



the dti

Department:
Trade and Industry
REPUBLIC OF SOUTH AFRICA

A South African Leather Research Institute

- A technical feasibility

**A technical feasibility for the Department of Trade and Industry through
the South African Exotic Leather Sub-National Cluster**

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A South African Leather Research Institute -a technical feasibility

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Executive Summary

An investigative assessment was undertaken on behalf of The Department of Trade and Industry (**the dti**) through Exotic Leather South Africa (ELSA) on the feasibility of the establishment of a proposed Leather Research Institute (LRI) in South Africa (SA). During May 2016, representative companies including: leather tanneries, hides and skin traders, chemical suppliers, education/training providers, retailers, and industry associations/programme participants were interviewed and a wider membership contacted through a structured questionnaire. The intention was to consult with the members of industry, trade, government departments, and agencies.

The proposed establishment of a LRI in SA is part of the technical infrastructure envisaged to enable development of human capital, research, development, and commercialisation services. The LRI could operate in support of the further development of the leather industry including the growth in: manufacturing, export revenue, employment, downstream beneficiation of local raw hides and skins resources, enhancing effectiveness of micro-economic reforms/ incentives, and recommended export prohibitive regulation on raw/semi-finished hides due for execution.

The technical feasibility is aimed at acquiring independent information and has been designed to offer inputs without prejudice to the stakeholders, to decide on the future options on establishment of the LRI in SA.

The assessment primarily informs that the SA leather industry has potential opportunities to contribute to the enhancement of the SA industrial economy. The independent assessment discovered that there are raw hides and skins that are not being processed to their fullest extent.

The assessment concludes that there is some local training and education capacity; however, such capabilities are assessed as not sufficient to enhance the three strategies set out, namely: human capital development, research/development, and efficient commercialisation services. Even though the services formally available from potential local and international sector specific education partners provide development support to the SA leather industry (through various government programmes/institutional partners), the independent assessment has recommended options on how the local sector-specific education, training, and skills should be enhanced (through formalisation of recommended operational strategies).

The assessment concludes that the formal SA scientific research conducted on leather is sparse and the resulting know-how disseminated to stakeholders/communities (involved with bovine, equine, game, sheep, and goat skins). The assessment reports that such efforts, particularly on the enhancement of exotic leather value chain, are formalised by ELSA through **the dti**, in partnership with University of Pretoria.

The assessment reviews and discusses the limited know-how of the local leather scientific and academic services required to advise and inform government policies, and to assist trade and industry development through merchandise testing, analysis and problem-solving services. The proposed establishment of a LRI in SA should be resourced to ensure the successful delivery of such industry services.

There is a general positive consensus in favour of the establishment of a LRI in SA, with specific reservations on capacity, capabilities, and merits. The scope of this independent assessment, however, does not include the design of the facility, legal risks and financial feasibility. This report would need to be supplemented by an assessment of the legal and financial climate, in which the LRI would operate, in order for **the dti** to develop the operational structure of a LRI, that is optimised to perform in the SA climate. Thus, the report cannot inform **the dti** on the budgets, cost benefit analysis, and the return on government investment.

In its essence, this technical feasibility deals with a simple question. What are the technical considerations needed to build a SA LRI in the current economic and political climate?

In summary, this research finds that **the dti** has created a cultural and political environment in which the framework exists to support and fund the creation and development of a LRI. **The dti's** consultations as well as the consultations from this report have shown that the industry would welcome a class-leading LRI with a SA focus on research and skills development. The biggest challenge to the successful delivery of a SA LRI is finding and securing the services of world-leading leather and tanning research experts who would form the nucleus of the LRI team and expertise.

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List of Abbreviations

ABET	Adult Basic Education and Training
AFLAI	African Federation of Leather and Allied Industries
AGDP	Agricultural GDP
AGOA	Africa Growth Opportunity Act
ANC	African National Congress
APDP	Automotive Production and Development Plan
ASGISA	Accelerated and Shared Growth Initiative of South Africa
ASSOMAC	Associazione Nazionale Costruttori Macchine Dell'area Pelle (National Association of Machinery Manufacturers Related to Leather)
ATCG	Automotive Trimming and Cutting Group
B2B	Business to Business
BBBEE	Broad Based Black Economic Empowerment
BLMRA	British Leather Manufacturers Research Association
CAD	Computer Aided Design
CAM	Computer Aided Manufacturing
CETP	Common Effluent Treatment Plants
CFC	Common Fund for Commodities
CIP	Competitiveness Incentive Programme
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CLRI	Central Leather Research Institute
COFE	Centres of Footwear and Leather Goods Entrepreneurship
COMESA	Common Market for Eastern and Southern Africa
COTANCE	Confederation of National Associations of Tanners and Dressers of the European Union
CPUT	Cape Peninsula University of Technology
CSIR	Council for Scientific and Industrial Research
CSP	Customised Sector Programme
CTCP	Clothing and Textile Competitiveness Programme
CTFL	Clothing, Textile, Footwear, and Leather (Superseded by FP&M SETA)
CTHP	Centre for Excellence in Tree Health Biotechnology

CtfISETA	Clothing, Textile, Footwear, and Leather SETA (Superseded by FP&M SETA)
DAFF	Department of Agriculture, Forestry and Fisheries
DHET	Department of Higher Education and Training
DSSA	Design School of South Africa
DST	Department of Science and Technology
The dti	Department of Trade and Industry
DUT	Durban University of Technology
DWS	Department of Water and Sanitation
ECOWAS	Economic Community of West Africa
ELRC	Exotic Leather Research Centre
ELSA	Exotic Leather Sub-National Cluster SA
EMAS	Eco-Management
EU	European Union
FABI	Forestry and Agricultural Biotechnology Institute
FAO	Food and Agricultural Organisation of the UN
FDI	Foreign Direct Investment
FE	Further Education
FET	Further Education and Training
FIETA	Forest Industry Education and Training Authority
FTA	Free Trade Agreement
FP&M	Fibre Processing and Manufacturing
FP&M SETA	Fibre Processing and Manufacturing SETA
FSA	Forestry South Africa
GDP	Gross Domestic Product
GNI	Gross National Income
HE	Higher Education
HEI	Higher Education Institutions
HND	Higher National Diploma
HRD	Human Resource Development
HRDSSA	Human Resource Development Strategy of South Africa
ICLT	Institute for Creative Leather Technologies
ICT ¹	Information and Communication Technology
ICT ²	International Council of Tanners
IDC	Industrial Development Corporation
INES	Integrated National Export Strategy
IPAP	Industrial Policy Action Plan

ISO	International Standards Organisation
ISTT	International School of Tanning Technology
ITC	International Trade Centre (UNCTAD/WTO)
IULTCS	International Union of Leather Technologists and Chemists
JIPSA	Joint Initiative on Priority Skills Acquisition
KPA	Key Performance Area
KZN	KwaZulu-Natal
LASRA	Leather and Shoe Research Association
LCA	Life-cycle analysis
LIRI	Leather Industries Research Institute
LRI	Leather Research Institute
M&E	Monitoring and Evaluation
MDG	Millennium Development Goals
MERS	Microeconomic Reform Strategy
MFA	Multi-fibre Agreement
MIDP	Motor Industry Development Plan
MTL	Merchandize Testing Laboratory
MTSP	Medium Term Strategic Plan
NAACAM	National Association of Automotive Component and Allied Manufacturers
NAMB	National Artisan Moderation Body
NBC	National Bargaining Council
NBCLI	NBC for the Leather Industry
NDP	National Development Plan
NEDP	National Exporter Development Programme
NFLC	National Footwear and Leather Cluster
NGP	New Growth Path
NMMU	Nelson Mandela Metropolitan University
NQF	National Qualification Framework
NRF	National Research Fund
NSDS	National Skill Development Strategy
NSF	National Skills Fund
NULAW	National Union of Leather and Allied Workers
NVQ	National Vocational Qualifications
OECD	Organisation for Economic Co-Operation and Development
OEM	Original Equipment Manufacturer

PG	Post Graduate
PIP	Production Incentive Programme
PPPFA	Preferential Public Procurement Framework Act
PTR	Previous Track Record
QA	Quality Assurance
QCTO	Quality Council for Trade and Occupation
QIDS	Quality, Improvement, Development, Support and Upliftment
RAFLIS	Regional Africa Leather and Footwear Industry Scheme
R&D	Research and Development
RD&I	Research, Development, and Innovation
RMLA	Red Meat Levy Association
RSL	Restricted Substances List
RU	Rhodes University
SA	South Africa
SABS	SA Bureau of Standards
SACTWU	SA Clothing Textile Workers Union
SACU	Southern African Custom Union
SACIA	SA Crocodile Industry Association
SADC	Southern African Development Community
SADFA	SA Dyers and Finishers Association
SAFLEC	SA Footwear and Leather Export Council
SAFLIA	SA Footwear and Leather Industry's Association
SAOEC	SA Ostrich Export Council
SAQA	SA Qualifications Authority
SARS	SA Revenue Service
SATEO	SA Tanning Employers Association
SATIA	SA Taxidermy Industry Association
SATRA	Shoe and Allied Trade Research Association
SCM	Supply Chain Management
SD	Skills Development
SDG	Sustainable Development Goals
SET	Science Engineering and Technology
SETA	Sectoral Education Training Authority
SEZ	Special Export Zones
SHALC	Skin, Hides, and Leather Council
SLA	Service Level Agreement

SLTC	Society of Leather Technologists and Chemists
SME	Small Medium Enterprises
SMME	Small Medium and Micro Enterprises
SSP	Sector Skills Plan
SU	Stellenbosch University
SWOT	Strengths, Weaknesses, Opportunities, and Threats
TCCoE	Textile and Clothing Centre of Excellence
THRIP	Technology for Human Resources for Industry Programme
TPCP	Tree Protection Co-operative Programme
TEI	Tertiary Education Institutions
TUoN	The University of Northampton
TVET	Technical and Vocational Education and Training
UG	Under Graduate
UJ	University of Johannesburg
UK	United Kingdom
UN	United Nations
UNCTAD	UN Conference on Trade and Development
UNIDO	UN Industrial Development Organisation
UP	University of Pretoria
VUT	Vaal University of Technology
WCM	World class manufacturing
WDI	World Development Indicators
WTO	World Trade Organization

1. Introduction

1.1 Background

The dti established a new Directorate of Leather and Footwear in 2011 to facilitate development of sectors facing stagnated growth, continued job losses and increasing trade deficit.

“There was complete lack of sector development infrastructure, skills, institutional investment in design Innovation, Research, and Development at the time. The domestic market share and exports orientation was low. Investment and technology demonstration in industry was low and raw leather resources were under benefited.”

“The department will spare no effort in supporting the leather and footwear industry in SA and this is evident in the R290 million that the department is spending through its Competitiveness Improvement Programme (CIP) to enhance the competitiveness of the industry by establishing five sector clusters. These are the National Footwear and Leather Cluster (NFLC) through Vaal University of Technology (VUT), Exotic Leather Cluster through University of Pretoria (UP) and three Retail Collaborative Vertical Footwear sub-national Clusters”, says Minister of Trade and Industry Dr Rob Davies.

Through the initial analysis in 2011 the SA leather and footwear value chain was divided in six sub-sectors and a structured programme-based framework for development of sector specific infrastructure was conceptualised in three layers consisting of national programmes, retail collaborative sub-national vertical clusters and the establishment of the Centres of Footwear and Leather Goods Entrepreneurship (CoFE) across the country (**The dti’s** Industrial Policy Action Plan, IPAP: 2016/17 2018/19).

During the exhaustive stakeholder consultations from 2012 to 2013 on recommendation of export prohibitive policy measures, **the dti**, together with Skins Hides and Leather Council (SHALC) and Automotive Trimming and Cutting Group (ATCG) recorded a demand from the stakeholders on a need for enhanced promotion of **the dti** production incentives and establishment of a LRI to assist industry in building

competitiveness and to sustain industry growth through the impact of export-prohibitive policies on raw or semi-processed materials.

With an objective to solicit international collaboration, **the dti** visited the University of Northampton, UK, on 19th November 2014 followed by a visit of the Exotic Leather Research Centre (ELRC) on 23 -24 February 2015, and proposed that the university assist in conducting a feasibility study for the establishment of a LRI in SA. The university would also offer a one-year MSc Leather Technologist programme from 2015. The funding for ten SA candidates was organized by the ELRC from the Fibre Processing and Manufacturing Sectoral Education and Training Authority (FP&M SETA).

