CHAPTER 2

PERSPECTIVES ON TECHNOLOGY, MUSIC TECHNOLOGY AND SOUTH AFRICAN MUSIC EDUCATION

The purpose of this chapter is to identify key concepts, recurring issues and areas of specialization in Technology, Music Technology and the predicament facing South African music education that will be used to shape the conceptual framework in Chapter 5.1.

2.1 Technology, music and education

This section traces the roots of the term "technology", explores perceptions of technology for the purpose of locating Music Technology within this discipline and places Music Technology within its musical and educational contexts, both internationally and in South Africa.

2.1.1 Technology defined

A variety of definitions for technology that informs this study have been explored. Of these definitions the Greek, French and English ones impact directly on this study. The term "technology" has its roots in the Greek word "technologia", which is made up of two words "technés", which means "art", "made by the human hand"; and "logikés", which means "study". It follows that technology is the study of art, the analysis of how "things" are made and work and how such knowledge can be used to make them better. The root "techné" "combines the meaning of an art and a technique, involving both knowledge of the relevant principles and an ability to achieve the appropriate results" (Wheelright 1996: 328). Technology, thus, implies reasoned application. The French use of the term "implies a high degree of intellectual sophistication applied to the arts and crafts" (Hall 1978: 91). The French use two terms, "technologie" and "technique", to give a more precise meaning to the English word technology. "Technologie" is used to refer to the study of technical processes and objects, whereas the term "technique" refers to the actual application processes (Willoughby 1990: 41). It is these two concepts that are mixed in the English usage of "technology", and this results in a failure to distinguish between its study and its application.

The term "technology" in the English language acquired limited use in the late 19th century as a way of referring to the application of science (knowledge) to the making and use of artifacts. In the 20th century, the attainment of formal knowledge is linked with the development of science and technology. More recent scholars (McGinn 1978; McDonald 1983; Vincenti 1984; Parayil 1991) emphasize the importance of knowledge in defining technology. The recognition of the centrality of knowledge leads to conceiving technology as more than artifact and as more than technique and process. This technological effectuation is the rational process of creating the means to order and transform matter, energy and information in order to realize certain valued ends.

2.1.2 A working definition of Music Technology

Although several authors (Williams 1992; Spotts & Bowman 1995; Rudolph 1996; Brown 1997c; Williams & Webster 1999; Lansky 2001) have all published in the field of Music Technology, to date apparently no clear definition of Music Technology exists. Attempts at defining Music Technology as a field, focus rather on a definition of technology that is related to music. Although each of these definitions makes a valid contribution towards understanding Music Technology, a fragmented perspective of the field emerges resulting from these definitions. In order to highlight this perspective I shall examine selected definitions in this section with a view towards establishing a working definition of Music Technology.

Williams (1992: 26) suggests a definition of "technology" that relates to computer technology. In his definition, the hardware and software required to give computer machines some semblance of intelligence should include a host of peripherals that interact with computers. Williams (1992: 29) goes further to add that a broader view of technology needs to be considered. This view should consider educational technology, a term that includes more critically the issues of teaching style and strategies, delivery systems, and curricula. In the latter, Williams considers technology from the point of view of educational technology. However, audio technologies and the issues of acoustics and psychoacoustics, which are central to studies in Music Technology involving audio, are not accommodated in his definition.

According to Spotts and Bowman (1995: 57), "technology is defined as the application of science concepts and knowledge to problem-solving, which may include many things, from processes to hardware". Both the definitions of Williams and of Spotts and Bowman are limiting in that the purposeful application to meet human needs as well as the needs of music are vital components. Rudolph (1996: 4) goes so far as to say, "the word 'technology' can be used to describe a wide variety of devices and applications in music and music education. By general definition, technology can be thought of as anything that uses science to achieve a desired result." The above definitions suggest a relationship between science and technology. I should add at this point that science and technology have different objectives. Basic science focuses on the understanding of ideas and concepts, which are expressed in linguistic or mathematical terms (Hindle 1966: 4-5). Technology, on the other hand, seeks means for making and doing "things" which can include the results of basic science (e.g. the use of lazers in Compact Disk technology or the use of fuzzy logic in appliances). It is a question of process, expressed in terms of three-dimensional "things" (Hindle 1966: 4-6). Technology would then be about applied science.

I find Brown's (1999b) discussion around searching for a definition to be quite complex. In his discussion Brown (1999b) states that "because the world appears to us through our interaction with it," technologies are "products of the objectification of experience". These objects, symbols and theories reflect one's understanding of particular aspects of the world. "In this process of working with technologies we progressively develop both our own understanding of the world and the representations of it. The medium for technological representation may be linguistic, visual, sonic, physical, imaginative, or mathematical." What Brown implies with this description is that technology manifests itself through our senses and our interaction with these technologies. Certain technologies according to Brown (1999b), for example computers, synthesizers and electric guitars, are more identifiable as technologies than acoustic music instruments (violins, oboes, etc.).

Acoustic music instruments on the other hand, in relation to society today, are less recognizable as technologies because of their introduction in the early stages of human history. According to Brown (1999b), symbolic technologies such as music notation and mathematics are even more identifiable, while theoretical technologies (which could include symbolic technologies in their representation) for music, systems of tonality and physical laws of acoustics are less apparent. These differences can be attributed to the manner in which human beings perceive such technologies. If one were to consider Brown's (1999b) comments, the field of Music Technology is vast, encompassing a multitude of technologies.

It follows that technology is integral to human existence, since it is individuals and groups who determine the technologies that are developed and how they are applied. Technology then adds to the changes in cultural, social, environmental and economic circumstances. A justification for this latter statement is the impact technology has had on the model of the composer-performer-listener triangle. According to Lansky (2001), this model permeates most art musics of the world where the composer is genius/author, the performer is genius/servant, and the listener respectfully adores both. Receiver of the greater glory, either composer or performer, varies from time to time and place to place. This is determined by the context in which the work is created.

Lansky (2001) goes on to add that in this three node model (composer, performer, listener), there is a basic conspicuous feedback loop. Each node responds to the actions, abilities and appreciations of the other unless, of course, the composer is dead. This network needs social institutions to provide a context for communication and interaction, typically concerts, in which some play while others listen. Even with recording today, concerts are seen as the excitation function of this network. Musicians and composers tend to think of recording as documentation of live performance, and perhaps as a less than perfect substitute for reality; an illusion and incomplete and distorted image (Lansky 2001).

