Methodologies for financial auditing have been perfected through trial and error. Over many years the discipline of financial auditing has grown to be a key ingredient in generally acceptable management practises. These well-tested methodologies may be employed in the innovation audit as well. By actively incorporating financial audit methodologies in the innovation audit, a strong base is formed from where future developments may be done. The thoroughly developed methodologies of financial auditing may also enhance the structure and understandability of the innovation audit.

This chapter will start by discussing some aspects of the financial audit methodology, and then progress to the possible application of these methodologies in the discipline of innovation auditing. Some other examples focussing on innovation audits will also be discussed. Finally the methodology for the proposed technological innovation audit is discussed.

4.1 A Financial Audit Methodology

The financial audit process (as opposed to other audit processes) is possibly the most widely recognised and best understood concept held by the general public. In this context an audit may be described as a measuring activity, involving the comparison of data to current set standards and policies. As such financial auditing can be defined in the following general terms:

> *Financial auditing is the process by which a competent, independent person accumulates and evaluates evidence about quantifiable information related to a specific economic entity, for the purpose of reporting on the degree of correspondence between the quantifiable information and established criteria.*[1]

Developing a basic understanding of the processes involved in financial auditing may be instrumental in dealing with the process of innovation auditing. These financial principles are discussed below.

Quantifiable Information and Established Criteria[1]

- To 'do' a financial audit, information in a verifiable form and standards by which the information can be verified, is necessary. Quantifiable information can and does take many forms such as financial statements, the amount of time spent by an employee on a task, the total cost of a contract or an individual's tax return.

  Criteria for evaluating quantitative information can also vary. Financial accounting does however rely on standardised practises and historical accounting principles. For customisation some organisations require criteria based on the standards inside their environment. This often happens where more strict criteria than in usual accounting practises are needed.

Economic Entity[1]

When an audit is commissioned, its scope must be made clear to the auditor. By defining an economic entity such as a company, department or even an individual, the range of the audit is set. Furthermore a time period defining the duration of the operation to be audited should be set. This period is usually one year, yet monthly and quarterly audits can also be done. In defining these boundaries, the auditor can be certain of his/her responsibility and complete the task effectively.

Accumulating and Evaluating Evidence[1]

Evidence is the necessary information for validating any conclusions and recommendations, as well as ensuring the accurateness of the auditing process. Thus any information used by the auditor to validate quantifiable information in accordance with established criteria, can be regarded as evidence. Evidence takes many forms including written or oral testimony, observations and written communication with outsiders. When auditing, deciding on the volume of evidence to gather, is one of the important tasks. The ideal would be not to waste time on collecting too much evidence, yet

finding enough to satisfy the audit criteria. As such gathering evidence is one of the primary auditory functions.

Competent Independent Person[1]
'Competence' and 'independence' are unscientific terms and can therefore not be defined in absolute measures, yet typically competent auditors are qualified individuals that understand the criteria for the audit, as well as the evidence needed to make proper conclusions. An unbiased opinion is necessary, yet often difficult to maintain. As such an auditor always strives towards an independent mental attitude. This does however become exceedingly difficult, when the auditor is also a company employee.

Reporting[1]
The final output from the audit is the audit report — i.e. the communication of the findings of the audit to the organisation. Audit reports differ from auditor to auditor, yet they all have the same basis, on informing readers as to the correspondence between quantifiable information and established criteria. Different audit subjects might also warrant different types of reports. An audit on an individual might require a verbal 'OK' while a corporation might require a formal, highly technical statement.

Financial auditing is a well-defined profession, based on standards and the measurement of conformance to these standards. To formalise these standards and introduce them as common business practise, GAAS (Generally Accepted Auditing Standards) have been compiled. Although others exist, this standard is widely used and accepted by most accounting institutions. By following these standards a better understanding of the auditing discipline is possible.

4.1.1 General Standards in Financial Auditing[1]

The quality of work done by the auditor is of great importance. Not only can this impact on the organisation being audited, but also on all parties relying on the audit information. Setting general standards of technical training, human independence and professionalism become necessary. A non-exhaustive list of these may include.

Adequate technical training and proficiency — Technical competence is a necessity in financial auditing. Formal University education, practical training and experience, as well as continued education are expected from all auditors.

Independence in mental attitude — This relates to the nature of the auditor and his/her ability to distance him/herself from the organisation being audited. It is important that no mental attitudes influence the auditor's objectiveness and cause him/her to misinterpret or represent findings as part of his/her duty.

Due professional care — Professionalism is required in many professions and is expected from the auditor as well. This requires the auditor to act in good faith and not be negligent while conducting an audit.

4.1.1.1 Standards of Field Work in Financial Auditing[1]

Conducting an audit at a client's place of business, requires a high standard as well as professional behaviour from the audit team. Such standards pertain primarily to the client, but should in general include adequate planning and supervision,

understanding the internal control structure of the organisation and obtaining sufficient competent evidential matter. These may be discussed as follows:

Adequate planning and proper supervision — to ensure effectivity and efficiency audit planning is required. Since assistants with limited experience often execute major portions of audit programs, planning and supervision should be on site to guide, and ensure adequate audit quality.

Understanding the internal control structure — the internal structure of the client's organisation has an influence on the validity and accurateness of the financial information. Understanding the controls and procedures that are in place, enables the auditor to assess the accurateness of the financial data.

Obtaining sufficient competent evidential matter — the heart of the audit relies on expressing, with a reasonable bias, the accurateness of financial data presented to the auditor. In this regard evidence and professional judgement is necessary. However, determining the amount and quality of evidence needed, rely on the auditor's experience as well as professional judgement.

4.1.1.2 Standards of Reporting in Financial Auditing[1]

Reporting comprises the outsets of the audit and standardising this format improves evaluation purposes. Four standards need to be met in reporting and they include statements presented in accordance with GAAP (Generally Accepted Accounting Practise), consistency in the application of GAAP, adequacy of informative disclosures and expression of opinion. These may be discussed as follows.

Financial statements presented in accordance with GAAP — the auditor identifies the GAAP standard as the factor for evaluating management financial statement assertions.

Consistency in the application of GAAP — the consistency in following the GAAP standard is highlighted. If not, deviations from the standard can be noted and no report is necessary.

Adequacy of informative disclosures — the adequacy of notes to the financial statements is expressed. If no deviations or insufficient notes are apparent, no report is necessary.

Expression of opinion — as final standard the auditor is required to express an opinion on the financial statements taken as a whole. Several standard opinions are available for appropriate inclusion to the report.