The University of Northampton was commissioned through the Exotic Leather SA (ELSA) sub-national cluster in March 2016 to conduct a feasibility study on the establishment of a LRI in SA.

The study maintains its independence, its institutional philosophy, in recommending the relevance of sector specific research and education systems in the development of sector competitiveness through enhanced know-how, competitive intelligence and sustainability.

1.2 The Department of Trade and Industry

The dti: Industrial Development Division, IDD (specifically the textile, clothing, leather and footwear unit) is working with industry representatives, export councils and technology consortia and have identified six sub-sectors that will receive support.

In addition to identifying these sub-sectors the Minister has strengthened four shifts in policy to help these sub-sectors, namely: the IPAP; the Preferential Public Procurement Framework Act, PPPFA; Special Economic Zones, SEZ; and a National Exporter Development Programme, NEDP. The SEZ and the NEDP are integral to the Integrated National Export Strategy (INES) for developing the increased export of strategic goods.

The dti has also implemented a Customised Sector Programme (CSP) and incentivised this programme using a Production Incentives Programme (PIP) and a Competitiveness Improvement Programme (CIP), including, the Clothing, Textile

Competitiveness Programme (CTCP). These incentives have resulted in real growth for the SA economy and further interventions are planned, particularly for the NFLC.

The operating framework of **the dti** can be easily encapsulated in the following principles:

a. Vision

A dynamic industrial, globally competitive SA economy, characterised by inclusive growth and development, decent employment and equity, built on the full potential of all citizens.

b. Mission

The dti will:

- Promote structural transformation, towards a dynamic industrial and globally competitive economy;
- Provide a predictable, competitive, equitable and socially responsible environment, conducive to investment, trade and enterprise development;
- Broaden participation in the economy to strengthen economic development; and
- Continually improve the skills and capabilities of **the dti** to effectively deliver on its mandate and respond to the needs of SA's economic citizens.

c. Values

The dti are:

- Operational excellence – service delivery standards, international best practice, Batho Pele Principles, continuous improvement and ethical conduct
- Intellectual excellence – continuous shared learning, innovation, relevant knowledge and skills improvement and knowledge management
- Quality relationships – improved and continuous communication, honesty, respect, integrity, transparency, professionalism, ownership, leadership and teamwork

As mentioned in **the dti's** mission, one of the fundamental aims of the department is to safeguard the national economy, in alignment with the New Growth Plan, 2010 (NGP).

1.3 SA economy

The world economy has been performing substantially below its potential since the US financial crisis of 2007, the ensuing recession of 2008/9, and continues to face considerable headwinds at the present time.

The SA economy suffered further setbacks through the successive “aftershocks” since that global recession, both because of the high levels of uncertainty prevailing on the global economy market as well as through several home-grown challenges.

Growth slowed further in 2015 to 1.3%, with the weak performance being broad-based at the sector level. This was further compounded by drought conditions within SA in 2015/16, as significant elements of the SA economy are agricultural (or dependant on the success of agriculture).

Several manufacturing sectors (including the footwear, textiles and clothing industries) experienced recessionary conditions within SA through this period, and in general reflected the general constraint of spending as illustrated in data on both average household spend and the manufacturing purchasing manager's index.

Industrial development is wide-spread across SA, with major industrial infrastructure located in Johannesburg, Pretoria, Durban, Port Elizabeth, and Cape Town. Recent industrial development and residential spread has increased between Johannesburg and Pretoria, and there are suggestions that this could be one of Africa's first mega cities (Cameron 2000)

In the last 150 years, the SA economy has grown from a mining and purely agriculturally based economy, governed by colonial administrations to a democratic country, which currently holds a top position as one of Africa's most affluent countries. SA has a 2015 nominal gross domestic product (GDP) of US\$312,797.5m (The World Bank 2016; **The dti** 2015).

The SA economy currently operates in a global environment that is characterised by depressed economic conditions (with low business confidence), high

volatility, and a rapidly changing political environment. Western politics shows indications of shifting towards conservatism, which includes protectionist policies, and focus on home interests. Shrinking international aid for middle and low income countries (as defined by Gross National Income, GNI), has resulted in these countries having to find internal resources to fund infrastructural change (Khokhar, and Serajuddin 2015)

Commodity-exporting countries, like many parts of Africa, and notably SA are having to adjust their industrial development programmes to secure reliable, quality-driven trade revenues. The changing global climate is forming a major driver for SA in re-evaluating its commodity sectors to understand where more revenue can be gained from value add.

Figure 1-1 shows that SA's GDP growth is currently 1.3% (The World Bank 2016, **the dti** 2015) and seems to be following the economic downturns of many of its trade partners (including the European Union, EU). Currently, SA's GDP growth is well below ~3% (twenty-year average).

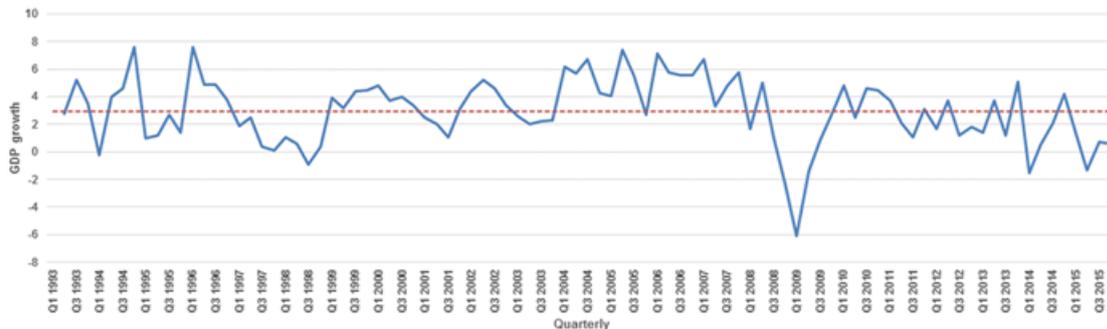


Figure 1-1: Seasonally adjusted annual GDP growth % for South Africa. (Data taken from **The dti** 2015)

After the international Heavily Indebted Poor Countries (HIPC) initiative and its extension Multilateral Debt Relief Initiative (MDRI) - of which SA and Nigeria were not recipients - great attention has been paid to the steady rise of the debt to GDP ratio and the Total Debt Service (TDS) percentage. SA's TDS in 2014 was 8%, up 4% from 2007, confirming using an international indicator, that **the dti** has already placed programmes addressing the SA trade deficit.

The latest *IPAP 2016/17 – 2018/19* maps out how SA is growing and strengthening indigenous industry to add value to its exported goods.

The leather industry forms part of the manufacturing sector of the SA economy and is of current interest - as it is a large employer and is key to further employment opportunities. The sector could be a great source of income for growing the national GDP and in lowering the trade deficit in alignment with the NDP.

1.4 Summary of previous industry studies

Many of the studies done on the leather industry in Africa have focussed on industry development in Northern, Eastern, and Western Africa. Very few studies have been done specifically on the SA leather industry, and so this section will briefly discuss the African research and the potential applicability to the SA industry.

The United Nations Industry Development Organisation (UNIDO) has focussed funding and research on countries previously classified as “developing” countries. In 2015, the World Bank started to classify all countries as either low-, middle-, or high-income countries based on their GNI (Khokhar, and Serajuddin 2015). SA has been placed in the upper-middle income category (US\$4,036m-12,475m).

However, as these reclassifications are quite recent, SA has not been looked at, directly, within the UN framework. Historically, SA has either done limited internal assessments or has had to gain insight from generic African studies and then apply them to a local context.

Table 1-1 shows a list of the main SA (or African) leather research that can be applied directly or indirectly to the SA industry. They are few and focus on the commodity nature of the raw material. Many of the studies focus on market development and some are strategic in nature.

Table 1-1 A list of studies outlining the SA leather industry, when the studies were carried out and some research details.

Reference	Date	Details
Shuttleworth	1983	A look at leading figures and some reference to the industry requirements from 1920 to 1980.
UNIDO	1991	Hide and skin grading and selection
Hailemariam	1997	Eritrean footwear and leather enterprises
Cipriani	2002	Quality control and management in Africa
Favazzi	2002	African policies, and environment protection
Jabbar et al.	2002	Hides, skins, and semi-processed leather
Milone	2002	Globalisation of African leather
Salazar de Buckle	2002	Production and management barriers
TLC	2002	Market requirements for importers of African leather
UNIDO 2002	2002	A blueprint for the African Leather industry – a development guide
Ballard	2002	A very comprehensive investigation into value addition to SA material
UNIDO	2010	Future trends in world leather
COMESA	2011	COMESA regional strategy (2012-2016)
Silimela	2011	Profile of capacity, growth and developmental needs.
DAFF	2012	Profile of SA value addition
Mokothu-Ogolla and Wanjau	2013	Factors affecting value add in Kenya
ETG 2015	2015	Kenya Leather Industry
AIEC	2016	Automotive export manual

1.5 Brief overview of leather processing

The SA leather industry faces some challenges that are unique to both the source of hides and skins (rural as well as abattoir sourced), and the types of hides and skins, particularly the exotic skins. Figure 1-2 to 1-4 overleaf outline the general progression of hide and skins through the SA production chain (modified from UNIDO, 1991). The flow of material can follow several choices and that export/import options occur at multiple stages.

The principles of SA leather-specific sub-processes and very specific operations are clarified in this section to help with the understanding of the terminology used throughout this study and the context within the SA leather industry.

All leathers are processed using four sub-processes: preparatory (compulsory), tanning (compulsory), crusting (compulsory), and surface coating (elective).



Figure 1-2 The production flow of hides through SA processing units. (Modified from UNIDO, 1991)

Bovine leather plays one of the largest parts in SA value chain. In the production flow outlining the movement of hides through SA processors, see Figure 1-2, the splitting operation give rise to split material, which is the lower layer of the hide that does not contain any grain. Split leather can be used to add additional value to the bovine value chain, either by it being sold on, or by being coated and sold as commodity bag, safety shoe upper, or other shoe uppers. Grain leathers that have the highest value can proceed (as wet blue) for export or can be processed internally.

The grain leathers will be processed into automotive/furniture upholstery, leathersgoods, belting, or shoe upper.

Exotic skins are the fastest growing sector of the SA leather market.