To summarize Lansky's description above, the impact of technology on this triadic paradigm is as follows:

- Listeners - are now involved in listening to digital recordings in the form of CDs, DVDs, MP3s and other data formats; they can also manipulate recordings (compile and re-edit exiting recordings) to satisfy their own needs and tastes and influence live music performance recordings.
- Performers - engage with instrument technological advances and interactive performances with technology, and are in a position to manipulate the output of sound waves, by means of amplification, movement on stage, and the like, according to their needs and desire.
- Composers - no longer need to use pencil and paper, but computers, and take cognisance of the new way in which music is perceived, generated and realized through the use of computers.

The impact of Music Technology on society and on economic factors can be noticed in the milieu of popular culture, where machines have had an immediate and rather drastic effect. The importance of the roles of concerts and recording has been switched (Lansky 2001). Recording is the norm and concerts are modifications of recordings, or a marketing ploy for CD sales. Concerts are, however, often pale substitutes for recording, because the illusion has become incomplete reality, and is usually an orgy of celebration for the new album (Lansky 2001).

Taking into account the definitions and descriptions surrounding Music Technology examined in this section, I propose the following working definition. This definition is a synthesis and elaboration of the definitions/descriptions expressed by Williams (1992: 29) where he addresses the issues of teaching style and strategies, delivery systems and curricula; Spotts and Bowman (1995: 57) in which they emphasize the application of science concepts to problems solving; Rudolph (1996:4) in which he talks of a wide variety of devices and applications to music and music education; and Lansky (2001) who speaks of the impact of technology on the music triangle.

> Music Technology is that part of the technological field which requires the application of engineering, scientific and music knowledge and methods combined with technical and music skills to music activities; it lies in the occupational spectrum at the end closest to the musician.

The occupational spectrum in this definition implies that the Music Technologist's focus lies closer to music than to technology. It is also assumed that knowledge is applied in both the technical and music skills. This research will be located within the electronic technology spectrum. Electronic technology, in the case of this study, refers to equipment predominantly using microprocessors with a view to achieving results in the field of music and audio technologies that are used in music creation, performance, appraisal and processing. The reasons underpinning this focus stem from the historical development of technology in music (see Chapter 2.2), and the Internet survey of international Music Technology trends (Chapter 3.3), showing that aspects of electronic and audio technology dominate international technology development and curricula.

2.1.3 The emergence of Music Technology as a field of study

The growing presence of technology in the music industry today is something that should neither be ignored nor underestimated. According to Bash (1990: 7-8), music performance and the role of music in television, film and multimedia are being defined through advances in technology. Economic indicators reflect the interest in technology, where in the USA as of the year 1989 for example, Americans owned over 17 million keyboards and synthesizers (Bash 1990:7-8).

Already in 1992 a survey (PR Newswire Association 1992: 15) found that 34% of all American households used a personal computer in work, school or at home. According to Jaeschke (1996: 1), it was also predicted that by the end of 1994, 4.5 million USA households were expected to be using CD-ROM equipped computers and that by the year 2000, users of the Internet computer link would have exceeded television viewers. This is a clear indication that the use of technology in most facets of life (music, business and communications) is on the increase.

Williams and Webster (1999: xxv) go even further in stating that, in the latter part of the 20th century, one cannot imagine any aspect of music that is not in some way touched by technology. Considering this view, educators "cannot fight a tidal wave ... to be relevant to young people in the 21st century, we [educators] must speak their language and use their tools" (Chung 2000: 26). What Chung highlights is the notion that, as an educator, one does not have much of a choice when it comes to the use and integration of technology into the mainstream of music instruction. Besides resisting change, educators must accept that "most of today's college students have grown up with more technology and often are more technologically literate than many of their professors" (Albright & Graf n.d.: 13). These learners or students often take technology for granted as part of their everyday lives. This latter trend has vital social implications for the providers of education, in that it questions the traditional roles of the learner and provider. According to Glidden (1997):

> we [educators] are required to change from a centuries-long era in which educators thought of themselves as experts in their disciplines and as the masters of knowledge in their respective fields. Now we [educators] are forced to accept the fact that the knowledge explosion prevents most of us from being true experts and masters of all.

What Glidden is suggesting is that educators need to take cognisance of the knowledge boom and adjust their mode of providing information by reassessing their role in education. Today, learners often possess current knowledge and pave the way for knowledge production, which places them at the forefront of the knowledge boom. Glidden goes on to add that rather than being a "sage on the stage" one is forced to be a "guide on the side". Knowledge and expected outcomes of learning have now become a social construct, which is in direct contradiction to past practices where the providers of education decided the content and outcomes of learning – a top-down approach. The knowledge boom in Music Technology can therefore be considered an agency for social transformation in that the manner in which music is and will be created, performed, received and taught has evolved and will continue to do so with the impact of newer technologies. Other role players in knowledge production, for example the learners, need now also be taken into account.

An "alternative" music market as opposed to the mainstream has emerged especially for the computer musician in the last 10 to 15 years (Waugh 1997: 200). In the 1980s, just two decades ago, it would have been inconceivable that one could earn a living writing music for computer games, creating sound effects, recording and designing sounds for sample CDs, creating MIDI files, scoring QuickTime movies or even writing music for company presentations. Even the areas of sales and merchandising of software, backup support, technology consultancy and multimedia have opened new job possibilities for the graduating music student. These trends require music educators to rethink their approach to music education by taking cognisance of these emerging employment opportunities.

The need to incorporate Music Technology as a field of study into the mainstream of music study, was recognized as early as 1985 at Berklee College of Music in Boston, USA (Mash 1999) and University of York, UK (University of York 2002). Both the Music Technology programmes at Berklee College and York University were the first of its kind. However, experiments, studies and research using music technology in electronic music (1940s) and computer music (1950s) had already been undertaken in Europe and the USA (see Chapter 2.2), prior to the Berklee programme. Up until the early 1990s, several journals (*Perspectives of New Music*; *IEEE Computer and Computer Music Journal*) write about music and technology but do not specifically make references to music technology.

The term "music technology" began to appear in electronic music journals, articles on electro-acoustic music and in Internet web sites during the 1990s - its exact first appearance is uncertain. Between the years 1992 and 1996, at the time of the publication of the first texts to use the term "music technology" in their titles or series, *Fundamentals of Music Technology* (1994) by Mauricio and Adams, *Music Technology* series (1995) under Francis Rumsey's editorship and *Experiencing Music Technology* (1996) by Williams and Webster, this term became used to describe technology related courses in music at several institutions in the USA (Berklee College of Music, Indiana University-Purdue University, Northwestern University and University of Illinois, to mention a few.). By the end of the 20th century, several institutions internationally were offering programmes (certificates, courses, diplomas and degrees) in the field of Music Technology.