This concludes the introduction to financial auditing. It sets the foundation to build and elaborate on methodologies for the innovation audit. The following sections will contain more relevant information on innovation auditing procedures.

4.1.2 The Adapted Financial Audit Methodology

Adapting the financial audit methodology to the requirements of an innovation audit may prove valuable. The innovation auditing discipline is relatively new and as yet few standards or formal procedures have been defined. The formality of the financial audit process serves in providing guidelines and definitions that may be adapted. One of these is the definition of the innovation audit. By changing some of the terms

in the financial audit definition, a workable innovation audit definition may be derived. It does not claim to be the best nor the only, yet it might hold some merit towards formalising the innovation auditing process.

A proposed innovation audit definition:

> *Technological Innovation Auditing is the process by which a competent, independent person(s) accumulates and evaluates evidence about the process of innovation, related to a specific entity, for the purpose of reporting on the degree of correspondence between the innovation process and established best known practices in the innovation environment.*

The definition touches on many interesting points, which may be applied in the implementation of an innovation audit.

Some perils exist in directly translating the financial audit into an innovation audit. Aspects such as quantifying and finding established criteria as illustrated in the application of GAAP (Generally Accepted Accounting Practise), in the practise of accounting, or GAAS (Generally Accepted Auditing Standards), in the practise of financial auditing, might prove difficult for an innovation audit. However, by adapting the most useful areas in the financial audit methodology, such as the accountability, professionalism, planning, and gathering of data to the innovation audit methodology, improved auditing may be expected. Some of the advantages and disadvantages of adapting the financial audit methodology to the innovation audit methodology, are illustrated in the following paragraphs.

Quantifiable Information and Established Criteria

The difficulty in qualifying innovation in absolute terms is a severe drawback to the process of auditing it. Presently no 'ideal innovation recipe' can be relied on to guarantee success. The reason for this is the amount of human involvement necessary to innovate, as well as the ever-changing nature of new innovations.

However, it is possible to audit many aspects of the innovation process effectively, yet with a slightly different methodology than financial auditing. Innovation practises, although less quantifiable and absolute than financial practises, may be audited by means of 'best practise criteria'. Finding these best practises criteria falls to the researcher in the field of innovation. By identifying the reasons why certain organisations are better at innovation than others, certain practises and methods may be extracted. It is these methods that may form the basis for best of breed practises.

Best of breed practises are not always the same for innovation processes in different industries. They may vary in impact on the innovation process as well as the practises themselves. The researchers' and auditors' dilemma lie in finding a set of standards to be used in auditing that will fit all industries well. Alternatively, designing customised best practises for each industry which suit their innovation processes best.

Specific Entity

As is the case with the financial audit, the innovation audit needs specific boundaries and scope. The diverse nature of innovation can cause poorly defined audits to escalate into very large projects, requiring many resources. By defining a specific group of people, department or process to be audited, the audit procedure becomes more manageable, and delivers better results.

Different methods in auditing innovation inside an organisation could include the following:

- Auditing a previous innovation/product from inception to implementation
- Auditing a management team for their leadership skills in leading innovation
- Auditing a department and the part it plays in the innovation-chain within the organisation
- Auditing a complete organisation and how it approaches and ensures new innovation

The above mentioned list is not exhaustive for other possible specific entities may be defined for auditing.

Accumulating and Evaluating Evidence
Evidence does not play as important a role in innovation auditing as it does in financial auditing. The reason for this lies in the nature of the innovation process and the information extracted from it for auditing purposes. Since the information mostly consists of human perceptions and notions, it is virtually impossible to evaluate quantitatively. The only evidence available is the hard facts of good or poor product performance. Yet this has no bearing on any of the issues influencing innovation, such as creativity, motivation, knowledge, drive, leadership, technology, market needs and many more.

Competent Independent Person
It is crucial that any person responsible for an innovation audit has adequate understanding of the subject. Since the innovation auditing process is so new, many years of implementation and developed will be necessary before competent independent auditors will be available. The best option at the moment may be to employ individuals knowledgeable in innovation. These auditors should, however, be able to respond to almost any situation and understand the implications it may have for the innovation process.

Internal innovation auditing can be quite risky since few individuals are absolutely biased towards their present employers. By contracting an external audit person or firm, more independence and sometimes more credibility are attached to the audit. This seems to be the better scenario.

Reporting
The output from the audit may take on many different forms or degrees of detail. Audit outputs should highlight strengths and weaknesses and leave any future planning to the organisation. They might include recommendations on which aspects of the organisation to change, as well as the best procedures to follow. However, it would be prudent of management to be cautious of audits prescribing certain actions. It is not the auditor's place to prescribe improvements or remedies, but rather to measure and report. It falls to management to plan and act on findings from the auditor's report.

In conclusion innovation auditing may in certain cases borrow methods from financial auditing. There does however seem to be a difficulty in identifying quantifiable information as well as criteria for the measurement of the information as part of the innovation audit. Rather than following the financial audit process blindly, only the most useful areas in the methodology will be applied.

4.2 Possible Technological Innovation Audit Methodologies

The financial audit methodology introduced some basic terms for inclusion into the innovation audit. These terms were identified over many years of auditing and empirical testing. The discipline of innovation does not have such a history, and neither have success factors been identified with complete certainty.

Although literature on management of technology and management of innovation often contains informal proposed innovation audits, they are seldom tested in practise. The example audit, as illustrated in paragraph 4.3, is one of a very select group of innovation audits, which have been implemented and tested in the British manufacturing industry.

The following paragraphs highlight three possible viewpoints on innovation auditing. They include auditing the competencies, processes or performance of the innovation process. Two of these are discussed in an audit, which was developed by Chiesa *et al*. This audit will be reviewed as an example audit after the audit viewpoints.

4.2.1 The Competence Innovation Audit

Human competencies may or may not form the basis for innovation. However, little research on human innovation competencies has been done. Research on culture and other social aspects have made some progress, yet the core of human innovation competencies has yet to be defined conclusively. Not only do the human competencies influence the innovation process, but also the organisation's competencies. Structures and resources provided by the organisation may go a long way in improving the innovation process. The model developed earlier in this thesis leans heavily towards the importance of identifying the competencies inside the organisation. Some of the reasons for this viewpoint might be found in the dynamic times we live in.

The nature of technology is that of relentless change and transformation. Organisations active within the high technology environment are often acutely aware of this, yet often find itself trapped when unforeseen technological changes occur. To cope with these changes, organisations have to have a base to fall back on which has little to do with their disciplinary knowledge. Innovation competencies may be such a base.