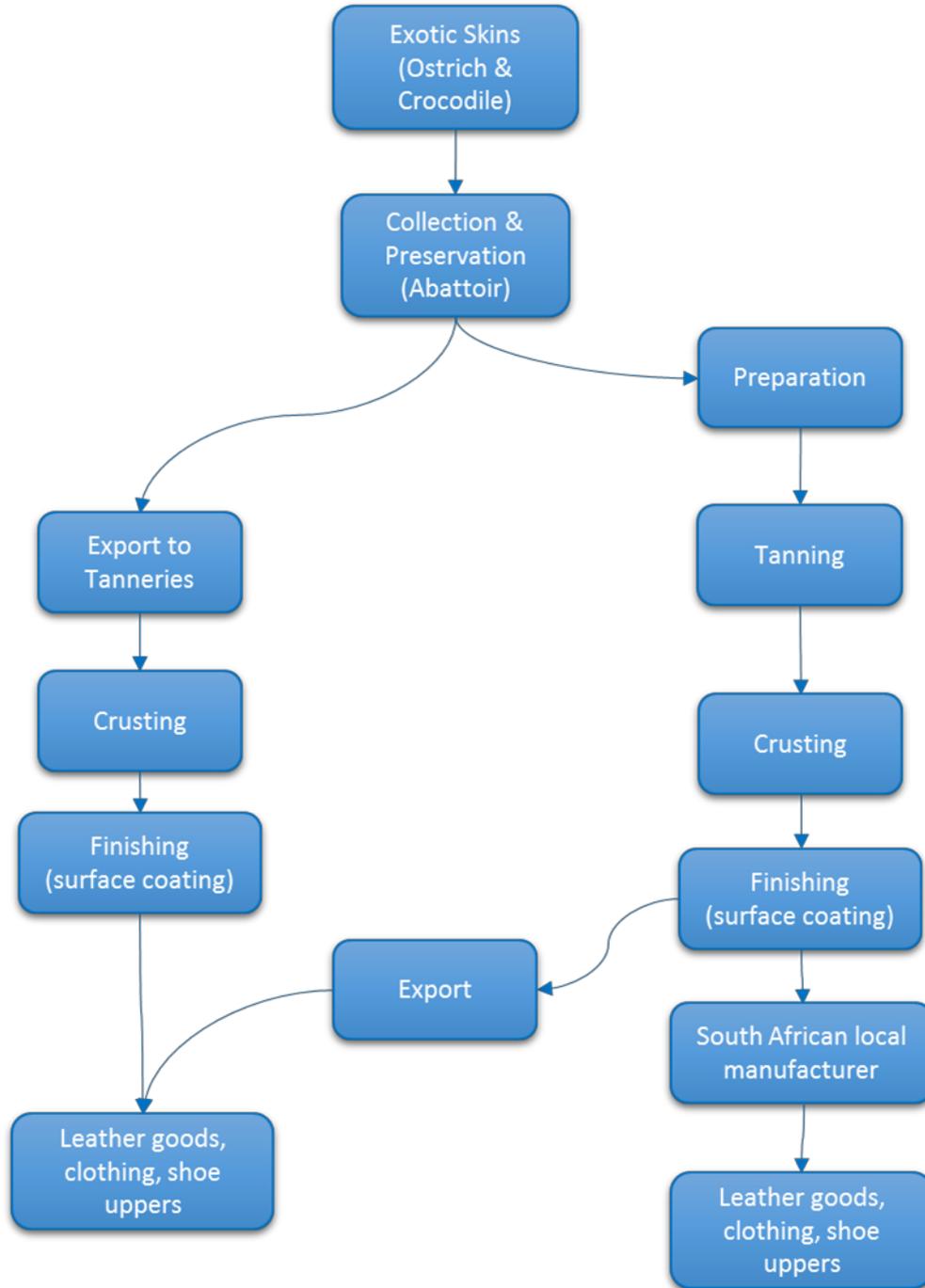


Figure 1-3. The production flow of exotic skins through SA processing units. (Modified from UNIDO, 1991)

Small skins, especially the Cape glover have always played a valuable part of the SA leather industry. The Karoo and other dry areas of the SA geography lends itself to the healthy growth and breeding of the Dorper sheep.



Figure 1-4 The production flow of skins through SA processing units. (Modified from UNIDO, 1991)

The operations that take place in leather manufacture are generally critical operations, or elective (depending on the leather type in question). Table 1-2 shows the list of operations and a brief description of their purpose.

Table 1-2 An outline of chemical and machinery operations during leather manufacture.

Operation	Description
Soaking	Rehydration of the dehydrated, preserved raw material. The water also washes off unwanted blood and dirt.
Fleshing	Removal of adipose tissue (fat and connective tissue)
Unhairing/Liming	Removes the hair and opens structure. Hair-on technology omits this step.
Deliming/Bating	Removes the lime and softens/cleans the material
Pickling	Lowers the pH in anticipation of tanning
Tanning	Penetration and fixation of tanning chemicals
Thinning	Reduction and levelling of thickness
Wetting back	Rehydration and cleaning
Neutralising	Reduction of reactive groups in anticipation of dye, retan, and fatliquor penetration
Dyeing	The colouring of the leather
Fatliquoring	Softening and strength enhancement of the leather
Retan	The imparting of customer specific properties
Fixation	Final linkage of all tanning chemicals
Washing	Removal of unwanted chemicals
Drying	Removal of water, setting of the texture and flattening of the material
Conditioning	Returning of some water into the leather
Staking	Softening of the leather by vibration
Milling	Softening of the leather by tumbling
Buffing	The correction of grain faults
Dedusting	Removal of buffing dust
Surface coat/Finish	Application of polymers and colourants to give final even colour and surface
Embossing	Imparting of texture
Area measurement	Machine measurement of surface area

1.6 Current leather technology challenges to SA tanneries

The current technological challenges experienced in the tanning industry in SA evolve around the internalisation of real manufacturing costs, environmental, corporate responsibility, and health and safety. Further, SA tanneries are being

encouraged to direct leather hides and skins to SA manufacturers, rather than export, in a drive to internalise the profits of higher value goods available from SA.

Many tanneries suffer from a lack of availability of capital injection to address market issues or to take up growth opportunities. This in turn hinders effective renewal and sufficient investment in the technology needed. **The dti** currently has PIP that helps to cover some, or all the capital costs needed for SA tanneries.

Tanneries also experience cost reduction challenges: correct product placement (commodity versus luxury), chemical and machinery substitutions (whilst maintaining value for money), growth control, raw material cost control, and making sure that they do not have a race-for-the-bottom in terms of price undercutting.

Tanneries further have consumerism challenges, namely: confirming the absence of banned or harmful substances, balancing the carbon and water footprint of the product, meeting retailer specifications, managing the ethical image of the products, and the life cycle of the leather material (trying to find a more sustainable cradle-to-cradle or cradle-to-grave approach).

SA tanneries experience unique challenges specific to the demographics of the country, as well as the nature of the materials produced. The rural nature of many of the un-exploited skins, predominantly goat skins are not making it into the SA economy. The tanneries operating on exotic skins also face unique challenges, for example the loss of revenue because of avian flu in ostriches, where global research was available on poultry but not directly applicable to the ostrich industry.

The LRI would be positioned to provide information, processes, know-how and focussed research to the SA leather industry to address these challenges within a SA context, allowing the leather and footwear sector to internalise the profits and benefits of strengthening the industry within SA.

2. Methodology

ELSA requested that ICLT undertake an assessment of the current industry status with special reference to what skills, research and testing capabilities were required, and how an increase of leather supportive infrastructure could enhance the sector. These assessments should include:

1. A snapshot of what current industry skill levels are;
2. To ascertain whether these resources can deal with the technological challenges that modern SA tanneries face;
3. To understand the leather industry's current skills, research and testing services demand;
4. And to help the SA government and the leather industry governing bodies to formulate a rational approach to the assessment of a LRI.

It was also requested that the range of current leather industry education and its support be considered through:

1. Technical, vocational education and training (TVET) assessment;
2. Formal university programmes both for education and as a basis for research and consultancy;
3. And suggestions as to how current industry practices could be enhanced to enable the leather industry to capitalise on the international market opportunities.

2.1 Feasibility question

In its essence, this technical feasibility deals with a simple question. What are the technical considerations needed to build a SA LRI, in the current economic and political climate?

In summary, this research finds that **the dti** has created a cultural and political environment in which the framework exists to support and fund the creation and development of a LRI. **The dti's** consultations as well as the consultations from this report have shown that the industry would welcome a class-leading LRI with a SA focus on research and skills development. The biggest challenge to the successful delivery of a SA LRI is finding and securing the services of world-leading leather and tanning research experts who would form the nucleus of the LRI team and expertise.

2.2 Aim and objectives

The main aim of the project is to gather information from SA leather producers and the allied industries, to make informed judgements that will answer the above research question.

This report has obtained data through the following means:

1. Interviews with the relevant managers, both technical and non-technical from a representative portion of the leather sector (Table 2-1), who commented on:
 - the current tannery technology;
 - and how each company meets their needs with skills development;
2. Interviews with academics from the University of Pretoria (UP) who discussed the possibility of how the university (or their partners) could provide a complete range of adult basic education and training (ABET) through to PhD education and training solutions.
3. Interviews with relevant academics from the UP who discussed the possibility of how the university (or their partners) could meet the industry's research requirements and whether the research opportunities could form the core of the funding for the LRI.
4. Follow-up questionnaires to the companies interviewed and to other companies that could not be included in the face-to-face interviews (to ensure as wide a consultation as possible).
5. Interviews with the relevant managers on the industry's current research needs and to gauge the age of the industry's information. Focus was placed on research priorities.
6. Interviews with the relevant managers at companies who provided insight into their companies' service requirements. Emphasis on, but not limited to, testing requirements, and environmental support.

2.3 Qualitative methods – opinions and views

To find the answers to the issues relating to the current mechanism of education training and skills development in the SA leather industry, the methods of inquiry were as follows:

1. A presentation was made to the Society of Leather Technologists and Chemists (SLTC) who are an industry technology consortium – the attendees were then called on for feedback and comment.
2. Current global, continental, regional development goals were consulted for strategic reference (particularly education and training developments)
3. The relevant SA government proposals, interventions, and strategic frameworks were consulted.
4. Company visits (34 companies and organisations) – ranging from small to large leather companies, taxidermists, trade unions, the KwaZulu-Natal (KZN) leather processing hub, regional footwear clusters, current education providers, chemical manufacturers, leather councils, industry forums, retailers, and shoe producers (see Table 2-2).
5. Follow up telephone calls with 16 other companies – to ensure that testing houses, research companies, training providers, and government offices were included in the overall industry view on the LRI feasibility and structure.
6. Several industry reports and consultations (14) were considered for relevance and qualitative comment (see Section 1.4).

Table 2-1: The list of leather companies visited to gauge the current educational activity and technological capability.

Company	Location (Province)	Type
African Hide Trade	Port Elizabeth (Eastern Cape)	Wet-blue
Bader SA	Ga-rankuwa (Gauteng)	Automotive upholstery
Brits	Brits (North West)	Wet-blue
Cape Produce Company	Port Elizabeth (Eastern Cape)	Wet-blue, pickle
Fusion	Parow Industria (Western Cape)	Leather Trader
Hannitan Leather	Springs (Gauteng)	Furniture upholstery
Klein Karoo International	Oudtshoorn (Western Cape)	Ostrich, crocodile, gameskin
Leather from Hart	Pietermaritzburg (KZN)	Wet-blue, vegan
Le Croc	Sanddrift (North West)	Crocodile
Mossop-Western	Wellington (Western Cape)	Shoe upper, split
Richard Kane	Maitland (Western Cape)	Pickle, chamois
Seton SA	Nigel (Gauteng)	Automotive upholstery
SCOT	Mossel Bay (Western Cape)	Ostrich, crocodile.
Sutherlands Tannery	Pietermaritzburg (KZN)	Upper, wet-blue, split

In the interviews the same format of questions as those seen in Appendix 1 were used. Interviews were conducted with two members of the research team being present (for later note-verification, consultation and consolidation for consistency within the same data and in comparison, to external data).

After initial data collection, national bodies were contacted to check the accuracy of quoted numbers and statistics.

Table 2-2 List of other organisations visited and interviewed

Company	Interview Location (Province)	Type
SCRFC (includes Watson Shoes)	Groot Brak River, Western Cape	Sub-regional footwear cluster
Eddels/Edcon	Pietermaritzburg, KZN	Shoe manufacturer and fast track cluster
ISTT	Grahamstown, Eastern Cape	Education provider
SACTWU	Cape Town, Western Cape	Trade union
Highveld Taxidermy	Hennops River, Gauteng	Taxidermist
EDTEA leather processing hub	Durban, KZN	Leather hub
SLTC	Pietermaritzburg, KZN	Industry consortium
University of Pretoria	Pretoria, Gauteng	Education provider
Enterprises – UP	Pretoria, Gauteng	Continuing professional development (CPD) provider
Skins, Hides, and Leather Council	Johannesburg, Gauteng	Trade organisation
Woolworths	Cape Town, Western Cape	Retailer
Dick Whittington	Pietermaritzburg, KZN	Shoe manufacturer
RMIF	Johannesburg, KZN	Industry forum
Forestry and Agriculture Biotechnology Institute (FABI)	Pretoria, Gauteng	Research institute
South African Leather Employer's Association	Ga-rankuwa, Gauteng	Employer association
ELRC/ELSA	Pretoria, Gauteng	Cluster/research group

2.4 Quantitative methods

Current industry levels of education, training, and skills development were assessed to provide baseline data on the levels of industry policy and engagement. The following methods were used:

Questionnaires (using the format seen in Appendix 1) were sent out to 175 leather and leather related companies. Most survey companies expect a 10-15% response rate for external surveys and this feasibility was not expected to deviate from that level. This study yielded a return rate of 17% of respondents.