2.1.4 Music Technology in South Africa

Although Music Technology was introduced as a formal study[8] programme during the 1990s and in the USA, parts of Europe and Australia, its manifestation as a programme of study at South African music departments only emerged towards the end of that decade. This could be deduced from the learning programmes/courses that are offered at some of the music institutions (in alphabetical order) in South Africa: Natal Technikon, Rhodes University, Technikon Pretoria, University of Cape Town, University of Natal-Durban, University of Port Elizabeth, University of Pretoria, University of South Africa, University of Stellenbosch, and University of the Witwatersrand. See Chapter 3.4 where an overview of Music Technology trends in South Africa is documented.

Against this upsurge in new Music Technology programmes, I was asked, in 1997, to set up a programme in Music Technology at the University of Pretoria. My programme commenced in 1998 as part of the mainstream Bachelor of Music degree. The Music Technology course formed part of a group of optional courses at fourth year level under the classification *capita selecta*. Other courses in this group were Music Therapy, Ethnomusicology and Chamber Music. The content and expected outcomes of the course were introductory in nature, pegged[9] at National Qualifications Framework (NQF) Level 5 (see Chapter 4.1.2).

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[8] Earlier programmes that involved technology and music, such as those at IRCAM since the 1950s, were probably not called Music Technology programmes at the time.

[9] A term used in South African Qualification Authority documentation to refer to locating or positioning on the National Qualifications Framework.

The learners (approximately fifteen each year) received two hours of instruction per week over two semesters of fourteen weeks each. The assessment of learners' progress was established through fifteen projects, encompassing the ten core components (see Chapter 3.3.1) and an oral examination at the end of the course. This undergraduate course was subsequently developed to post-graduate level degree programmes (Honours with five students and Masters with two students).

The undergraduate course at the University of Pretoria merely introduced learners to the field of study in order to "whet the appetite", with no integrated strategy for the implementation of technology as a field of study in its own right. The undergraduate course, Honours and Masters Music Technology degrees formed the Music Technology programme at UP. The issues of marrying South African education policy with Music Technology as a field of study, at UP over the period of three and a half years, prompted the research toward this study. Contact with other Music Departments in South Africa (Devroop 2001b) indicated that my own situation was indicative of a national trend.

Institutional feedback with regard to Music Technology issues took place through administering a questionnaire and interviews that were conducted telephonically. The telephonic administering of the questionnaire and interviews, as opposed to postal questionnaires, was undertaken to ensure a 100% response rate. All of the telephonically contacted institutions (Devroop 2001b) alluded to the fact that their introduction of Music Technology was determined by the following variables: cost effective ways to attract more students; staying in touch with what appeared to be fashionable international trends; as a mechanism to indicate education transformation; and to attract more funding from the academic institution to offset departmental financial cut-backs (Devroop 2001b). In almost all of the cases, except the University of Pretoria and University of Potchefstroom, the tendency to introduce Music Technology as a field of study commenced with differing specializations. Audio Technology (sound engineering and audio recording) was the primary focus of several programmes instead of equally weighting all of the Music Technology components (see Chapter 3.3.1). The dominance of Audio Technology in these programmes is still apparent. In the case of the University of Natal-Durban, the Music Technology programme is closely aligned to courses in Composition and Electro-Acoustic music. A detailed analysis of South African Music Technology trends in South Africa is presented in Chapter 3.4.

2.2 Historical development of technology in music

The synopsis[10] of the historical development of technology in music that follows, serves as an indicator as to the depth and breadth of Music Technology. The historical development presented in this section can be traced back to music compositions, literature on electro-acoustic music, hardware such as audio recording equipment, electronic musical instruments and computers, software and audio/video recordings. As a discussion of technological advancement in acoustic music instrument design lies outside the scope of this study, I shall here offer only a chronological outline of the development of electronic and audio technologies.

2.2.1 1877-1905: Early experiments

Edison's phonograph (1877) used a diaphragm with a needle attached to make indentations on a moving strip of paraffin-coated paper-tape. This device led to a continuously grooved, revolving metal cylinder wrapped in tin foil.

One of the first music instrument inventors to take advantage of electricity was Thaddeus Cahill, builder of the Telharmonium (ca.1898), a 200 ton instrument designed to play music to a wide audience over the telephone network (Disley n.d.). Here, the sound spectra were synthesised by combining the output of a series of alternating current (AC) generators (a technique called additive synthesis in which outputs of several oscillators are added together to produce a composite sound) (Chadabe 2000). This instrument was played by means of a touch-sensitive polyphonic keyboard (Cahill 1906: 519). It was not until the mid-1980s that a touch-sensitive feature was incorporated into the modern synthesizer. The failure of the Telharmonium was largely due to the interference it generated with other telephone traffic (Hunt & Kirk 1999: 10).

Most of the initial experiments with instrument design were discontinued with the development of vacuum tube technology.

[10] Detailed historical developments are documented in, among others, Chadabe's *Electric Sound: The Past and Promises of Electronic Music* (1997); Williams and Webster's *Experiencing Music Technology* (1999); Chadabe's "The Electronic Century. Parts 1-4" in *Electronic Musician* (2000); "120 Years of Electronic Music" in *Electronic Musical Instrument* (1998); and "*Audio recording: History and development*" (Jones International 1999).

2.2.2 1906-1960: Vacuum tube era

In 1906, Lee De Forest patented the first vacuum tube or triode, a refinement of John A. Fleming's electronic valve (Electronic Musical Instrument 1998). Although the vacuum tube's main use was in radio technology, De Forest discovered that it was possible to produce audible sounds by using the tubes – a process called heterodyning. This was an effect made by two high radio frequency sound waves of similar but varying frequency, that combined to create a lower audible frequency, equal to the frequency difference between the two – approximately 20Hz – 20Khz (Electronic Musical Instrument 1998). De Forest's heterodyning led to his invention of the Audion Piano (1915). Other instruments that exploited vacuum tube technology were Léon Theremin's Theremin (1919) and Maurice Martinot's Ondes Martinot (1928). These instruments produced sound by means of the beat or difference effect (Rossing 1990: 151), using two oscillators to produce an audible beat frequency of the desired pitch. In the case of the Theremin, the performers moved their hands around a rod and aerial, while with the Ondes Martinot an electrode was moved around the aerial by the performer (Disley n.d.).