If an organisation encouraged its employees to specialise further and further into their fields of expertise, they might easily become redundant when a technology paradigm shift occurred. These employees would not have any generic knowledge or tools that would work in the new environment. This would severely impair these employees in times of change.

However, if an organisation were to educate its employees in the discipline of innovation, they would be better at innovation as well as better prepared for change. A technology paradigm shift might be just such a change they would have to be prepared for. In the event of a paradigm shift disciplinary knowledge easily becomes obsolete forcing employees and organisations to change. By educating its employees in the discipline of innovation the organisation is able to give them some generic tools useful in many different paradigms. These employees would therefore be better equipped to deal with change and might even welcome it due to the many new possibilities associated with it.

By building competencies in innovation, organisations might build a knowledge base applicable to new opportunities, changes or threats, resulting in a highly valuable generic competency which cannot be destroyed by change.

The competence innovation audit focuses on the innovation competencies of the organisation, its resources, structures, leadership, management and employees. By determining the ideal competencies embodied in these elements, the competence innovation audit may find its application.

By examining the technology, market and networking competencies, the organisation and its procedures, and the individual employees of the organisation, a clear measure of innovation competence may be obtained. A competence audit could therefore identify strengths and weaknesses in the innovation environment, inside the organisation.

4.2.2 The Process Innovation Audit

Where the competence audit focuses on the environment created for fostering innovation, the process audit focuses on the step-by-step actions necessary to develop and implement an individual innovation. Systems engineering and new product development processes both find its application in this discipline. Detailed measures of these processes have been developed as part of the new product development processes. They are therefore more accessible and quantifiable than the competence measurements. This facilitates auditing and the identification of clear strengths and weaknesses. An example methodology for process auditing may be found in an excellent audit developed by Chiesa *et al*[2].

The Chiesa *et al* audit, as illustrated in section 4.3, focuses on dual aspects of the innovation process. The two sides are described as performance and process. Process can be understood as the outputs or results obtained when innovating and by looking at these, strengths and weaknesses can be identified. The process audit is a general auditing method, and addresses the holistic attributes such as culture, creativity, structures, implementation and others forming part of innovation. When auditing in such a way, all employees can offer significant value in completing the audit questionnaire. These responses can, however, be emotional and not always reflect the true state in the organisation. They are often answered on 'gut feel', reducing the audit to possibilities and perceptions rather than facts.

4.2.3 The Performance Innovation Audit

Different to the process audit the performance audit moves away from all the 'soft' emotionally driven innovation attributes, cutting directly toward the factual process of new product or process development. The performance audit requires the identification of metrics (units of measurement) whereby processes, methods and involvement is measured and equated with another measurable entity, usually money or time.

The process audit may be quite difficult to implement, since few if any clear metrics exist in the innovation process. Long discussions as to good or poor metrics may lead to unacceptably high implementation time for the audit. The process audit has the added drawback of high level implementation, often excluding lower level employees from participation. As tested by Chiesa *et al,* this audit is sometimes regarded as too difficult to implement, resulting in a shift of emphasis towards finding the best metric.

Although the performance audit has its niche of implementation, it tries to measure a qualitative process by applying a quantitative measure. In the world of financial auditing this is possible, for there quantitative data is compared with quantitative measures, resulting in a quantitative outcome. When trying to compare qualitative and quantitative data with each other difficulties may be expected, and since innovation is by enlarge a qualitative process this may often occur. This makes the performance audit a difficult audit methodology to implement.

4.2.4 Conclusion to Technological Innovation Methodologies

The three proposed audit methodologies proposed above is not an exhaustive list, and should not be interpreted as a total representation of the field of auditing. However since innovation auditing is new few explicit methodologies have been defined and the above mentioned is therefore only a beginning.

Competencies are from this audits perspective valid measuring aspects in the innovation process. Competencies of organisations represent the skills, processes, procedures and perceptions of an organisation, and by measuring these the audit methodology is able to hit at the core of organisational practises.

The following section will give a opposing view from the one of competence auditing, in the example of an innovation audit by proposing a *process* and *procedure* audit.

4.3 An Innovation Audit Example

A Technical Innovation Audit Developed by Chiesa *et al.*[2]

The need for innovation auditing is steadily being recognised as a good management tool for increasing and improving the innovation process. The United Kingdom Department of Trade and Industry, encourages the development of an innovation audit as it sees technological innovation as one of the drivers of national competitiveness, and sought a means of getting companies to develop and improve their innovation management processes and performances.

A dual approach to innovation auditing is followed by the Chiesa *et al* audit. Innovation performance and innovation processes are split to form outcomes based and best practise audits.

> The *process audit* (best practise audit) focuses on such questions as whether the individual processes necessary for innovation are in place, and the degree to which best practises are used and implemented effectively.
>
> The *performance audit* focuses on the measurable outcomes of each core and enabling process of the overall process of technological innovation. Concerned with results and outputs from the innovation process, the performance audit looks at quantitative results, facilitating the comparison between current performance and expected or required performance.

In developing the audit, a general model of the technological innovation process is constructed. This model consists of 'core processes' as well as 'enabling processes'. The core processes, of which there are four, form the main focus of the model, while the enabling processes form part of the innovation environment, and interact with the core processes. This may be observed in Figure 4.1. The model creates the basis of the innovation audit, and both the performance and process audits draw their representation of the innovation process, from this model.

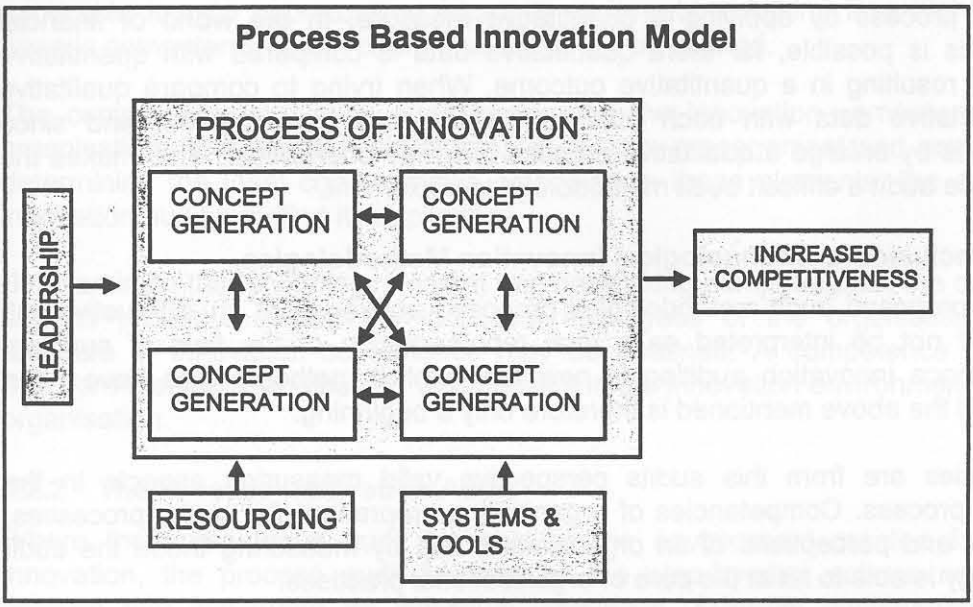

Figure 4.1: A Process Based Model for Innovation, Source: Chiesa et al[2]