Several factors were planned to help improve the response to the survey:

1. The survey was designed to be easy to fill in and the time taken for the initial assessment was planned to be low – *these questionnaire survey questions were designed to take no more than 10 minutes.*
2. The respondents were encouraged to feel engaged with the topic in question – *it was felt that the topic and questions asked were of vital importance for the long-term sustainability of the respondent's livelihood.*
3. The survey was widely distributed, encompassed all industry participants and allowed a range of technology methods to suit the age and technology proficiency of most respondents – *older age respondents were interviewed in person so that the digital barrier was reduced. Web-based surveys were ruled out due to the unequal access of the internet in SA.*

All questionnaires were designed, distributed, collected, processed, and stored in compliance with the University of Northampton (TUoN) procedures and policies outlining the ethical guidance concerning surveys. Attention was given to TUoN compliance with the Data Protection Act (1998) in terms of respondent anonymity and the prevention of personal (company) data given in good faith (UK Parliament 1998).

To be able to do the benchmarking and gap analysis for the SA leather education and training, the modified Delphi estimation method used by ETG Consultants in the *Kenya Leather Industry – Development, Strategy, and Action Plan* (2015) was used.

3. Part A - Technical

3.1 The global leather supply chain

The international global leather supply chain is conspicuously divided into a commodity supply chain and a luxury supply chain. The level of industrial intensity differs according to the supply chain that the leather will ultimately fall under, with a greater final price and level of technology being experienced in the luxury sector.

Raw materials, for example cattle/sheep/goat, that enter the leather industry are classified as by-products of the meat industry (Brugnoli 2012), and will be split between the commodity and luxury supply chains. Exotic raw materials, such as ostrich and crocodile skins, are classified as dependent co-products, but can be determining in some cases (Consequential-LCA 2015). Exotic leathers predominantly fall within the luxury supply chain, and offer a unique opportunity for SA industry to capitalise on.

The main uses for leather are restricted to apparel (including: footwear, belting, clothing, and gloves), seating/trim, and leather-goods (including: bags/purses/wallets, covers/binding, luggage, and trinkets). The type of skins used for specific articles is generally restricted to specification, wear properties, price, and aesthetics.

The generation and collection of the raw hides and skins, takes place at abattoirs, or (in SA) from rural slaughter. It is accepted by the industry that the leather life-cycle analysis (LCA) system's boundary begins at this point (Brugnoli 2012). The material is processed in a tannery (which produces leathers from any raw or semi-processed material), fellmongers (who process raw to pickle sheepskin), or dressers (who take unfinished leather and apply dry finishing and/or wet processes to complete the leather-making process). The sheets of leather are purchased in the raw state by tanneries (at a weight-dependant price), and sold by area of final leather, to a factory who will create the final article deemed as above.

The global movement of materials is like most other commodities, it generally moves where the price and demand dictate it. SA's export prohibitive policy proposal is aimed at keeping raw and interim products such as hides, skins and leathers in SA, to ensure that the value-add part of the industry (manufacture of garments, shoes and other articles) is captured within the SA economy.

In Figure 3-1, the location of the main sources of raw materials for the leather industry are shown. Historically, these raw materials were moved to the United States of America (USA) and Western Europe for processing into leather (and up until the 1950s into final leather-containing goods).

As can be seen from Figure 3-1, the countries that currently farm the animals are focussed in low- and middle-income economies. SA's challenge is to retain the hides, skins and leathers through the manufacturing stages to draw the benefits to the SA economy.

Many leather manufacturers in Western Europe have seen the benefits of vertically integrating their supply chain. Factories are buying or co-operating with farmers to be able to control raw material prices. Similarly, some retailers are performing acquisitions down-stream and they are owning cutting, stitching plants or owning shoe factories. Some retailers, have bought their own tanneries, to be able to control supply and quality.

It is not uncommon for materials needed by tanneries to be shipped globally as raw or semi-processed material. Finished leathers, cut leathers (also known as cut kits), or semi-assembled articles, are commonly transported to areas where they are assembled and then moved back to the high and medium income economies, increasing the carbon footprint of these products. The biggest markets for final leather goods are the EU and the USA.

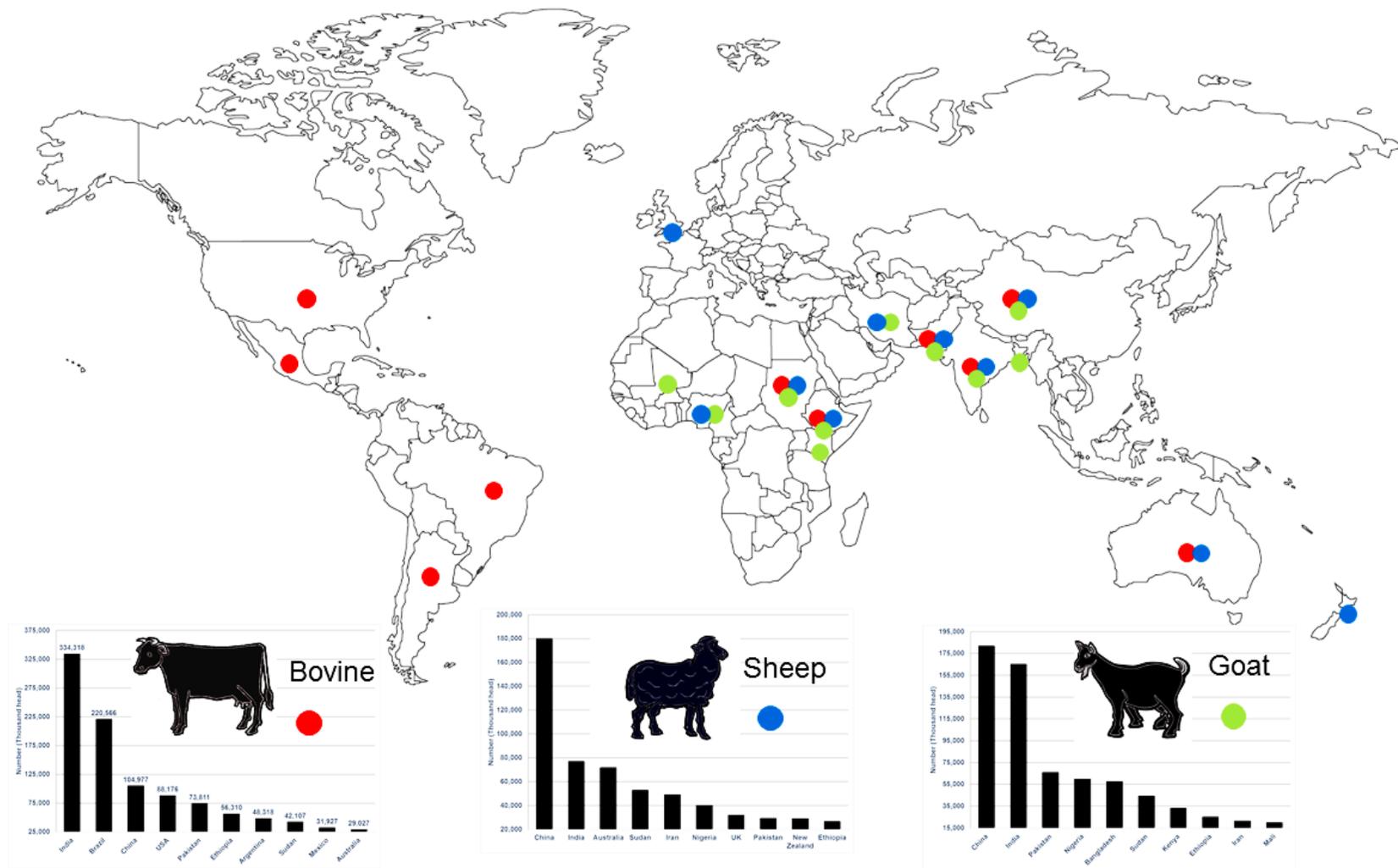


Figure 3-1 Global map showing the location and quantity of the top 10 countries with the largest herd/flocks (FAO 2016)

3.2 SA leather industry overview

The roots of the modern SA leather industry stretch back to the Dutch, and later in British colonies need for saddlery, harness leathers, and in the *veldschoen* (and other boots/shoes). The two Boer Wars and the two World Wars (in which SA was a vital boot supplier) all drove a fledgling industry forward.

Recently, the SA leather industry has come under direct threat from the transition in the SA footwear industry, the rise and fall of the automotive seating and trim industry, and immense competition in the wet-blue and pickled sheepskin export market.

The number of leather tanneries has declined in SA since the late 80s, approximately 25 leather processors have closed, or restructured (through merger or buy-out). In the other countries, such as the UK, as the leather industry contracted, the relative size of the remaining tanneries increased to absorb the spare capacity. This has not always been the case in SA tanneries. Recent figures published in their annual performance report, by **the dti**, show that the SA trade is starting to recover.

Entrepreneurial activity in the SA leather industry, as in most countries is difficult. High barriers to entry exist: high capital costs, low margins, cash flow, and fluctuating raw material prices. Many start-ups fail in the first two years and SA is no exception. In recognition of these challenges, **the dti** is establishing Centres of Footwear and Leather Goods Entrepreneurship to drive the demand for leather hides and skins from within the SA economy.

Employment in the SA clothing, textile, footwear and leather sector has declined since 2001, but the decrease in numbers stabilised in 2012, and since then the employment numbers have stayed at around 150,000 employees (**the dti** 2016).

3.2.1 Industry make-up and size

The leather and footwear value chain was divided into six sub-sectors in 2011 due to diverse marketing, manufacturing and operational requirements:

- Domestic market oriented:
 - Leather sub-sector (31 companies)
 - Footwear sub-sector (175 companies)

- Leather Goods, General Goods, Handbags and Luggage sub-sector (84 companies)
- Export market oriented:
 - Crocodile leather sub-sector (more than 80 crocodile farms and 3 tanneries)
 - Ostrich leather sub-sector (400 Ostrich co-operatives and 2 tanneries)
 - Taxidermy sub-sector (141 companies)

Independent strategies and programs have been developed for the above six sub-sectors in consultation with seven industry associations, two export councils and organized labour. The bodies involved in driving the SA leather economy are:

Industry representative organizations:

- South African Footwear and Leather Industry Association (SAFLIA)
- Skin Hide and Leather Council (SHALC)
- Automotive Tanning and Cutting Group (ATCG)
- Association of SA Manufacturers of Luggage, Handbags and General Goods
- South African Crocodile Industry Association (SACIA)
- South African Taxidermy Industry Association

Export Councils (**the dti** established and co-funded):

- South African Footwear and Leather Export Council (SAFLEC)
- South African Ostrich Export Council (SAOEC)

Technology Consortia:

- Society for Leather Technologists and Chemists (SLTC)

Organised labour:

- National Union of Leather and Allied Workers (NULAW)
- South African Clothing and Textile Workers Union (SACTWU)
- National Bargaining Council for the Leather Industry (NBCLI)

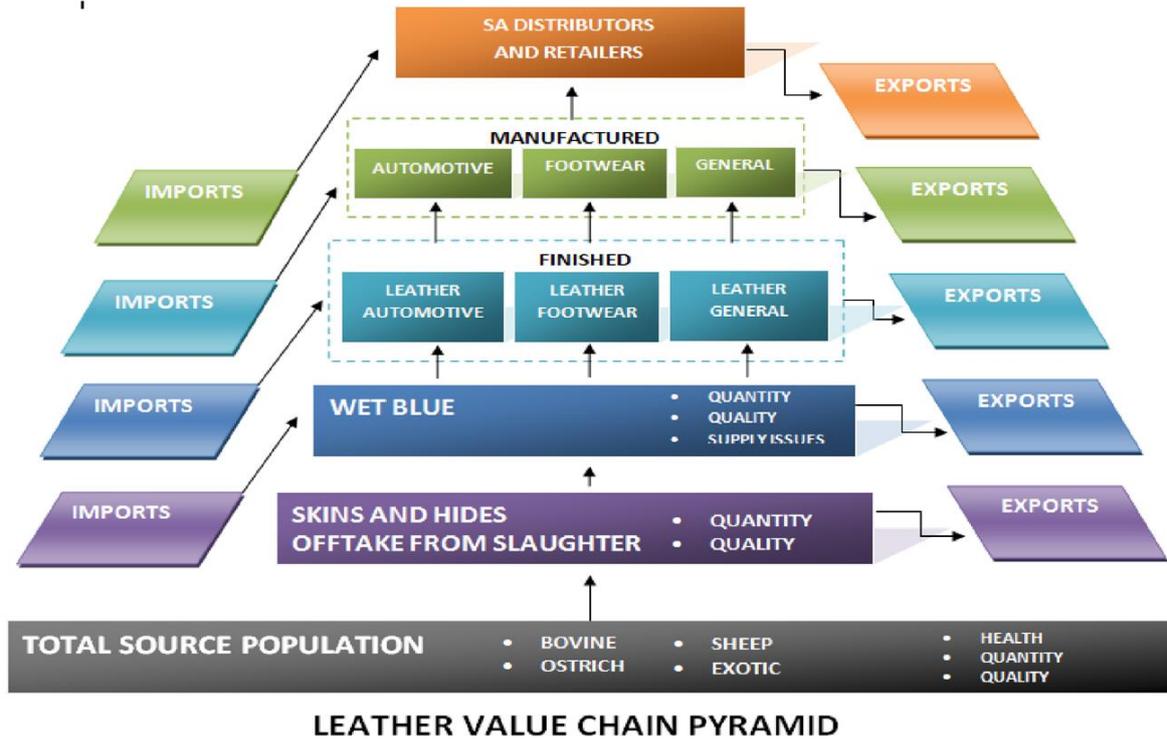


Figure 3-2: South Africa's leather value chain pyramid, showing value to be generated from local hides and skins.