The Hammond Organ (1929), developed by Laurens Hammond, used the principle of synthesizing sounds by combining pure sine waves of different frequencies to make a complex waveform (additive synthesis). The Hammond organ generated sounds in the same way as the Telharmonium. However, the pitches of the Hammond organ approximate to even-tempered tuning. Unique to the Hammond was its drawbar system of additive timbre synthesis (Rossing 1990: 523) and stable intonation. Most electronic instruments of the time produced unstable intonation. The primary difference between the Hammond and its electronic predecessors was that it allowed precise control of the volume of each harmonic (Disley n.d.).

Meanwhile Edison's phonograph had evolved into the popular 78rpm record, which became the high fidelity Long Playing record, or LP, by 1948 (Disley n.d.). Plastic audiotape and "optical" audio storage (storage onto film) was invented in the 1930s. The magnetic tape opened new avenues for personal recordings, in that recordings or parts thereof could be cut, copied, pasted and manipulated using various techniques (such as time stretch and fast playback), and then stored according to the sound engineers'/composers' requirements or needs (Jones International 1999). The development of cinematic sound and the storage thereof created a new medium of audio storage. These so-called "optical" sound tracks on the edge of film were used to record sound and allowed a form of direct synthesis (Hunt & Kirk 1999: 13).

Pierre Schaeffer, a sound technician working at Radio-diffusion-Télévision Française (RTF) in Paris, used magnetic tape technology in his composition *Étude aux Chemin de Fer* (1948). This marked the beginning of studio realizations of a sound collage called *Musique Concrète*. Compositions by Pierre Henry (*Vocalize and Antiphone* – 1952), Edgard Varèse (*Déserts* – 1950-54) and Iannis Xenakis (*Behor I* – 1962) used this technology as well. The RTF Studio primarily concerned itself with the manipulation (tape transformation) of acoustic sound sources, that is, sounds from the real world. Karlheinz Stockhausen (*Kontakte* – 1959-60), Herbert Eimert (*Selektion I* – 1959-60) and György Ligeti conducted similar experiments with electronically generated sounds in Cologne at the Nordwest Deutscher Rundfunk using a studio equipped with electronic sound generators and modifiers (*Elektronische Musik*) (Chadabe 1997: 30-44).

The invention of the transistor, a device that controls the flow of electric current, launched by Bell Labs (Murray Hill, New Jersey) on 30 June 1948, transformed the scientific world (Sciencecentral & the American Institute of Physics 1999). Some scientists regard this as probably the most important invention of the 20th century (Sciencecentral & the Amercian Institute of Physics 1999). Although the first transistors were used in hearing aids and transistor radios, they soon made their way into music instrument design. The computer and music instrument industries immediately began designing computers and electronic musical instruments using transistors. These electronic musical instruments were faster (in terms of producing timbre changes), smaller, more economical and more powerful.

Les Paul developed the 8-track recording system in 1953, the first ever multi-track deck (Schoenherr 2001). Paul's machine allowed musicians to record different parts of a song at different times, so that enough parts could be recorded to sound like an entire band. Thus was born the one-man band, which became ever more popular in the late 1990s with the widespread use of MIDI (Schoenherr 2001). MIDI is discussed later in Chapter 2.2.4.

The RCA (Radio Corporation of America) synthesizer in 1957 was a revelation in electronic music development in that, unlike the Hammond with its limited variety of timbre possibilities, this synthesizer allowed a wider range of sounds to be generated. These included reproductions of acoustic instrument sounds and sounds that had never before been heard. The principle behind this design was different from that of previous electronic instruments in that the RCA was "programmed" by paper-tape. Information input was done with a typewriter-like device that punched holes in a paper roll. The paper roll was then passed through a reader, and read by contacts between metal brushes that touched through the holes, thereby closing switches and causing the appropriate machine process to start or stop (Hunt & Kirk 1999: 18).

These RCA synthesisers had multiple attack, decay and glide possibilities, and could produce lifelike (to musician's ears) sounds, especially of the piano (Roads 1985: 117). The possibility for substantial complexity in rhythm and texture, combined with an extensive palette of timbre, were the qualities that Milton Babbitt later found important for his works *Philomel* (1963) and *Vision and Prayer* (1964) (Chadabe 2000). The RCA Mark II synthesizer, a development of the initial model, was a forerunner of the programmable synthesizers that appeared circa 1978 (Sequential Circuits). The Mark II used a punched-paper-tape reader, a mechanism that prefigured the software sequencers of the MIDI age (Chadabe 2000). After the development of the RCA came the introduction of several real-time analogue synthesizers with a performance interface such as a conventional music keyboard, the sound being fed to loudspeakers. Whilst researchers in electronic engineering laboratories used these devices initially as the basis for the development of newer electronic musical instruments, musicians on the other hand sought the new instrumental sonorities.

Apart from the great strides made in synthesizer technology, whereby most of the functions were controlled by means of inputs in the form of commands, musicians also endeavoured to control these devices by means of conventional scores. It is worth noting that some synthesizers (RCA and later the Oramics system) often incorporated proprietary scoring systems. However, in 1957 the introduction of the computer saw the emergence of digital sound synthesis. In that year Max Matthews (Hunt & Kirk 1999: 21) wrote his *Music I* computer programme. Over the next few years, together with his collaborators, Matthews wrote a series of synthesis programmes that became known as the *Music-N* series: *Music II* (1958), *Music III* (1960), *Music IV* (1962) and the last in the series, *Music V* (1968). For composers this was revolutionary, in that they could now "compose sound itself, and computers and analogue synthesizers provided the means to do just that" (Chadabe 2000).

In 1958, the music industry's world standard for stereo records was established. This year heralded the selling of the first stereo LPs (Schoenherr 2001).

2.2.3 1960-1980: The performance interface

During the early 1960s, developments in computer music were centred at Bell Labs (New Jersey, USA) with Max Matthews and his collaborators. The impact of Matthews' work spread to the Massachusetts Institute of Technology (MIT) and to Princeton University, where sound synthesis became an important direction for music research. In Europe, the French government recognized the importance of this new technology and established the *Institut de Recherche et Coordination Acoustique/Musique* (Institute for Research and Coordination of Acoustics and Music) (IRCAM) in 1977. Jean-Claude Risset, who had worked with Max Matthews at Bell Labs, headed IRCAM's computer music department. International research in computer music provided the backdrop to the first round of creative music compositions with computers. James Tenney's *Analog #1* (1961), *Dialogue* (1963) and *Phases* (1963), which used stochastic methods to determine the sequencing of sounds, and John Chowning's *Sabelithe* (1977), *Turenas* (1972) and *Stria* (1977), which simulated sounds moving in space, were among the first computer music compositions (Chadabe 1997: 127). Many composers who were to follow, such as Charles Dodge, Larry Austin, Denis Smalley, Paul Lansky and others, realized that a significant problem with computer music was that computer programming skills were necessary for both composers and musicians (Chadabe 2000).