By building on the model, a detailed innovation audit may be constructed. Such a comprehensive approach to auditing a firm's technical innovation competence, should encompass a means for:

- assessing the current innovation practise and performance;
- identifying the gaps between current and targeted practise and performance and the reasons for gaps;
- defining the action plans needed to close these gaps.

4.3.1 Process Audit

A process audit of a firm's innovation competence requires reviewing the practises adopted to mange the innovation process. The following are noted by Chiesa *et al*:

- the degree to which there are appropriate business processes in place;
- the deployment of good practises — the breadth of use in the company;
- the degree to which each practise meets known 'best in class' or world standards.

Due to the perceived and real complexity of the innovation process, organisations often require various assessment methods. The Chiesa *et al* audit proposes the use of an in-depth audit as well as an overall assessment scorecard approach. The scorecard, as based on the model, would serve as a rapid assessment method, identifying areas of high and low importance. The outputs from these high or low areas could then be used in the in-depth audit, reducing the amount of in-depth testing necessary.

In developing the model as well as the scorecard, an extensive literature review was conducted by Chiesa *et al*. This was necessary in order to identify, as well as quantify the best practises in the discipline of technological innovation. An integration of literature from several sources yielded a strong foundation in identifying best, as well as worst practises. These were then applied to the innovation scorecard as part of the innovation audit.

The scorecard was constructed using a general four point ranking, where each of the four points represents an improved state, from poor to exceptional. As these all involve some sort of description of the particular process, care is taken to be general, yet topic specific. The scorecard requires the participant to select the description best resembling the organisational innovative actions. This can significantly improve total participant understanding.

4.3.2 Performance Audit

The focus of the performance audit is on measurable qualities of the innovation process. This differs from the process audit, where best practises are used for measurement. The performance audit requires the definition of metrics that can be quantified and measured unbiased. The metrics needs to be defined by the organisation, as they are highly specific. To facilitate the definition process, the innovation auditor might propose the following areas wherein metrics might be defined:

Concept development — the number of innovations, new product ideas, number of new product based ventures, averaged product lifecycle, product planning horizons

Product development — time to market, product performance, design performance

Production process innovation — effectiveness, speed, development cost, continuous improvement

Technology acquisition — R&D/technology acquisition cost per new product, R&D projects that lead to new or enhanced products, number of licences, number of patents, cost benefit of R&D projects

Leadership — number/percentage of members from technical functions/product development in the main and subsidiary/divisional boards, percentage of employees aware of innovation policies and values, number of pages in the annual report devoted to innovation and technology

Resourcing — personnel in product development who have worked in more than one function, percentage of projects delayed/cancelled due to lack of funding, percentage of projects delayed due to lack of human resources

Systems and tools — percentage of designers with access to CAD screens, percentage of products on CAD database, percentage of designers trained to design for manufacture, percentage of teams trained in creativity techniques

Metrics is specific to organisations, although some similarity might occur between companies in the same industry. Metrics offers the innovation auditor a precise method for measuring. This may lead to identification of areas for improvement, as well as gaps between current and expected performance. It may even be used for comparison of performance, against goals set by the company or the competition. Future performance standards may be set, based on final outputs from the performance audit.

The single biggest drawback of the performance audit is the nature of the process it proposes to measure. No innovation is ever the same — as per its definition —

assigning performance measures to parts of this process, assumes one innovation will be comparable with the following. In certain special cases this might be true, yet for the majority of innovations, few if any repetitions are present.

4.3.3 Example Review

The Chiesa *et al* audit focuses on dual aspects of the innovation process, namely the performance and process sides. The process side may be understood as the outputs or results obtained when innovating, and by looking at these, strong or poor practises may be identified. The process auditing method addresses the holistic attributes of innovation such as culture, creativity, structures, implementation and others. When auditing in such a way all employees are able to participate and offer their assessments and perceptions. Since the questions are understandable and most employees may have some experience at the fields in question. However these responses may in some instances be emotional and will not always reflect the true state in the organisation. They are often answered on 'gut feel', reducing the quantifyability of the audit results.

The performance audit mentioned in the Chiesa *et al* example focuses on the quantitative measures in the innovation process rather than the 'soft' human innovation attributes. It focuses on identifying quantifiable and measurable entities inside the process of new product development. The performance audit requires the identification of metrics (units of measurement) whereby processes, methods and employee hours may be measured against money or time. The process audit is often difficult to implement, since few if any clear metrics exist in the innovation process. The performance audit has the added drawback of high level top down implementation requirements, due to the definition of metrics and associated control that is necessary to measure them accurately. This excludes and disempowers lower level employees who may often be the main innovators of the organisation. It was concluded in the results of the beta tests conducted by Chiesa *et al* that this audit is often regarded as too difficult to implement.[2]

Although other audits have been proposed by Shumann *et al*,[3] Tidd *et al*,[4] and Burgelman *et al*[5] they have yet to be implemented. These efforts were considered in the development of the proposed model and innovation audit methodology but will not be discussed at this time. They often consist only of proposed questions to ask and seldom includes a methodology for implementation.

The example audit by Chiesa *et al*, as well as the proposals made by Shumann *et al*, Tidd *et al*, and Burgelman *et al*, indicate some of the difficulties and advantages associated with different types of innovation audits. Although the field of innovation auditing literature is insufficient to make adequate conclusions on the best method for innovation auditing these offer some guidance. The difficulties and advantages will be of value in the following paragraphs where a proposed audit methodology is discussed.