Figure 3-2 shows the products, industries and markets through which value addition can be achieved through the SA leather industry. In 2015, the estimated raw materials available were: bovine hides, 2.5 million; sheepskins, 5 million; ostrich skins, 0.25 million; crocodile skins, 80,000 (Mello and Irkhede, 2015).

The dti's support for the clothing, textiles leather and footwear industry since then has amounted to over R3.5 billion in production incentives and R0.712 billion in the establishment of retail collaborative industry clusters. An estimated 6,000 jobs have been saved and 6,000 new, decent, sustainable jobs have been created.

There has been a strong growth in leather and leather goods exports – up by 60% from 2011 to 2014, with substantial improvements in productivity over the period. Twenty-eight new factories were opened in the leather and footwear industry from May 2012 to December the 2015.

This report represents a continuation of the support the dti has committed to providing into the leather and footwear manufacturing sector. The clothing, textiles, leather and footwear sectors have benefitted substantially from the CTCP which was introduced in 2009, by the government, as an answer to the pressures which the sectors were suffering from, particularly pressures around cheap and illegal imports. Many of these were from the Far East in the early 2000s due to the reduction of

safeguards to the industry during accession of South Africa to WTO, and saw many manufacturing companies closing their operations due to the pressures of the competition.

As a result of the CTCP, real output in the textile, clothing, leather & footwear sectors grew by 13.39% from R24.4 billion in 2010 to R27.8 billion in 2013. The impact of designation and support provided under the CTCP has enabled the leather and leather goods industries in SA to grow, including the establishment of 26 new footwear factories till the 2015/16 financial year (**the dti** 2016).

The challenges facing the leather industry are as follows:

Skills of Leather Industry Staff

The number of skilled people in SA is perceived to be low (which correlates with **the dti** statistics) showing a declining number in the CTLF sector. A LRI would need to provide the infrastructure to address this gap in the SA leather industry and help to promote the aspirations of the National Development Plan 2030 (NDP).

Raw material challenges

The raw materials in the leather and taxidermy industries come primarily from three sources: the meat industry, the dairy industry, and the hunting industry. The main materials used in the leather industry are cattle, sheep, and goat. These materials are collected at the abattoir, and are generally in demand, so prices for raw material are slightly inflated. These prices fluctuate and account for up to 60% of the variable costs of leather production (Sharphouse, 1983). A LRI would be able to provide industry data on the price of raw hides and skins, and to undertake research on the economics of the leather industry, allowing the Government to understand whether incentives are necessary to allow a standardisation of raw material prices.

Threat from cheaper imports

At the moment, India and China produce the largest quantities of leathers and despite material export levies being high on Indian material, these two countries tend to flood international markets with low priced leathers. One of the key challenges to remaining competitive in the SA leather industry is to try and remain competitive with price and specification. The LRI would be a useful vehicle to understand and track the impact that global leather prices have on the SA leather industry and to research potential incentives and mechanisms to mitigate the risks to the SA industry.

Distance from Europe

The technical difficulty of leather tanning processes, particularly higher specification leathers, often requires precision machinery, in-depth technological skills, product knowledge and acute problem-solving experience. The global centre of leather expertise is without a doubt in Europe. The geographical distance of SA from these centres of excellence does mean that the lead time of technical solutions, if overseas consultants are to be used, is often protracted. A LRI would provide a clear advantage to the SA leather industry by providing local proficiency within SA, reducing the distances to expert knowledge and building a body of localised expertise.

SA specific research and academia

Very little leather research is carried out in SA and very few SA academics have the equipment and expertise necessary to perform this research. This is a clear function of the LRI – to provide specific leather research, both at an academic level and to inform understanding, and at an applied level within the sciences of leather chemistry, biology and the economic impacts.

3.3 Education and training in SA

National government is responsible for education in SA (as a whole) and as such, provides national education guidelines. Each of the nine provinces has its own education department which has a reasonable degree of autonomy in how they implement national policy.

On 10 May 2010, the previous Government Ministry of Education was split to make provision for a Ministry of Higher Education and Training (The Department of Higher Education and Training, DHET), and a Ministry of Basic Education. The latter ministry is now responsible for all school education, while the Ministry of Higher Education and Training oversees higher and post-school education and training, including the college sector.

Approximately 2,300 students are trained every year in leather companies in leather and non-leather subjects

In 2012, DHET released a Green Paper, for industry wide consultation on the future of post-school education including regulation of adult training and guidance for

the future of tertiary education. The White Paper is expected to carry forward SA tertiary education into 2030 and it is expected to address many of the challenges to education in SA identified in the UNESCO 2016 report.

3.3.1 Tertiary Education

In 2004, the SA Universities were restructured into three categories: traditional universities; comprehensive universities; and universities of technology.

An assessment of a nation's university participation level provides an indicator of the country's policies (in relation to secondary schooling, admission standards, the cost of tertiary education, and curriculum design). Globally, the number of students enrolling in universities has doubled from 100 million students in 2000, to 207 million in 2014.

The tertiary education gross enrolment ratio is the enrolment as a percentage of the population and has globally increased from 19% to 34% in the last 14 years. Low averages are recorded in sub-Saharan Africa (8%), but SA shows a much higher average than the rest of Africa, 19.7% in 2013 (World Bank Data Team 2016) This figure can be inflated by a higher enrolment age or a university course design that has a wide time spread of modules.

The gross graduation ratio is another indicator of tertiary education success, and it is defined as the number of graduates as a percentage of the population. Madagascar has a ratio of 3%, and the data for SA as stated by the Centre for Higher Education Trust that the average annual pass rate of the SA universities sits at 74%. This indicates that of the students that attend SA universities, a high proportion of them achieve their degrees.

3.4 SA Skills and Support Structures

3.4.1 SA education infrastructure

There are three components to education in SA:

1. General education and training (GET); Grade R up to Grade 9 and these form the basis of the compulsory schooling age, with the exception of Grade R;
2. Further Education and Training (FET): Grade 10 up to and including Grade 12 comprise further academic schooling, as well as intermediate

vocational education at technical colleges, community colleges and private colleges;

3. Higher Education and Training (HET): universities and continuing professional development.

The SA constitution states that everyone has the right to basic education, as well as to adult education and secondary education. Education in SA is compulsory between ages 6 and 15 years (or up to Grade 9) This obligation to attend school is secured in the SA Schools Act, 1996.

3.4.2 SA leather industry infrastructure and programmes

Below is a brief description of some of the trade organisations, their influential policies and how they influence the dynamics of the leather industry.

3.4.2.1 Exotic Leather SA Sub-National Cluster (ELSA)

This sub-sector of the SA leather industry was formalised by **the dti** in 2012. The sub-national cluster was formed to allow the industry to focus leather activities in these areas to allow SA to tap into the international luxury and

26% of leather companies use local testing facilities

79% of leather companies would use a LRI for research

exotic leather market and begin to compete on a global level. ELSA manages aspects of the IPAP, for example the procurement and management of this technical feasibility.

3.4.2.2 SA Footwear and Leather Industry Association (SAFLIA)

This is an industry organisation that allows a centralised point of contact for people who wish to have a trade dialogue with key people in both the leather and footwear industry. The association is an official employer's association; and represents the employers in three industrial sectors: footwear, suppliers, and leather companies. SAFLIA also is a party on the National Bargaining Council of the Leather Industry of SA (NCBLI).

3.4.2.3 National Bargaining Council of the Leather Industry (NCBLI)

Based with their headquarters in Durban, the NCBLI is responsible for the handling of labour related issues and to represent the employees of the leather industry. National bargaining councils work closely with specific trade unions and with employer's associations to handle labour disputes, wage negotiations and representation.

3.4.2.4 SA Clothing and Textile Workers Union (SACTWU)

One of the largest trade unions, with their headquarters in Cape Town, SACTWU encourages members of the textile and leather industries to join their membership and receive many of their benefits which include: wage negotiation, research findings; and representation.

3.4.2.5 National Union of Leather and Allied Workers (NULAW)

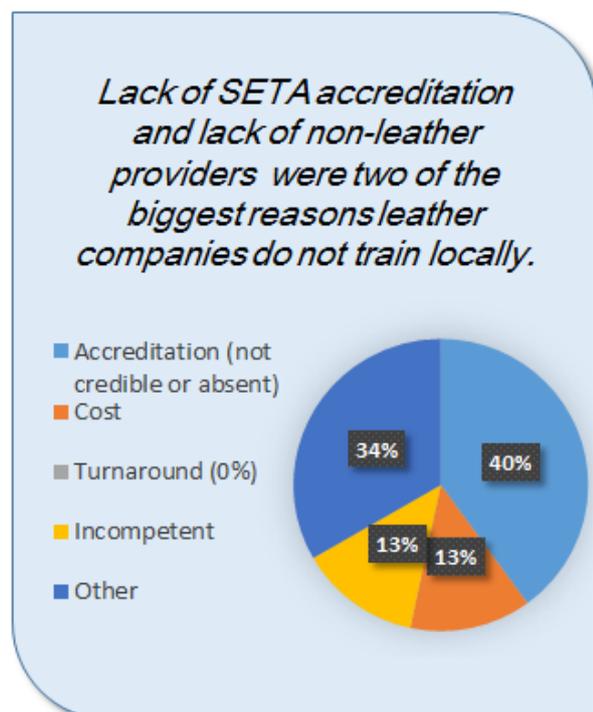
NULAW is a union that also represents worker's rights in the leather industry. Historically, they used to represent more workers, but SACTWU currently has more members. The benefits for NULAW members are like SACTWU with some minor differences.

3.4.2.6 Sectoral Education and Training Authority (SETA)

SETAs were first established in 1998 to help address skill shortages in the SA industries (DHET 2011). After the publication of the Skills Development Act, 1998, the National Skills Agencies and the SETAs have operated alongside each other. Both groups of organisations enact the National Skills Development Strategy (NSDS).

The NSDS is now in its third iteration and focusses on the following areas:

- *Goal 4.1: Establishing a credible institutional mechanism for skills planning.*
- *Goal 4.2: Increasing access to occupationally-directed programmes.*



- *Goal 4.3: Promoting the growth of a public FET college system that is responsive to sector, local, regional and national skills needs and priorities.*
- *Goal 4.4: Addressing the low level of youth and adult language and numeracy skills to enable additional training.*
- *Goal 4.5: Encouraging better use of workplace-based skills development.*
- *Goal 4.6: Encouraging and supporting cooperatives, small enterprises, worker-initiated, NGO and community training initiatives.*
- *Goal 4.7: Increasing public sector capacity for improved service delivery and supporting the building of a developmental state.*
- *Goal 4.8: Building career and vocational guidance (DHET 2011).*

3.4.2.7 Export Councils and Organisations

The export councils for the leather and footwear industries promote and focus the energy of industry through the encouragement of trade deals, trade fair delegations, collective representation, and through the development of markets, particularly for export. Some of the dti established export promotion agencies include the SA Footwear and Leather Export Council (SAFLEC) and the SA Ostrich Export Council (SAOEC).