The solution to the problem of computer programming skills was provided with the birth of analogue synthesizers, which provided a new world of sound possibilities, without the need for programming skills. Most of these synthesizers were designed for performance and customized for an immediacy of response that simulated the performance capabilities of traditional music instruments. In the BBC Radiophonics Workshop in the early 1960s, Daphne Oram developed a system called Oramics (Oram 1972: 97). Oram's technique involved the drawing of sounds as waveforms and envelopes directly onto a transparent plastic sheet. As the plastic sheet was moved over a strip of photocells, the cells reacted to the pen-strokes on the film and subsequently controlled a monophonic voltage-controlled synthesizer.

In 1964, the inventions of Robert Moog (Moog modular synthesizer), Paul Ketoff (Synket and Synthesizer Ketoff) and Donald Buchla (Series 100) heralded the first round of analogue synthesizers. These were voltage-controlled modular systems – a collection of individual modules in which each module had a specific audio or control function. The audio modules comprised oscillators, noise generators, filters and amplifiers. The sounds were made using the subtractive synthesis technique. This technique was achieved through linking oscillators in frequency- or amplitude-modulation configurations to create complex waveforms, whereupon the focus shifted to the elements of the sound itself through use of filters to subtract partials (Chadabe 2000).

The Moog, a traditional (early) synthesizer, resembled a traditional piano, because of its keyboard, size and operation. The interest by commercial musicians in these new sound possibilities brought about the launch of portable models, such as the Minimoog, which made their appearance in many pop music bands. Transistor-based technology increased the portability of these devices. Wendy Carlos went on to record "Switched On Bach" (1968) which became a hit in 1969 and became one of the best selling classical music recordings ever (Chadabe 2000). Although several of these synthesizers were still monophonic, it should not be interpreted that later polyphonic synthesizers were superior. Several musicians today still prefer the analogue sound.

As technology advanced into the 1970s, computers, analogue synthesizers and other music technology equipment became less expensive, more portable and easier to use. They were also joined together in what were called hybrid systems (Chadabe 2000).

Several studios (Bell Labs, Murray Hill; Institute of Sonology, Utrecht; and IRCAM, Paris) employed computers as sequencers to generate control voltages for analogue synthesizers. Compositions reflecting the use of these combined technologies are: Emmanuel Ghent's *Phosphones* (1971) and Laurie Spiegel's *Appalachian Grove* (1974) at Bell Labs, and Gottfried Michael Koenig's *Output* (1979) at the Institute of Sonology.

A key trend that emerged in the 1970s was the increasing accessibility of digital technology (which involves representation of information in the form of binary numbers). Polyphonic capabilities and memories to store synthesizer settings were developed, commencing with the Prophet 5 in 1978. These polyphonic capabilities and memory storage systems evolved by the late 1970s into digital synthesizers developed at institutions like Bell Labs and IRCAM.

In 1979, the Fairlight Computer Music Instrument (CMI) was developed, using a technique already found in Oram's work in the early 1960s. The Fairlight depended on the technique of using a waveform that could be "drawn" by the performer directly on a screen using a light pen rather than synthesising it. Performers were now able to draw a waveform on a screen, or select from a library of pre-recorded sounds (Disley n.d.). The Fairlight CMI's novelty was the digital storage and playback of sound (sampling) combined with an interactive computer display.

The *Musique Concrète* and *Elektronische Musik* [11] trends were enhanced by Philips's invention of the compact cassette in 1963, which became the primary recording format well into the latter part of the twentieth century. In the USA in the 1960s many cars were fitted with 8-track stereo cartridge players (an automobile audio player utilizing an 8-track compact audiocassette to store audio signals) that allowed listeners to access any four different sections of a recording at the touch of a button. A battle ensued between 8-track cartridges and cassettes, with the latter emerging victorious (Jones International 1999). Blank and pre-recorded cassettes and tape decks established themselves largely due to their size and the advent of Dolby Noise Reduction (1969). This was an answer to the unpleasant hiss that confined the use of the audiocassette to the voice dictation market, and increased the audio storage opportunities for people to make their own recordings (Jones International 1999). The invention of Sony's Walkman (1979) has since added further flexibility and convenience to the enjoyment of cassette tapes (Jones International 1999).

2.2.4 1980 to the present: The digital domain

The development of digital technology (operations based on a series of numbers) from the 1980s onwards, particularly of the computer and its application to music synthesis, recording, storage and playback, is regarded by Hunt and Kirk (1999: 21) as of "the most important and influential developments in the technology of music in the twentieth century".

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[11] The referenced sources on Electronic music in this thesis used the German term *Elektronische Musik* which referred primarily to the music of Karlheinz Stockhausen and his contemporaries at the Cologne Studios at the time. For the sake of consistency with these sources the German variant of the term is maintained.

Microprocessors were in abundance and increasingly powerful, and caused an explosion in the quantity of computer-based music instruments and processing systems.

Since precision of control over digital information was easier than with analogue information, the creation of sound (synthesis) using "artificial" means was possible. "Artificial" in this case refers to the creation of the sound by humans using some kind of electronics. Most people consider synthetic sounds to be those produced through the use of electronic devices, and since digital sound synthesis grew out of these techniques, they are referred to as "synthetic" sounds. The Casio "VL-tone" (1981) was the first synthesis and sequencer unit that appeared on the market (Hunt & Kirk 1999: 27).

Barry Vercoe of the Massachusetts Institute of Technology (MIT) in 1986 translated the latest version of the *MUSIC* programme, developed by Max Matthews and his collaborators, into the "C" programming language. Due to the flexibility of programmes written in C (they could run off most hardware and software platforms), Vercoe's translation was called Csound. Csound is today one of the most widely used direct synthesis programmes (Hunt & Kirk 1999: 22). This programming language allows the user to create sounds and use them as desired.

Several users of Csound experimented with ways of controlling dedicated synthesisers externally. This developed from mere control over simple analogue signals to the complex digital language of "Musical Instrument Digital Interface" (MIDI). The MIDI concept became a standard for the electronic music industry around 1983. MIDI was basically designed to turn sounds on and off by pressing keys on a synthesizer and was primarily the result of commercial interests (Chadabe 2000). From an economic perspective MIDI was a success. Its universal format allowed companies to present "the world with an original concept of music" (Chadabe 2000).