With the aim of building on the work by Chiesa *et al* the proposed competence audit for technological innovation developed in the next paragraphs, focuses on enabling and fostering innovation, through identifying and measuring competencies. Many of the themes and aspects highlighted by the Chiesa *et al* audit, can be followed through as competence measurements. The proposed audit methodology focuses intently on the 'measurement of human and group competencies', hoping to facilitate and coach organisations to the factors crucial for technological innovation.

4.4 A Proposed Audit Methodology (based on a competence audit framework)

Innovation auditing is an emerging discipline. As yet, few organisations have tried to implement such a process. The audit methodology proposed here, draws on ideas and literature in the fields of auditing, technology and innovation. Interaction with key people in the industry, as well as the academic environment, helped to clarify and validate many proposed audit questions and ideas. A 'prize', in the form of an innovation audit was found in an article by Chiesa *et al*. This had a significant effect on the proposed methodology of this thesis.

As stated before the proposed audit methodology focuses on competence analysis of technological innovation process in the organisation. The proposed audit methodology builds primarily on the model developed in earlier chapters of this thesis, as well as on the competence audit methodology discussed above in paragraph 4.2.1. The model is integrated with the innovation audit in such a way that it provides structure, and ensures that all the necessary parts of the innovation process are covered. Due to the diverse nature of innovation, it is easy to leave out some aspects when auditing. Since the model theorises to represent the entire field of innovation, it enables the audit to identify and target the strengths and weaknesses in the organisation in short order.

4.4.1 The Fostering Environment Methodology

Innovation is often referred to as a very sensitive process,[4] easily undermined or compromised by uninformed people. Therefore to 'get innovation going', a special environment with open inviting structures, knowledgeable people and available resources are necessary. To attain this in the innovation process, organisations will have to change the way they look at innovation. Innovation does not happen on demand and neither can management 'drive', command or require innovation from employees. Without vastly improving perceived advantages of being a creative and innovative person in the organisation, few employees will be prepared to accept the risk of failure, inherent in the innovation process. Therefore innovation will only occur consistently when all the correct procedures, as well as reward possibilities are in place. Conversely, innovation will almost never happen before every obstacle has been removed.

This concept of total compliance, or unification in innovation, may be observed in many innovation models,[6,7] as well as in actual organisations. For example: 'At Pfizer there is an institutional memory that supports the way we solve problems and organise our work.'[8] This accumulated knowledge and institutional awareness act directly to the advancement of innovation at Pfizer, thus making it one of the most successful pharmaceutical organisations in the world. It is therefore clear that unification and working towards a common goal can have powerful influences on the innovation process.

The innovation model developed in an earlier section of this thesis is based on the dual areas of the innovation process, and it forms the basis for unifying the innovation process. The model describes the new product development process as well as the fostering environment.

Although the new product development cycle is and will always be a key part of the innovation process, it has been studied and analysed extensively. The audit in this thesis therefore avoids the new product development process in its methodology. It

rather focuses on the fostering environment, where small improvements may still have large payoffs.

Due to the nature of innovation and its current management procedures, little analysis has been done on the innovation-fostering environment. This creates the opportunity for measuring and implementing best practice models in this environment, deriving significant advantage to innovative organisations. By adding some structure to a field of 'soft' issues, improvements in understanding are possible. Without structure and understanding, learning is not possible and without learning organisations are unable to improve this discipline.

The methodology for auditing the organisational competencies by focussing on the fostering environment might initially look one-sided, but on deeper inspection one will find all functions of the innovation process covered. Is it not true that the competencies of an organisation lie in its individuals and procedures? And is this not precisely what the innovation model proposes to measure? Saying the audit is one-sided from a new product development point of view, may have some merit, yet when one observes the total innovation process, this is no longer the case. Innovation auditing is a broad and difficult process, which has to be customised for each and every organisation. However the kernel of knowledge used in the innovation audit stays the same for all, because in essence the competence to innovate has more to do with individuals, processes and procedures, than with in-depth scientific knowledge.

A proposed methodology for auditing an organisation is discussed in the following paragraphs. A flow diagram was also developed and is illustrated in Figure 4.2. Some resemblance to the discipline of financial auditing may be seen, however, elements of other audit methodologies are also present. The methodology starts by introducing the concept of standard for the innovation process, and is concluded in the application of findings of the innovation process.

4.4.2 General Standards

No general standards exist in the discipline of innovation. Unlike the discipline of financial auditing, generally accepted innovation practises do not exist, and neither might such practices be easily defined in the near future.

The only solution to finding standards is to look at the field of best innovation practises. These pseudo-standards may temporarily serve as a benchmark for the innovation process; that is until better ones have proven themselves. The innovation audit therefore strives towards capturing the best practises in the discipline of innovation and adopting them as temporary standards.

The next chapter will focus on identifying many of these best practise standards. Based on these a beta test innovation questionnaire was developed and may be viewed in the addendum [Appendix C].

Although best practises are a solution to the dilemma of defining standards for the innovation audit process, it by no means guarantees that the standards are correct. This means that an audit developed for a specific industry might not be applicable to another. Therefore the discipline of innovation auditing will always require specialised consultants with experience in innovation and its possible permutations. Without the trained knowledge of these individuals, organisations may find that even by scoring high on a 'do it yourself' innovation audit, the innovation process of the organisation might still be weak.

Defining standards in innovation will always be a contentious issue. Through experimentation and learning, organisations might find 'that which works best' for them, yet always remembering they operate in competition with others, and the ones with the best standards are the ones with the best innovation competencies.

4.4.3 Audit Boundaries

When a new project or measuring activity is started, certain boundaries have to be laid down. This too is crucial in the innovation auditing process, since innovation can often occur in many diverse forms throughout an organisation. Technological innovation forms part of the discipline of innovation and may be used as boundary. Other areas, as highlighted in previous chapters, such as the type of innovation, product, process or service, as well as different business units, management, employees or other groups may also be successfully used to define audit boundaries.

In the proposed innovation flow diagram, illustrated in Figure 4.2, the sources of data are identified as *management*, *key innovative people* and *employees*. Other classifications may be utilised, depending on the required results of the innovation audit.

Choosing the audit group sets the first boundary on the audit process. The flow diagram shows only three group selections. Different ones are possible. By choosing the audit groups carefully, a *management*, *general* or *specific* innovation audit may be conducted. These may be used for different purposes, such as *strategic planning*, *department restructuring*, *fault diagnosis*, *human resource management* or even *technology* strength and weakness assessments.

The boundary between technological innovation and innovation is obtuse at best. Betz[9] goes as far as implying technology and innovation are one and the same, while Noori[10] clearly distinguishes between technological innovation, invention and creativity. For the purpose of this thesis it is proposed that the boundary between technological innovation and innovation is defined by the 'technology'. Technological innovation would not include financial, management, political, social or other non-scientific innovation. It would focus on innovation related to technology and science, rather than non-scientific based procedures and processes.