The SAOEC also provides many functions within the industry beyond the export remit. The SAOEC handles the enhancement and growth of the Ostrich Producers.

3.4.2.8 The International School of Tanning Technology (ISTT)

ISTT is a small, private provider of effective leather education in SA. It has been operating since 1999 and is in Grahamstown. ISTT has one of the two SA leather-specific PhD holders, Dr Clive Jackson-Moss (the other is Dr Neville Slabbert).

63% of leather companies train with a local supplier

ISTT provides leather specific education and training at NQF Level 2 to 4, but some elements of the Advanced programme are Level 5. Dr Jackson-Moss, is a very experienced leather educator.

3.4.2.9 Skins, Hides, and Leather Council (SHALC)

The leather industry is enhanced, represented, and monitored by SHALC. The benefits of being a SHALC member include: trade statistics, representation at a national level, and being part of an extensive national network.

3.4.2.10 SA Crocodile Industry Association (SACIA)

The SA Crocodile Industry Association was formed in 2014, in recognition that the added value from an export item made from crocodile skins is significantly more than the value of the hides themselves.

In the interests of the animal welfare during the farming and production of meat, and more recently in the production of leathers and leather goods, the industry has an association that manages the affairs and bargains on the behalf of all producers.

3.4.2.11 Taxidermy

Three organisations are central to the governance and regulation of the taxidermy industry: the Taxidermy Association SA (TASA), Wildlife Ranching SA (WRSA), and the professional hunter's association of SA (PHASA). Members receive benefits from these organisations and help to direct the industry

3.4.3 Leather Industries Research Institute (LIRI; 1941 to 2000)

There have been many organisations that have existed in the SA leather industry. The most well-known has probably been LIRI.

The Leather Industries Research Institute (LIRI) was a research, education and training provider located on the Rhodes University campus, based in Grahamstown, Eastern Cape.

3.4.3.1 History

In 1938, the Rhodes University College initiated a small, but successful tanning/hides/skins section in the Chemistry Department. The department was formed as a response to a World War II economy, which required a boost in the SA manufacturing industry (Meyer 1963) (Louw 2012).

LIRI was formed in 1941 as a research institute of Rhodes University College, and it was established as a stand-alone institute that was responsible for its own administration and finances. The institute was formed under its first Director, Dr

Stanley Shuttleworth (who had previously earned the first PhD at Rhodes) (Shuttleworth 1983) (Brown *et al.* 2004).

In 1947, the institute was reconstituted under a Council for Scientific and Industrial Research (CSIR) research association scheme as an autonomous, non-profit company, while Rhodes was applying to become a fully-fledged University (granted in 1951).

In 1966, the institute had grown into an internationally recognisable institute that was well supported by the hides and skins suppliers, the wattle extract producers, other chemical companies, and the employers and employees in the national tanneries and footwear companies.

89% of leather companies would use a LRI for testing

In 1993, the Institute was re-incorporated into the Microbiology, Biochemistry, and Biotechnology department under the leadership of Prof. Peter Rose. The Institute continued to run its administration and budget independently, but the payroll, educational, and buildings/estates were managed by Rhodes University.

Nearly all companies (95%) wanted to know the structure of the new Leather Research Institute

LIRI ran until 12 January 2000, until the Section 21 company (associations not for gain), accumulated R2 million worth of debt, and a major creditor applied for LIRI's liquidation.

3.4.3.2 Function

The Institute served to meet the demands of five key areas in the beginning, which later changed to six under the leadership of David Sweetnam in the late 90s (see Appendix 3– refers to organogram of LIRI):

1. A leather department
2. A biotechnology department (including bacteriology and hides/skins)
3. An environmental department

4. A leather testing (including physical and chemical testing)
5. A footwear department
6. A leather products and leather crafting department (added later).

The structure was loose in the beginning, which evolved into finite departments in the latter years with departmental managers who were responsible for budgets and deliverables.

90% of the companies wanted to know who was going to do the training

Several service departments were also added in later years to help support the function of the primary departments:

1. Engineering workshop
2. Finance department
3. Education and registry department

The Institute significantly contributed to the progression of international and national leather science with the following notable contributions:

- The elucidation of the structure of Black Wattle tannin (*Acacia mearnsii*) – including a 230-page book on the chemistry of the tannins (*Wattle Tanning and Mimosa Extract*);
- The early mechanisms of vegetable and chrome tannage;
- *Liripuff*, A patented process for applying synthetic resins to a novel range of impregnated fabrics for use in stiffening the toes and heels of footwear;
- *Liritan no effluent system*, which used wattle extract as a base instead of other tanning materials for the rapid manufacture of sole leather;
- Wattle extract used in the field of timber adhesives;

Every company wanted to know who was going to head the Institute

- *Liricure* - a patented preservation method for use on hides after animal slaughter which made use of antiseptics (including ethylene-diamine-tetraacetic acid, EDTA);
- The development of a new tanning method for shoe upper leather based on the use of mimosa (wattle) and aluminium;
- In collaboration with the Water Research Commission practical methods for tannery solid waste and wastewater management were developed.

The Institute was often referred to with very high esteem and was visited by international researchers.

3.4.3.3 Funding

The funding regime of LIRI changed over time. It was seeded using money that had been granted or guaranteed to it by four sources:

1. The wattle industry
2. The footwear industry
3. The tanning industry
4. The hides and skins industry

It was not uncommon for Shuttleworth and Gustavson (who were great friends) to argue at international conferences about chromium tanning mechanism.

It was through these funding streams (representatives of which sat on the LIRI Board of Control) that the initial capital was realised. Rhodes University College invested in the building infrastructural and land acquisitions.

Maintenance of the LIRI finances for the first 50 years was delicately balanced between government stipends and an injection of a considerable sum when the Council for Scientific and Industrial Research was created. LIRI was the first Research Institute placed under this umbrella. A strong case was made to move LIRI from annual grants, to five-year grants so that longer term planning was possible.

The LIRI membership was a great source of income for the institute with considerable monthly revenues coming from the tanneries and footwear companies. At one point, there were 250 members which helped provide a substantial source of maintenance budget. The membership gained great benefits with over 1,500 LIRI Research Bulletins being distributed to the membership. The tanners and footwear companies sent students who enrolled on three-year courses that included a block release (one week residential).

Roughly 50% of companies wanted to know who paid for the running costs.

Other courses were varied and revolved around diverse topics that affected the industry. One of the first books published was the definitive text on Personnel Management that maintained its position as the seminal text for well over fifty years.

The Institute consulted widely and its first remit was trouble shooting and testing issues in the tanning industry. These two functions continued throughout its nearly 60 years of existence.

In the 1950s and 1960s the Institute spun off a company called *LIRI Components* which handled the exploitation of the footwear intellectual property, particularly the *Liripuff* toe stiffening system.

Other cash injections from research grants occurred particularly when the Water Research Commission and LIRI teamed up to help tanneries comply with the increasingly stringent water standards that were gazetted in 1961.

No function of LIRI would have been possible without the hours of free time given to the institute by tanners, experts, academics, industrialists, volunteers; not to mention the free equipment, chemicals, and raw materials that were donated to the institute. These gratuities would not have been given to an institute that was not supported as highly by the industries it collaborated with or if it did not have the reputation that it held.

3.4.3.4 Strengths

LIRI created the following assets that the SA leather industry benefitted from: a substantial international reputation, a student alumnus with a substantial international

impact, researchers who provided high class content with local context, and numerous publications of LIRI research bulletins (a valuable, relevant resource for the industry).

LIRI also ran several block release courses that was very well regarded and valued in the industry, in addition to their Diploma programme.

The weak currency exchange rate, particularly in the late 1990s, made it a viable international study destination as a cost-effective place of study.

3.4.3.5 Weaknesses

LIRI did have several weaknesses: it had a very high non-earner to earner ratio, and in the latter years was no longer sufficiently aligned with government to benefit from support grants. The industry membership fees and other financial support was not sufficient to enable the level of research to be maintained, and LIRI may have had to consult the entire industry more.

LIRI had many infrastructural weaknesses: their footwear testing was a main focus but it tended to be delivered using older equipment that could not be used for automotive leathers. The equipment in the tannery was often donated, and thus was old and out of date as soon as it had been installed. LIRI did not have the capital to reinvest in their laboratory or tannery equipment.

LIRI had good links with Rhodes University, but over time the academics drifted apart and collaborations were lost. The administration and intermingling of LIRI and Rhodes staff and students were very kept separate.

Only 2 out of 5 leather companies wanted to know when it would be launched.

The environmental division of LIRI grew rapidly over the course of its history, but at the end failed through a lack of influence at municipal and government level.

Whilst LIRI over the course of time, boasted many great icons, at the end it had failed to succession plan its world-class researchers, and only carried national *gravitas*, which was not going to attract international funding or research fellows.

3.4.3.6 Opportunities

The opportunities were always to serve an industry that had the potential to grow. With innovative product and service design – LIRI could have lead the industry

rather than waited for the industry to come to it. The new LRI as proposed by **the dti** is ideally suited to take up this opportunity within the context of a modern SA, with policies designed to maximise revenue from high value product manufacture.

3.4.3.7 Threats

The international research centres would generally attract the big European and international funding streams. International students wanted to go to the two big names: Nene College (now ICLT) and Lederinsitut Gerberschule (LGR – now defunct) – they would have aspired to have the highest value of qualification.

Many of the research functions that LGR carried are now being done by the Central LRI (CLRI) and by Chinese Universities and LIRI would have struggled to compete with the Eastern organisations, or adapted to the needs of a changing and evolving SA industry.

3.4.4 Education vs. training (Lessons Learned from LIRI)

The global tanning industry has focussed on vertical skill development, i.e., it has aspired to get as many people to PhD level, rather than focus on horizontal skill, whereby practitioners have a wider depth of knowledge at a particular level of skill or understanding.

For example, within the tanneries and manufacturers, the leather industry needs people with an education level around NQF Level 6. The SA leather industry would benefit from a small number of PhD graduates to lead the proposed new LRI, but a flood of PhD-level tanning practitioners would not be the best benefit to the SA economy. Instead of adding more education levels to their skill set, the problem-solving part of any business requires that the employees know more facts, figures and have more practical experience at their level.

*7 out of 10 companies
wanted to know who was
going to pay for it*

LIRI's focus was to often to train people vertically up the NQF levels instead of focussing on more types of leathers and the complexity involved in making those.

LIRI did not focus enough on the lower levels. After the dismantling of apartheid, the national priority shifted to ensure that the foundations of education were available

to all. Adult basic education, and NQF Level 2 should have been LIRI's priority. Many leather companies expressed this during the interviews. The current SA workforce needs expertise on both ends: technical managers with higher degrees, and solid education and a wide base of training and experience at low NQF levels.

Tanners in the interviews often said:

"The real need in tanneries is doing the basic operations and doing them well"

3.4.5 Innovation vs. Research (Lessons Learned from LIRI)

LIRI focussed on pure research (some applied), and perhaps not enough on innovation that the industry could apply and which was relevant to the changing economic and political climate.

With a focus on commercialisation of the research, LIRI failed to recognise that they were not providing the innovation and technical management support that the industry needed. A LIRI for the modern SA needs to be able to provide services that can address management and technical concerns in a way that enables tanneries to manage and train production teams in the most efficient manner possible.

It is not easy for tanneries to pay or send people away to a school, so in an ideal world two things would happen: people with high cognitive requirements would be schooled formally – preferably at their own expense or possibly through a longer programme. Training (internal and external training) of operatives would then be done through in-house learnerships or apprenticeships and on-site training.

The use of block release courses, coupled with distance or blended learning would be an effective way of doing most the training in a way that can be balanced against tannery operational schedules.

3.5 SA leather industry skill set

The SA leather industry skill set is primarily based on practitioners who have learnt experientially through the trade (learnership or apprentice style), some who have graduated from university with science or commerce background and have "topped up" with leather knowledge and others who have graduated from one of the other international leather schools (LGR, or Nene College (now ICLT), or have learnt through LIRI or ISTT.

Raw SA wet-salted, pickled sheepskin, and pickled Cape gloves are well regarded internationally and generate good revenue. An attempt to add value to these commodities could result in good gains if the associated branding and perception of the value-added products are improved.