Yamaha's DX (1983) series of keyboard synthesizers (DX7, DX 21, DX100, DX7 FD II) was among the first to use MIDI technology (Chadabe 2000). Apart from its MIDI capabilities, the Yamaha DX7 keyboard synthesizer was a landmark synthesis device using Frequency Modulation or FM digital synthesis techniques and having a polyphonic velocity sensitive keyboard with "aftertouch", pressure bar, pitch modulation wheels and allowed various parameters to be controlled, such as the MIDI parameter "breath control" and the like (Hunt & Kirk 1999: 126-7).

Following the introduction of the Yamaha DX series, several instrument manufacturers (e.g. Korg, Roland and Kurzweil) began producing electronic MIDI instruments. By the mid-1980s, digital sound samplers (such as the Ensoniq "Mirage" and the Akai "S" series) became available at a reasonably low cost. These sound samplers made available novel sounds (synthesis), the recording and editing of existing sounds (sampling) and accurate playback without human input (sequencing) to the larger population (Hunt & Kirk 1999: 30).

However, for some users this still proved inadequate. So programming languages were developed such as MAX, written by Miller Puckett, which allowed composers to define interactive musical environments, and MIDAS (Hunt & Kirk 1999: 276), a multimedia language that includes MIDI commands, audio and video. These languages allowed the user to network computers, thus increasing processing power and in the case of MIDAS, allowing "working in a variety of ways, from graphically connecting together boxes that represent audio-visual functions to programming the system in computer code" (Hunt & Kirk 1999: 36).

On the audio technology front, the introduction of Compact Disc technology in 1982, made digital sound possible at an affordable price. It had a high sampling rate of 44.1kHz and a resolution of 16 bits, or 65536 levels of amplitude. But it was not easy to record in this format. As a result, the professional recording environment adopted the Digital Audio Tape (DAT)(1987) as its norm. This tape is smaller than a compact cassette, but caters for greater bandwidth (48kHz as opposed to 22.05kHz-24kHz in case of the compact cassette) (Rossing 1990: 566), which gives it much higher recorded audio quality. There have since been several attempts to bring affordable digital recording formats to the masses, including Philips' Digital Compact Cassette (DCC) and Sony's Minidisc. These formats employ compression techniques in order to reduce the amount of data stored. The compression process is achieved by removing information from the sound signal that in most instances the human ear would not register. In 1995 the Digital Versatile Disk (DVD) consortium agreed on a standard that would be used to encode compressed video and audio data onto a single disk. In 1996, DVD players started selling in Japan and were sold one year later in the USA (Schoenherr 2001). Michael Robertson formalized further developments in compression in 1997 with the MPEG 3 format (MP3), which enabled the distribution of entire movies over the Internet. These digital technologies culminated at the end of the 20th century with the release of Disney's *Fantasia/2000* in the IMAX film format with 6-channel digital sound (Schoenherr 2001).

The use of computers has added an entirely new dimension to Music Technology. Today, computers allow for a greater appreciation of acoustics, especially in areas of instrument design and the analysis of instruments and acoustic environments. For example, in Farina's (1998: 359-379) analysis, knowing the acoustic characteristics of instruments helps in the successful creation and restoration of many acoustic instruments and in the synthesis of electronic ones.

In the domain of MIDI, different music instruments can be interfaced with the computer, allowing for various types of experimentation in real-time performances, backtracks, composition and music notation. Computers play a significant role in the distribution of music over the Internet. However, most audio files were either very large or too highly compressed, and have first to be downloaded onto the user's machine in their entirety, prior to being played. The implementation of streaming audio over the Internet in 1995 (a process whereby audio files can be played as they arrive from the host site, that is, the user does not have to wait until the complete file has been sent) has resulted in a delivery mechanism less susceptible to delay associated with worldwide (postal) music distribution. Presently, large record companies such as Sony and Columbia Records are investigating the possibilities of having customers download and pay for specific tracks of CD recordings over the Internet (Hunt & Kirk 1999: 36).

Composers are also experimenting with computers in the creation of music within certain predetermined parameters (tonality, rhythm, instrumentation and the like), such as artificially intelligent jazz performers (Ramalho 1998: 105). Computers are used in the artificial intelligence context to respond to inputs made by the composer by generating a random response. Other areas of research into the use of computers lie in the implementing of new performance interfaces, for users unwilling or unable to utilize traditional interfaces such as the keyboard. The MIDIGRID, for example, allows users to perform music by dragging a mouse over a grid of sounds displayed on the screen (Hunt & Kirk 1999: 34). These technologies particularly help music making by severely disabled people.

2.3 The sub-domains of Music Technology

The adherents of *Musique Concrète* and *Elektronische Musik* defined new ways of musical composition (Baggi 1991: 6). According to the history of technology in music (Chapter 2.2), it is evident that these directions in composition also impacted on the manner in which Music Technology, the field, was approached. Music Technology programmes internationally seem to be based on the music processing and/or music creation paths (see Chapter 3.3 and 3.4).

2.3.1 Music processing

In the case of *Musique Concrète,* technology was used as a utilitarian tool selected for its speed, efficiency and opportunity as a means of expression that also impacted on the compositional process itself. Similarly, music technology can be efficient in accelerating the composition, analysis or publication process (Brown 1999b). Technology's role here is neutral; its use in this case is referred to as music processing. Most Music Technology programmes internationally and in South Africa (see Chapter 3.3 and 3.4) adopts predominantly the music-processing route. Of the ten core areas of Music Technology identified in Chapter 3.3.1, seven areas (MIDI Sequencing; Music Notation; Computer-based Education; Multimedia and Digitized Media; Internet and Telecommunications; Computers, Information Systems and Lab Management; and Audio Technology) are music processing based.

2.3.2 Music creation

In the case of *Elektronische Musik,* technology influenced the outcome of the composition. According to Brown (1999b), technologies used in *Elektronische Musik* were even selected because of the impact that they would have on a composition. The use of technology, which followed the *Elektronische Musik* developments (Max Matthews and his collaborators), initiated technology as an equal partner in the composition process. This development was termed music creation, where the composer entered data into the technological device (computers in most cases) that was then processed by the device and generated into a composition or sound. These advances in composition or sound creation resulted from the marriage of computer expertise and musical expertise, called computer music (Baggi 1991: 6). Computer music thus refers to two things: "the direct synthesis of sound by digital means and computer-assisted composition and analysis" (Baggi 1991: 6). Within the ambit of the core Music Technology areas of specialization, both creation and synthesis form integral constituents of two areas of specialization (Electronic Musical Instruments and Computer Music). Music creation would then be a sub-category of Computer Music. Music technology, in this case, therefore, forms an integral part of the composition in which the technology functions as an enabler within the music creation process.