Other boundaries may be set in consultation with the organisation, and the outputs required from the innovation audit. This would incorporate the current procedures in the organisation and how they innovate and utilise technology. It should also include what the organisation wants to achieve in the future, and the typical changes that might be necessary to achieve this.

4.4.4 Defining the Audit Group

Defining the correct audit group is important for many reasons. Every element of the audit is influenced by the perception and understanding of the auditee, especially if the audit is based on qualitative rather than quantitative measures. By selecting groups with approximately the same level of perceptions, knowledge, hierarchical position and influence on the innovation process, a representative data sample may be obtained.

One possible method for choosing a representative audit group or groups may be by studying the organisational structure. Through this structure various groups with

similar competencies may be identified. It is also a good idea to work in conjunction with senior management to identify the various groups.

The different audit groups may be selected to represent the different hierarchical levels within the organisation. They may also be selected by vocation. Or they may be grouped into *invent*, *realise*, and *implementation* groups as discussed in 'the proposed innovation model', in chapter 3.

Grouping the organisation before auditing is important yet a large group audit, which covers virtually every employee, may not be such a bad idea. The questionnaires received from such an audit may be sorted into groups afterwards. However, this generalises the audit and applied explanations of questions are impossible in these situations.

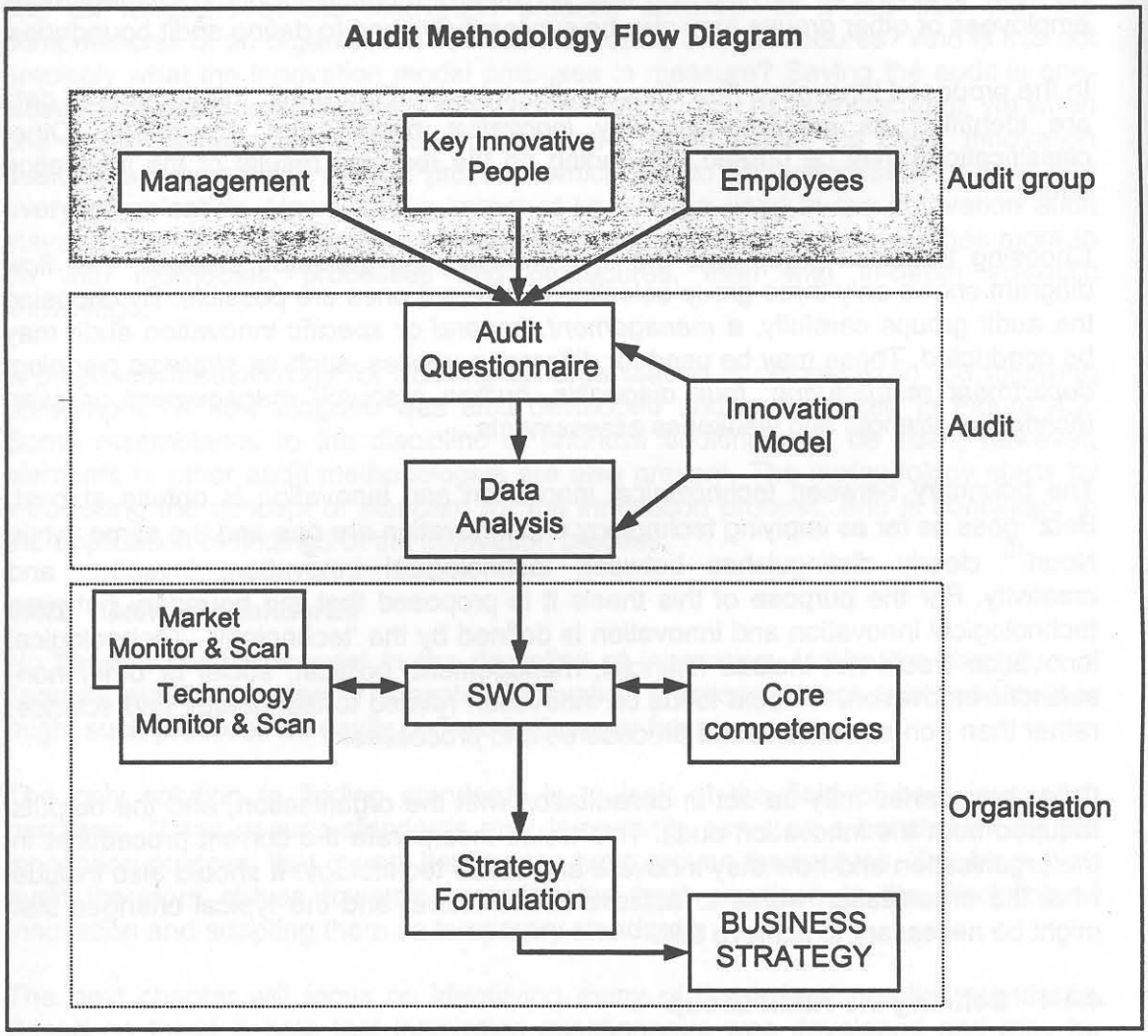

Figure 4.2:Proposed Audit Methodology Flow Diagram

The advantage of smaller and better-focused audit groups lie in the applied advice and explanations the auditor may give at the audit occasion. This facilitates understanding and reduces the possibility of ruined audit questionnaires.

The number of employees in a group becomes significant if an individual is able to influence the results significantly. The ideal would be to ensure that at least ten participants complete the audit questionnaires. However, this is often difficult when smaller organisations are audited, or when a group, representing top management, completes the questionnaire. In these instances care should be taken to discuss and

explain each question in the audit questionnaire, thereby reducing the chance for misinterpretation and distortion of the answers.

Without due care and consideration, the audit groups may severely influence the innovation audit process. Direct consultation with the groups is advantageous, but not essential. The audit groups have to be chosen in accordance with the results required from the organisation, be they strategic, disciplinary or elementary.

4.4.5 The Audit Questionnaire

The questionnaire forms the front end of the innovation audit. By using the questionnaire, responses to issues on innovation may be gathered from an audit group. Through the use of a questionnaire, a large amount of data may be gathered. When analysed, this data would represent the organisation's abilities relative to best practises in innovation.

The proposed audit questionnaire developed in this thesis was compiled from the 'proposed innovation model' as developed in chapter 3. Other literature on innovation case studies, models and management methodologies, was also used in the compilation of the questionnaire. The innovation audit is therefore an extension of the innovation model.