Recent funding from the FP&M SETA, have allowed ten students to attend the professional three-month residential, and nine-month blended learning MSc at the ICLT at the University of Northampton. These students will be able to increase, in a very short space of time, the knowledge within SA of international leather technology, and will hopefully disseminate this technology into their tanneries. Two of the students, were given accreditation of prior learning *in lieu* of having a BSc degree as it was judged that they possessed the correct level of technology and science (obtained from ISTT courses) to study at MSc level.

Some of the practitioners who have entered the industry have had science degree backgrounds, often chemistry. These members have gone on to make outstanding successes in their career within the Leather industry, and it may be that the LRI looks to chemistry researchers for class-leading research and collaborative expertise.

A classical education base generally provides a comprehensive skill set that allows higher cognitive problem-solving skills, entrepreneurial mindset, initiative, and very advanced network and information harnessing skills.

3.6 SA industry needs analysis – opportunities for the LRI

There are no qualified tannery engineering companies or tannery engineers within the SA leather industry. The box below illustrates the skills needs from SA tanneries, both in terms of trained and competent staff, as well as available consultants and research expertise.

This section presents some of the findings of the questionnaire and the recommendations and discussion on the interviews. Nineteen companies out of 112 sent the written survey have responded to the questionnaire, and their responses inform the discussion and recommendations in this section.



The areas in which a LRI could provide valuable data on and for the SA leather industry are listed and discussed below. A key point to keep in mind is that there is a clear need for leather tanning expertise and knowledge in the industry to become available to the industry. The LRI would be able to contribute to the expertise significantly through class-leading collaborative and applied research programmes, and through support for structured leather-related studies would increase the knowledge and skills level within the industry.

The primary challenge for the LRI in addressing each of the opportunities listed below is the development and sourcing of sufficiently skilled and knowledgeable experts to lead the LRI in the early years of development. As mentioned above, many experts in the tanning industry have come from chemistry or commercial backgrounds, and it may be that the LRI core expertise is drawn from a nucleus of staff who bring a

complementary range of skill sets into a single LRI to focus on supporting the leather industry.

The following are areas of research, educational deficit, and consultancy knowledge that could do with improvement in the SA economy:

3.6.1 Raw materials

The source, type and quality of the hides and skins in SA are often unique to SA (such as crocodiles and ostrich), and opportunities to maximise benefits from the hides are missed by industry due to lack of knowledge. The LRI could collate and provide this information to the industry, helping it to maximise value from each raw material within industry, and informing Government policy to support GDP development from the leather industry.

3.6.2 Animal welfare

The effects of animal disease and welfare on the hides and skins have been well documented, but the availability and reliability of the information within the SA context has been erratic. A LRI would be able to draw on expertise from academics

21% of SA companies were concerned about regional focus.

and industrial consultants in these areas to collate definitive information specific to welfare issues in Southern Africa, and to drive applied and novel research to address specific needs where existing research fails to provide answers.

3.6.3 Histology

Understanding skin histology and the structural defects of hides and skins and breed quality on final leather and their products is vital to being able to enter and sustain activity within the luxury leather goods market. The LRI would be an ideal vehicle for collating not only the data, but also information on local experts who can advise industry on and develop best practice. Further, the LRI would be able to identify the gaps in the industry's knowledge on the luxury leather goods market in relation to exotic leathers and drive research and development of systems to address the gaps.

3.6.4 Beamhouse

The LRI could collate information on the beamhouse preparatory processes, as well as help to identify who the people are in SA who have the technological and environmental expertise in relation to the beamhouse processes. The LRI could investigate how these can be best disseminated and possibly funded by government (and UNIDO if appropriate).

3.6.5 Tanning

The LRI would help to understand who the key skilled and knowledgeable people are within the tanning processes who can help the mimosa chemical companies and help stimulate those companies to

47% of leather companies use more than 5 chemical suppliers

More than 60% of leather companies use international chemical suppliers

More than 73% of leather companies use local chemical suppliers

represent SA more competitively. It may become a vehicle to help SA tanneries educate the SA and international consumer about chromium-free leathers, and to drive local research to implement new technologies.

3.6.6 Crusting

The LRI would be in an ideal position to help the SA leather industry to understand and capitalise on the new polymer tannages and in doing so achieve time and cost savings to drive higher profitability and GDP.

3.6.7 Surface coating

A clear challenge to the SA tanning industry is the skills and ability to be able to compose high specification finishes that meet automotive and high performance shoe specifications. The unique quality issues of SA leathers, particularly hides and skins showing defects because of rural livestock management techniques, will need unique finishing technologies.

3.6.8 Chemical suppliers

Chemical production is an area of the SA economy that has been a strength for many years. The momentum and experience of this can be used in future planning and prospects that can help local chemical suppliers produce cost effective chemicals for local consumption or export. The compliance with restricted substance and REACH compliance can be enhanced. The drive to build the SA chemical industry (**The dti**, 2016) will provide ideal conditions for collaborative research between the LRI and chemical research institutes.

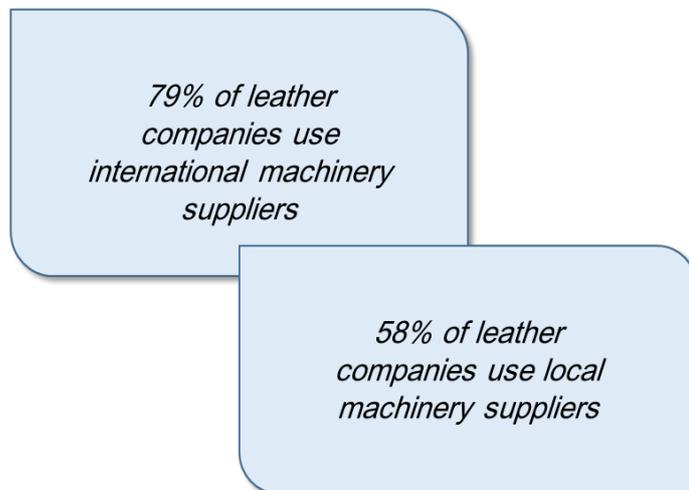
3.6.9 Exotic leather

The industry has unique opportunities when it comes to exotic leather production and associated innovation. The areas of greatest funding and potential lie in the crocodile and ostrich leather. An incredible amount of innovation and study need to be invested to allow SA to keep ahead of the rest of the world. The LCA of the exotics, Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) guidance, and the understanding of inherent properties are priorities.

3.6.10 Machine suppliers

Machinery manufacturers who can gain access to local stainless steel, Iroko hardwood (*Milicia excelsa*), and possibly newer technologies such as polypropylene can manufacture local vessels. With development and time, new machinery to match the thinning, buffing, and finishing operations could exist.

Synergies between the LRI and manufacturing industries would help the tanning industry to capitalise on the local industrial engineering and manufacturing expertise within SA.



3.6.11 Quality compliance

SA needs chemical and physical leather properties analysts who have the skills to comment on and suggest remedies for common tannery problems. The LRI would need to initially draw this expertise in from other fields of study,

16% of leather companies use local consultants

58% of leather companies would use a LRI for consultancy

such as chemistry, engineering or commerce, but in time would provide the ideal incubator for industry-specific detailed knowledge and expertise within SA to advise tanneries on the best means of managing and delivering quality to international class-leading standards.

3.6.12 Environmental compliance

The SA industry needs more skilled people who can advise on effluent issues, particularly with respect to the challenges unique to tannery effluent, and who can also aid on the civil engineering required in the control of water and air emission. The government (local and central) needs people who can advise on the monitoring and perhaps licencing of the tanneries to ensure effective take up of clean technologies. The LRI would be an ideal advisor to the government on recommendations for tannery effluent management policy.

3.6.13 Legal compliance

Many SA tanneries don't have access to resources to ensure that they are fully aware of the EU and global tanning related legislation that they need to understand to export materials. A LRI could support the development of this legal awareness within industry, the import/export knowledge on legislation such as REACH and CITES, and assist with taxation and international trade deal experts (government officials).

3.6.14 Business development

The industry has a current lack of skilled people who can help with the growing of the Broad Based Black Economic Empowerment (BBBEE) leather business community. Barriers to entry include financing, logistics, layout, production, customer

service, quality, technology, and performance monitoring. The LRI could provide information specific to tanneries, which would strengthen their business growth opportunities and lower or help to remove many of these barriers.

3.6.15 Manufacturer, retailer and consumer awareness

There is a clear opportunity for retailers to create consumer awareness of leather goods and the industry supporting it, including within school programmes, restricted substances lists (RSL), leather expectations and performance. Career guidance teachers and SET implementation could be put in place in secondary schools as career path investments in a future SA industry

3.6.16 Educators

The people to deliver these training courses will be key to the success of the LRI. They will need to be trained to the highest standard possible, and may come from a demographic of trainee teachers who never thought of a career in the leather industry until the opportunity was presented.

90% of the companies wanted to know who was going to do the training

3.7 Three possible institutional models

After the results of the questionnaire were analysed and after collation of the results from the tannery interviews it became clear that the industry could undergo three scenarios going forward. These are:

- Model 1 – Industry *status quo*
- Model 2 – Industry enhancement and international collaboration
- Model 3 – Leather Research Institute

Each model is presented in detail below, with a discussion on the strengths, weaknesses, opportunities and threats of each.

3.7.1 Model 1 – industry *status quo*

An assessment of the *status quo* (also referred to as the “do-nothing” option) allows a robust assessment of the business case of additional action (*Model 2* and *Model 3*) to be made and to ensure that the additional benefits are identified and

realised. The *status quo* option for the SA leather industry would include a continuation of the current levels and means of training, business support and research, without new investment in facilities or in the establishment of new industrial collaborations.

The *status quo* option will continue to rely on secondary-school level workers or university graduates (with no leather experience) who are taught through internal HR departments or through ISTT to gain technical insight. It also continues to rely on research and industry knowledge developed outside of SA and then adapted wherever possible for SA conditions.

3.7.1.1 Education and training

In the *status quo* option the industry will continue to follow the NSDS III that terminate in 2018, and will help to shape the NSDS IV that is currently in consultation. Leather workers in the system will skill-up given time and the leather industry will have a skills base that can produce most commodity leathers, but with limited value add. This will limit the ability of the SA leather industry to fully capitalise on the commercial value available through the leather industry on an international platform.

Industry associations (e.g., SHALC) could be given the mandate and funding to work with the FP&M SETA to help ensure better efficiency in the collection of skills levies and in the disbursement back to the tanneries on completion of successful training.

3.7.1.2 Research and innovation

The industry would continue to rely on research and innovation developed overseas, with small pockets of localisation and application of international research into the SA conditions. A lack of SA focussed research would limit the amount and value of any industrial innovation that is developed. The industry would continue to rely on indiscrete packages of bespoke research commissioned from international consultants and research bodies, supplemented by small existing indigenous research capability.

3.7.1.3 Testing and consultancy

The SA Bureau of Standards (SABS) would continue to be the primary SA source of testing standards. Most tanneries would continue to send samples and products for testing by bodies operating internationally and outside the SA economy.

3.7.1.4 Business case

The business case for the *status quo* option is the weakest option. The long-term outcome for the industry will be continued contraction and the eventual industry conformance to a raw material and semi-processed leather producing model. The impact on the profile shown in Figure 3-3 would be significant.

The capital needed for the *status quo* option will be negligible and the government funds allocated for development of the leather industry could be diverted to other industrial sectors. Employment could then be enhanced in those sectors that would absorb workers that may be forced to leave the leather industry.

The preparation of raw materials for export abroad is typically low skilled, and the focus of production in a *status quo* leather industry could simply be on volumes, mechanisation, and production efficiency. The amount of technical ability (equipment, control, training, and testing) required for adding value can result in excellent returns, if and only if, the resulting product will be sold for the highest possible price. Many producers who set out to add value, then find themselves unable to produce the required quality, end up having to cut margins or make a loss just to move their product.