Although computer music has existed internationally as a formal application of Computer Science for approximately thirty-five years (Baggi 1991: 6), its impact on the music curricula at South African post-secondary institutions has yet to be felt (Devroop 2001b).

2.4 Music Technology as a tool

According to Merriam-Webster (2001), a tool is "something used in performing an operation or necessary in the practice of a vocation or profession". This explanation suggests that a tool is some sort of "thing" that is used for an intended purpose. A more contextualized definition of a tool with regard to Computer Science (Merriam-Webster 2001) suggests that a tool "is an application programme, often one that creates, manipulates, modifies, or analyses other programmes". This later conception of a tool suggests a device that is allowed to have influence on a particular process or activity. These two definitions suggest a significant difference between a creative relationship with technology (a creative one) and a more common utilitarian one (a neutral, non-creative one). Irrespective of whether one approaches music technology from a creative or utilitarian viewpoint (see sub-domains of Music Technology, Chapter 2.3), technology in relation to composers, performers, listeners or educators for that matter implies tools, selected for their speed or cost and ready to be discarded when better evolved and more efficient tools become available (Brown 1999b).

Other considerations related to the notion of technology, as a tool, would include social and cultural values. An example of this view is expressed in the writing of Ivan Illich (1973: 21) who states that:

> An individual relates himself in action to his society through the use of tools that he actively masters, or by which he is passively acted upon. To the degree to which he masters his tools, he can invest the world with his meaning; to the degree to which he is mastered by his tools, the shape of the tool determines his own self-image.

This social perspective acknowledges the effect of tool selection on production and the impact the social forces elicit in shaping that effect. The connection between one's self-image and one's tool usage is also recognized: however, Illich portrays the user-tool relationship as one stimulated by control and mastery. This latter notion of mastery is one which musicians in particular appreciate, in that mastery over a music instrument, compositional process or computer music system, is a common tendency when working with tools.

Within this study the use of music technology (the activity) is considered a tool and in the broader context of social transformation in South Africa, Music Technology (the field of study), will be considered a tool for transformation within the South African education context. The latter is significant for music educators because the knowledge production in Music Technology is socially constructed. With the international pressure regarding the use of technology, it is hoped that Music Technology as a tool will help make progress with the predicament that is discussed next.

2.5 The predicament in South African music education

Christine Lucia (1986: 2), past chairperson of the Committee of Heads of University Music Departments (South Africa) and at present Chair of Music at Wits School of the Arts, Johannesburg, South Africa, highlighted some deficiencies of the present system of music education in South Africa as early as 1986, in the proceedings of the first national conference on music education in South Africa (*Theme: Music Education in contemporary South Africa*):

> South African music education stands in sharp contrast to music education in most other countries in the world, where the local musical culture is (in varying degrees) reflected in educational programmes at all levels. Our music education programmes, on the other hand, reflect almost exclusively the cultural tradition of Western Europe, and even that tradition is not adequately represented, in that Early Music, jazz, popular music and post-war classical music are largely excluded.

With the exception of the universities of Cape Town, Natal-Durban and Rhodes, few institutions have attempted to address these deficiencies seriously since 1986.

Entrance requirements for music study at a large number of institutions are still discriminatory with regard to the historically disadvantaged student in South Africa (Asmal 2000a). The discriminatory practices exist in areas of access towards formalized music studies. Recognition of prior learning (a primary component of outcomes-based education) or non-western art music practices are not regarded as adequate for studies towards currently registered music qualifications. Besides, having adjudicated most of the country's national music competitions it is apparent to me that there exists an imbalance in the number of participants of historically disadvantaged communities represented at these national music competitions (ABSA, ATKV, Sanlam, Sasol, and UNISA). This racial imbalance reflects the inequalities of the past education policies.

Compounding the problems of access, the 1993 Human Sciences Research Council's report on South African music education found that "tertiary courses do not address the needs of prospective music teachers" (Hauptfleisch 1993: 50) and more recently Hauptfleisch, in her 1997 thesis *Transforming South African music education: a systems view*, addressed the issue that "South African music education must simultaneously overcome a fragmentation legacy and define its role and nature within a new and largely unknown context of outcomes-based education. This requires current music education practices to change essentially in both structure and character." Hauptfleisch confirms Lucia's previous statement that South African music education has been characterised by restricted content and approaches resulting from the historical exclusion of many South African and world music practices from music curricula (Hauptfleisch 1997:9). Asmal (2000a) adds to this by criticizing current practices from a social and governmental policy perspective, and goes so far as to say that he

> will not be silent about the serious inequalities which exist in [music education] … and will not allow access to continue to be denied to the vast majority of learners … while many former white schools have levels of provision that ensure that all learners are exposed to music education.

The views expressed above suggest that current music education practices need redress, equity and access from both a curricular as well as a social and moral viewpoint. The notion of implementing a technology-based area of study is in keeping with the South African educational transformation agenda. The need to implement technology-based curricula poses a predicament to which music educators need to respond, internationally but more specifically in South Africa. This poses a challenge to music educators to transform by adopting a new pedagogic approach that sees technology as being a pivotal part of music education.

2.6 Music Technology within the current education system

It is self-evident that Music Technology straddles two disciplines – Music and Technology. Prior to the institution of the South African Qualifications Authority (SAQA) as the agency responsible to instruct bodies to implement the NQF (pre-1994), Music had existed as a subject in its own right controlled by the Department of National Education (Smit & Hauptfleisch 1993: 8). Initiatives to introduce Technology as a school subject date back before 1994. Before 1994 technology was offered as "design and technology", mainly at advantaged schools in education departments such as the ex-Natal Education Department. Historically disadvantaged schools and communities were dependent on non-government organizations (NGOs) such as ORTSTEP (ORT-Science and Technology Education Project) and PROTEC (Programme for Technological Careers) for some form of technology education (Kahn & Volmink 1997: 1).

The classification outlined in the *Standards Generating Body Manual – Fourth Draft* (SAQA 2000a: 5) recognizes Music as a sub-field under NSB 02 Field: Culture and Arts (see Table 4.2). According to the discussion following the Minister of Education Kader Asmal's address (Asmal 2000a), the classification of Music under the Field: Culture and Arts raised a concern among educators. Educators felt that if the arts were grouped together, Music would be marginalized; a concern expressed even at the highest level; "given declining budgets and prominence afforded to learning areas like mathematics, science and technology. There is a danger", said Minister Asmal, "that music education will be relegated to the margins of the teaching and learning process" (Asmal 2000a).