The questionnaire consists of three sections, which each consists of three to four subsections. The sub-sections contain the questions. Each sub-section contains five questions. In all there are 50 questions. The questionnaire is included in the addendum and may be consulted there.

The questions take the form of asking a question on a single subject, and then proposes four separate answers. The answers are arranged from best to worst. However, there are no correct or incorrect answers, for the questions form part of a measurement tool and not a prescription tool. By supplying the audit group with four possible answers per question, their responses may be measured more formally. This improves the data analysis process as well.

Each person identified in the audit group, receives an audit questionnaire and is asked to select one of four answers for each question. These are later calibrated as part of the analysis process.

4.4.6 Data Analysis

In analysing the data, the four proposed answers for each of the questions are numbered from one to four, with one being the worst possible answer, and four being the most ideal. The chosen answers are then individually entered into a database for further analysis. If groups were defined beforehand, the data should be kept in this format.

At this stage the data of each questionnaire is still treated individually. However, by summing and unitising the answers of the individual questionnaires, a representative answer of the total audit group may be found. With this step, the many audit questionnaires are combined into one, which represents the total audit group. This may be done with the whole audit group or with groups identified inside the bigger audit group. A management sub-group may be one ideal group to keep apart.

This formatted data from the audit questionnaire may be analysed and presented in different ways. High-level organisation strengths or weaknesses may be presented

as trend lines, bar charts or other graphical images, while specific weaknesses may be highlighted by comparison with 'best in category' results.

The data may be formatted into **individual**, **sub-sectional**, and **sectional** sectors.

Individual

Each of the questions in the innovation audit questionnaire addresses a part of the innovation process, and therefore indicates a particular strength or weakness. These may be analysed in conjunction with the other questions or individually.

Commonly the individual answers would be analysed after the key strengths and weaknesses have been identified in the sub-sectional and sectional sectors. When reasons for strengths or weaknesses are required, the individual questions may be analysed.

In analysis, if a particular answer was to diverge greatly from the others, misunderstanding, ignorance, or impatience in the audit group may have been the cause. These individual questions should be discussed with management and a decision on their place in the audit made.

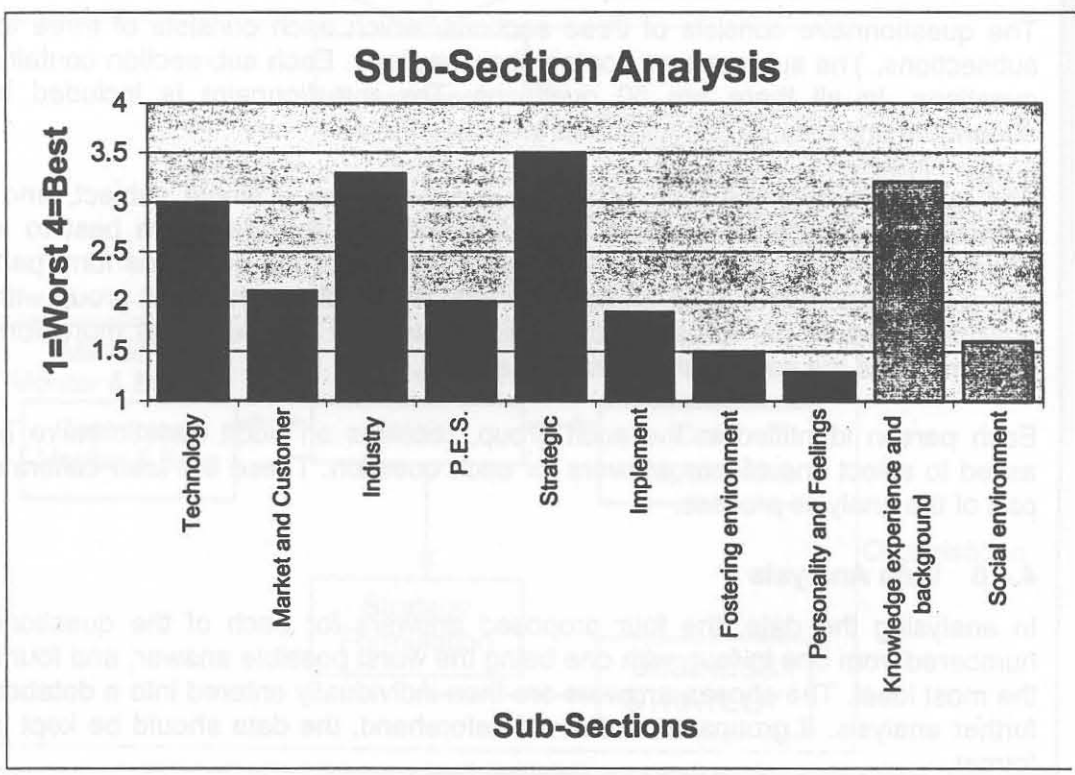

Figure 4.3: Example of Sub-Section Analysis Results

It is not sensible to represent each question on a chart. The sub-sectional and sectional analysis do however lean themselves to bar chart representation.

Sub-sectional

Each of the sub-sections addresses a part of the three innovation model sections, namely *environmental, organisational,* and *individual* as discussed in chapter 3. As such they represent key areas where focus is necessary in the innovation process.

After the section analysis process has identified a poor section, examining sub-sectional results will indicate which of them influenced the section the worst. When a sub-section has been identified, plans and procedures may be implemented, to improve the section as a whole. By looking at individual questions in the sub-section, the detail problem areas may be identified.

Sectional
Formatting the data into sectional areas of strengths and weaknesses may offer a holistic view of the innovation process. This data may be used effectively in strategizing the development of the *environmental*, *organisational*, and *individual* areas of the innovation process.

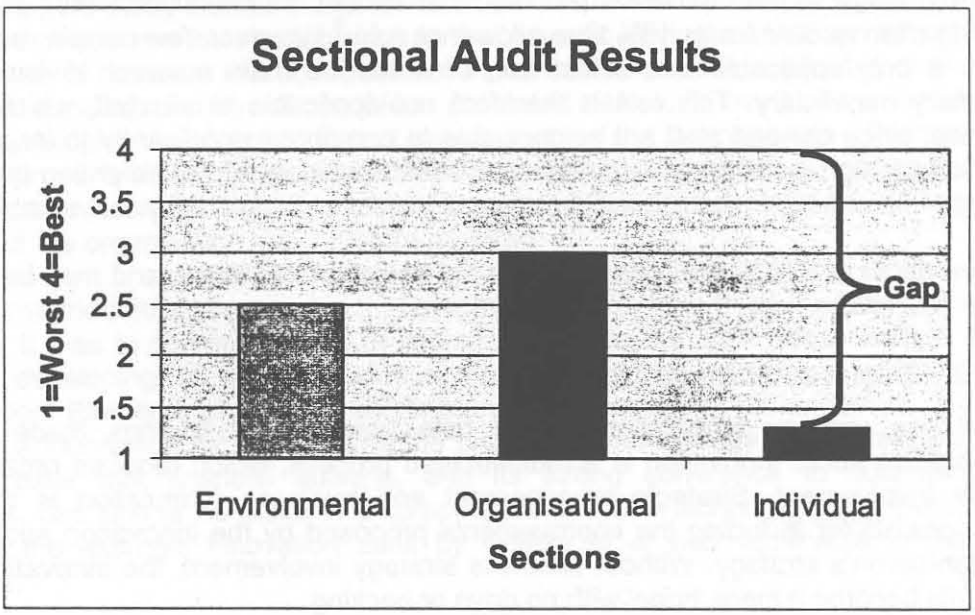

Figure 4.4: Example of Sectional Analysis Results

The three sections discussed above represent the findings of the innovation audit in a graphical way. By measuring the relations between the bars, organisations are able to focus on improving the weaknesses. The 'gap' between the top of the charts and the best possible score, may be used in defining the growth possibilities in innovation for the organisation, as illustrated in Figure 4.4. Through identification of strengths and weaknesses, as well as growth potential, the innovation audit results represent a valuable tool to top management. It offers them a holistic view of the current innovative competencies in the organisation, as well as identifying where improvements may be required. Offering a plan for improvement may ultimately reduce the amount of mystique surrounding innovation, and actually improve the organisations' abilities.

> *Auditing goes beyond measuring: it builds on this to identify gaps between current and desired performance, to identify where there are problems and needs, and to provide information that can be used in developing action plans to improve performance*
>
> — Chiesa *et al*[11]

The audit data may also form a benchmark for future innovation competence audits. By implementing an innovation audit in a yearly fashion, the previous data may

calibrate the amount of change over the past year. Improving the ability of top managers to understand the current and future of the discipline of innovation within their organisations.

4.4.7 Strengths, Weaknesses, Threats and Opportunities (SWOT)

SWOT-analysis is often used in organisational analysis and strategy formulation. By integrating the results from the innovation audit with this analysis, advantages of understanding and familiarity may be gained. The SWOT-analysis methodology may also contribute to the credence of the innovation audit findings.

Care should be taken to implement findings from the audit throughout the whole organisation. Many of the competencies addressed by the audit, are specific to a certain stage of the innovation process, and should not be implemented randomly. 3M is often quoted for its 15% time allowance rule.[8] However, few people realise this rule is only applicable to a select few, of which the main research division is the primary beneficiary. This rule is therefore not applicable to all staff, which makes sense, since general staff are seldom able to contribute significantly to innovations, based on high technology. Organisations should be wary of implementing innovation proposals without strategic consideration of where they might be most valuable.

More detail of SWOT-analysis is beside the theme of this thesis and may be studied at a later stage.

4.4.8 Business Strategy Formulation

Business strategy formulation should take note of the findings made by the innovation audit. Innovation is a multi-faceted process, which requires organisation wide involvement. Strategic management and business formulation is therefore responsible for including the improvements proposed by the innovation audit in the organisation's strategy. Without business strategy involvement, the innovation audit results become a mere 'hope' with no drive or backing

4.4.9 Advantages and Disadvantages of the Proposed Audit

The proposed competence audit for technological innovation is able to identify strengths and weaknesses of the innovation environment within the organisation, and represent these strengths and weaknesses in such a manner that action may be taken.

It is also capable of improving the understanding of the innovation process and culture inside the organisation, improving management decisions and strategy formulation. This is possibly the greatest advantage held by an innovation audit. It being a source of knowledge on the competencies of the work force, to reach certain goals, and their ability to innovate.

However, the audit is not suitable for identifying quantitative measures of the innovation process. It is based on qualitative factors of the organisation, such as *perceptions, competencies, cultures, leadership,* and *interaction*. To identify quantitative measures of the innovation process, another type of innovation audit will have to be developed. However, due to the qualitative nature of innovation, such an audit may prove to be difficult to implement in practise.

Due to the nature of innovation, no standards are available. The audit makes use of best practises for standards and in this lie the audit methodology's predicament. Identifying the 'correct' and 'best', best practises can become the number one activity

in developing an innovation audit, reducing the significance of a formal methodology. For if the best practise standards are correct, almost any methodology will do. However, if the best practise standards were actually not best practises, the best audit methodology in the world would not help.

Since the audit methodology has yet to be thoroughly tested in practise, further advantages and disadvantages is difficult to define. Chapter six will discuss a beta-test of the audit questionnaire, and may be able to identify some implementation problems.

4.5 Conclusion

There are many ways of improving the innovative competence of an organisation. Often managers study literature and research articles on entrepreneurship, creativity and culture to address the shortcomings in their specific environment. Even though a large volume of literature exists, it does not mean the literature is applicable or even correct for applying to a specific problem. As stated before, innovation is a 'holistic' business principle, meaning that almost every aspect of the business can influence it, and to improve it, the whole business has to change. Better practises in managing innovation and incorporating it into a holistic approach towards strategy development throughout the organisation are therefore required.

The audit methodology proposed in this chapter does not claim to be the best nor the only one. It tries to define an order of implementation to the audit questionnaire, as well as developing a holistic concept of the innovation process, within the organisation. Elements of financial auditing and one example of an innovation audit, serve as a foundation for constructing the proposed methodology framework. But it became clear that financial auditing, and its strong adherence to quantitative measures, has little or no place in a competence audit for technological innovation. However the example innovation audit by Chiesa *et al* was applicable in many instances.

Innovation auditing is based on best practises, and therefore variable in nature. Measuring the organisation's competencies against these best practise standards, are unfortunately the best available option, although it may never be perfect. Therefore the identification of the correct standards, play the most important part in developing an innovation audit; resulting in different audit methodologies, being able to do the job. In consequence, diminishing the development of a formal innovation audit methodology.

The next chapter will discuss the best of breed standards, used in developing the innovation audit questionnaire. As mentioned above, these standards are crucial for developing a valid innovation audit and were therefore studied in detail.

4.6 References

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