However, Curriculum 2005 (the national government's documentation on life-long learning, DoE 1997) places great emphasis on Technology, which is also one of the eight identified learning areas (see Chapter 1.9) into which the national curriculum has been divided (DoE 1997: 14,15). Technology in C2005 is used very broadly. However, computer technology is one of its central components. It could be assumed then that Music Technology would be given preference.

The Technology learning will promote "all aspects of technology: planning, design and manufacturing, and it is to be introduced from the lowest grades at school" (Dixon 1998: 2). The emphasis on Technology education by the Ministry of Education (Asmal 2000a) is a positive development for music educators, especially at the time when the arts are being marginalized. Music Technology presents itself as a “saviour” to music education, in that technology-based education is given preferential treatment by national government. Curricula, funding, employability, marketability and the goals of lifelong learning within the music sector need to embrace Music Technology as a transformational mechanism.

2.7 Summary

Definitions, discussions and developments in this chapter suggest that technology impacts on the economic, social, cultural and environmental contexts internationally. The increased usage of technology in all aspects of life requires educators to re-examine current educational practices by including strategies for technology-based education. Furthermore, they should realign current education practices to meet the demands of an interdisciplinary approach to education, i.e. application-based knowledge production as opposed to discipline-based knowledge production.

The technology definitions examined in this chapter suggest that the field of technology refers to both knowledge and skills that coexist. One could assume by this coexistence that the skills aspect in technology is underpinned by knowledge. Therefore, a qualification design in technology will need to take into account both aspects of knowledge and skills. It is also apparent that the construction of knowledge in technology is not solely the domain of academics. Learners are sometimes ahead of their teachers in knowledge production and application issues. Future knowledge production is fast becoming a social construct, where the inputs of all stakeholders in education are to be considered.

The increased usage of electronic musical and audio equipment and computers for music applications suggests a trend that supports the overall technology boom. The variety of devices, processes, products, applications and research related to music and technology has given birth to Music Technology, the field of study. The field of Music Technology, as is the case with technology, is about knowledge and skills that are related to music activities.

It is apparent from the historical trajectory that a body of technology knowledge has been developed over time. This body of knowledge relates to music and shows how emerging technologies have helped to move the field forward. The areas of audio technology, electronic musical instruments, Internet and telecommunications, music notation, and research are clearly identifiable through the historical development in music technology. These comprise five distinctive areas.

Areas that share common processing and application techniques, emerging from the historical development, can be grouped together. The most obvious of these areas are audio sequencing, digitized media and multimedia. These all work with digital data and could therefore be grouped into the area multimedia and digitized media, comprising the sixth area of development.

Since the computer forms the basis for most of the applications above, it is crucial to understand how computers work, the systems related to computers, computer laboratories and computer-based education and training. There is currently an increase in computer training/instructional software for musicians and music educators. Besides, formalized studies in computer literacy or informatics have traditionally fallen outside the ambit of arts-based disciplines. Therefore two areas that would supplement the above would be computers, information systems and laboratory management, and computer-based training (instruction or education), thus creating the seventh and eighth areas of specialization.

Although the sub-domains of Music Technology indicate that *Musique Concrète* and *Elektronische Musik* forms part of music processing (see 3.3.1.2 MIDI Sequencing) and creation (see 3.3.1.8 Computer Music), they impact on other technology areas as well. These areas relate to music synthesis and computer music. The principles that emerge from *Musique Concrète* and *Elektronische Musik* (tool and enabler concepts) can be applied to computer music. It would then be appropriate to categorize these developments collectively as computer music (area nine). Although area ten, sequencing related to MIDI, is also digital, it remains a specialized independent area because of its dependence on a combination of differing skills (composition, arranging, recording, mixing and mastering and music publication).

The categorizing of the historical developments into these ten separate areas shows the distribution of knowledge in Music Technology. These areas of specialization from this point on will be referred to as the core components (ten) of Music Technology. It should be added that the Technology Institute for Music Educators in the USA (Rudolph *et al* 1997: 2), which recognizes seven of these ten components (audio technology, computer music and research are not recognized) refers to these components as areas of competency. Also "electronic music instruments" are referred to as "electronic musical instruments". From this point further the term electronic musical instruments will be used. The core components derived in this chapter will be used to identify the core competencies necessary for qualification design Chapter 5. These components will be indicated by means of the upper case from this point on (see Notes to the Reader, no. 6).

The historical development and emerging Music Technology trends reveal that technology impacts on the traditional discipline of Music. The impact of technology on music within Music Technology suggests that the latter field is interdisciplinary in nature. Music educators therefore need to take cognizance of the interdisciplinary nature of Music Technology (dynamics of the field) and the impact of these technologies and find ways of integrating such technological advances into current teaching practices (pedagogy).

Much of the integration of technology in Music is apparent in the courses and qualifications in Music Technology that are available. Towards the end of the 1990s there has been a boom in Music Technology programmes that are offered internationally. These Music Technology programmes open new career paths for the music learner, by addressing the pedagogic and employment needs of societies internationally. South African music education institutions have responded to these international Music Technology trends by implementing similar programmes nationally. However, the South African programmes are largely academically driven with little input from the employment sector.

Music education, which responds to international trends in Music Technology, is in a predicament in that the approach towards pedagogy has shifted from being teacher-centred to learner-centred and the learning content needs to affirm the musics of global cultures. Most music education programmes are still largely dominated by western art music curricula, where indigenous knowledge systems have not been fully implemented as formalized studies within existing curricula at post-secondary institutions. Several of these music institutions have also not put into place mechanisms that address the issues of equity, access, redress and the recognition of prior learning (especially in the informal sector of education). Due to the fragmented education system in South Africa prior to 1994, these issues are pivotal in bringing about transformation and would therefore need to inform the design of new qualifications.

Although arts-based disciplines are threatened within the new education framework, being poorly funded and less important, when compared to disciplines such as Mathematics, Science and Technology, the survival of Music within this education framework is secured when combined with Technology. This is apparent from the prominence attached by national government to technology and technology-based education.

Finally, the concepts and recurring issues discussed in this chapter will be elaborated upon in forthcoming chapters. These concepts and issues will then be used to inform the construction of a conceptual framework in Chapter 5 to aid the design of a qualification.