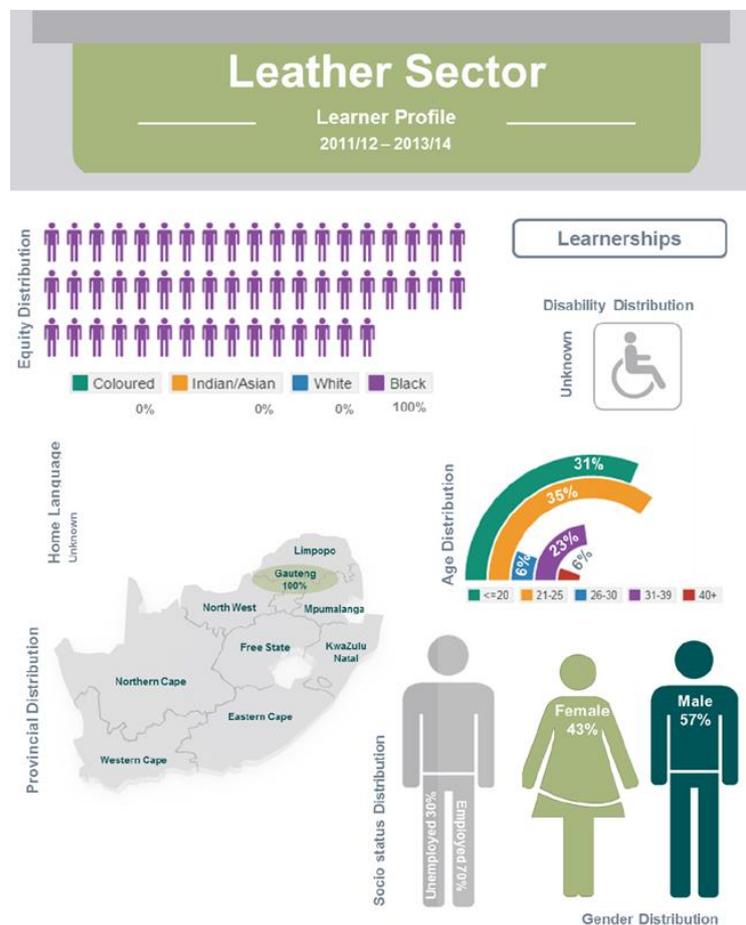


Figure 3-3: A profile of the clothing, textiles, footwear and leather sub-sectors, published by FP&M SETA

Value addition is also a risk, in that if inadequate technical ability is available to advise in the production of the final article, then the final product margins will be low and the raw material that could be exported (and sold) would also be wasted.

It must be stated that a nation's balance of trade will only worsen if the potentially-earning raw materials are converted into a lower value commodity and exported. In the financial feasibility part of this study, the investigators would be remiss in their duties to not investigate the loss of trade income if the current raw material value is lowered by poor value add.

3.7.1.5 Strengths

The major strength of the *status quo* is that the industry and government do not need to act on any interventions and money is saved.

The hides and skins industry can then focus on improving the inherent quality of the raw material and the producers who carry some raw materials into semi-processed materials can focus their production on techniques that are environmentally responsible and are maximally efficient. Government interventions could consist of focussing on the PIP and the CIP, for example through helping current tanneries to recapitalise their businesses and increase the level of technology they are currently using.

3.7.1.6 Weaknesses

The loss of leather workers from the industry would mean a further contraction of the industry, and if there was no alternative for these workers to enter, then they would contribute towards unemployment within SA.

Where there is potential to make more from the resources that are currently harvested in SA, then every opportunity must be made to exploit them. As per **the dti** sector data on trade flow, the value of raw cattle hides and sheep skins exported in 2015 from SA was R 3.7 billion and imported to SA was R 1.26 billion with a trade surplus of R 2.44 billion (Fig. 3-4).

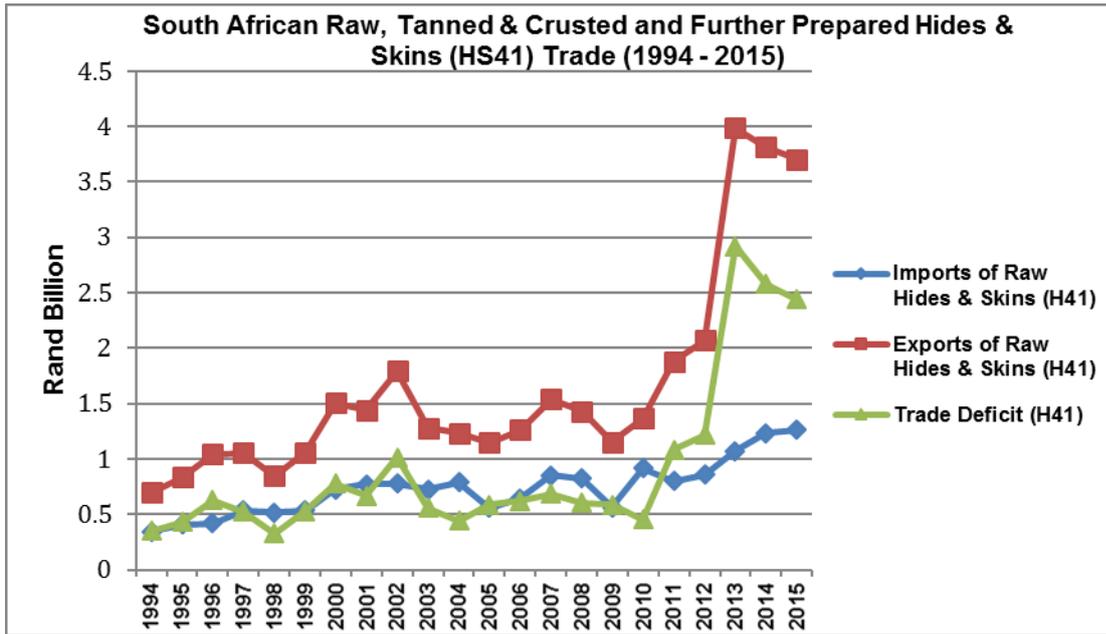


Figure 3-4: South African Raw, Tanned and Crusted and Further Prepared Hides and Skins (HS41) Trade (1994 – 2015)

However, **the dti** sector data on trade flow confirms that the value of products of leather exported in 2015 from SA was R 1.11 billion and imported to SA was R 3.32 billion with a trade deficit of R 2.21 billion (Fig. 3-5). Every percent of value added to these numbers will result in increased revenue for the SA economy.

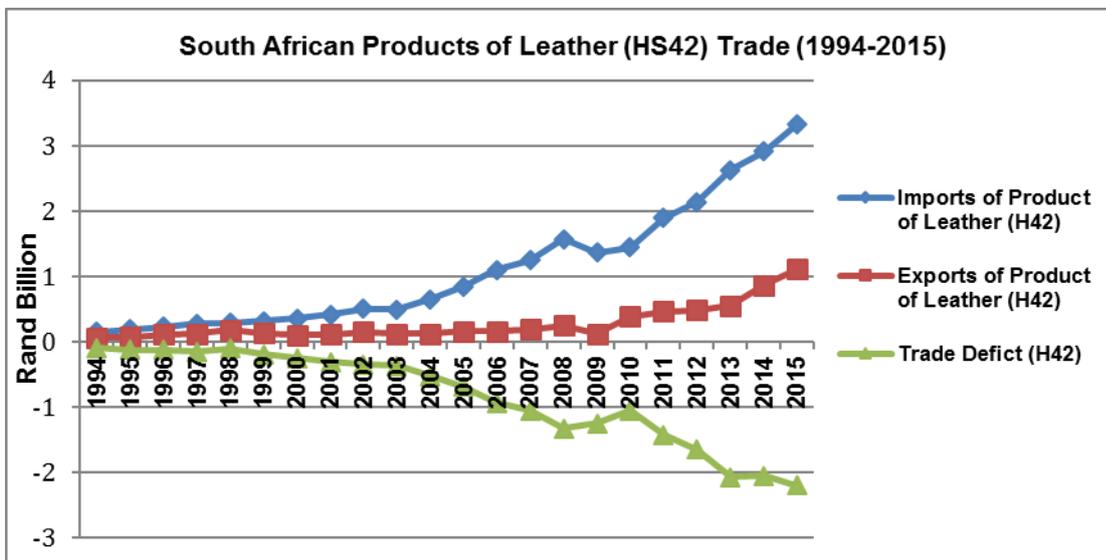


Figure 3-5: South African Products of Leather (HS42) Trade (1994 – 2015)

The ageing profile of the industry mean that the tanneries are going to continue to lose skilled and experienced practitioners if an institution is not available to ensure that new skilled experts are trained and grown for the leather industry in SA. These

losses will mean that as time moves on fewer people will be able to receive TVET at their current factories.

Under *Model 1*, the primary source of leather education is Dr Clive Jackson-Moss, through ISTT. Without a succession plan for SA, it is likely that ISTT will cease to trade when Dr Jackson-Moss retires (within approximately 10 years). Under this *Model 1*, the SA leather industry will lose the only independent, qualified TVET supplier for formal leather education. A *status quo* option can therefore be said to be a 15-year towards an under skilled leather industry. Early retirement of current skilled workers or suppliers (such as Dr Jackson-Moss) will expedite the problem.

ISTT and other independent training providers do not currently supply leather technology (and leather science) education and training to companies outside of the formal tanning industry. Footwear manufacturers and retailers do not have access to affordable, quality information that they can use to train their buyers and quality officers. Leather service suppliers cannot make leather-related offers without leather specific knowledge. Progressively, policy decisions and advice will be offered to policing authorities, such as customs and tax offices without accurate data to inform them.

Without local knowledge SA, will become increasingly dependent on international consultants and suppliers for their technical information both in terms of education and research to solve and address challenges that the SA leather industry faces. The dependence on overseas consultants will be costly and the dependence on external suppliers will result in biased information and results that drives very specific agendas that may not align with the SA ambitions.

3.7.1.7 Opportunities

There may be other opportunities with the *status quo*, in that the government or a private organisation may purchase ISTT and run it as a going concern. The leather industry could also purchase the school and equipment, and increase its training staff who would resume the duties currently performed by the school.

The coordination of the activities of the National Footwear Leather Cluster and the Exotic Leather sub-national cluster can be a national priority to satisfy the research, consulting and testing services available to the SA hides, skins and leather industry.

The current skilled workers in SA tanneries could take early retirement and would operate as independent consultants who could impart their knowledge and experience to the next generation.

In SA and abroad, distance learning materials on leather technology are in development. These materials could be purchased by HR Departments of the existing tanneries and would enhance the NSDS III framework that companies currently use. Tanneries could then use these materials in conjunction with their internal HRD to upskill their workforce.

3.7.1.8 Threats

The biggest threat arising from a *status quo* option would be the lack of options that a tannery would have in terms of their business model for growth. The competition that would arise from SA using one business model would encourage a monopoly on raw material and would reduce the technological diversity, further reducing long term value addition success.

A monochromatic flavour of industry in the Southern African region would allow the rest of Africa, particularly Nigeria, Sudan, Ethiopia, and Kenya to pull ahead in terms of ability and credibility of their leather industry.

3.7.2 **Model 2 – industry enhancement and international collaboration**

In this model the local tanning industry would not invest in a physical new institute, but would enhance the provision that is currently being run in tanneries, private institutions, and the existing leather research and entrepreneurship centres to create a co-ordinated programme of delivery.

3.7.2.1 Education and training

Tanneries would continue to use the SETA platform as per NSDS III and future NSDS IV for maximum returns for the leather and taxidermy industry.

Companies would continue to develop learnerships and internships internally, and in partnership with the FP&M SETA. These employees would be able to learn and develop within factories and would gain the practical experience that these schemes encourage. More work could be done on the practical tasks required within learnerships and the industry standards applied in the learnerships could receive wider industry consultation and revision.

Additional training providers that can cover leather and non-leather materials would help to create healthy competition to ISTT (and other organisations). Investment from government/industry could be used for part or complete ownership of ISTT and/or the development of other training facilities such as those provided to the footwear industry by the NFLC.

Tanneries and taxidermists could see a paradigm shift in their organisations in terms of how they handle their internal training. An effective shift in their company HR to a HRD function is a pivotal exercise in the investment in people. Human resources, like equipment, needs constant maintenance and improvement to ensure peak performance.

The industry could increase the diversity of courses offered by local universities to provide graduates with options to get leather “top up” degrees in overseas institutions. The use of international scholarships and subsidies has been identified (by UNESCO) as one of the critical elements in the improvement of education, particularly in Africa (UNESCO, 2016).

In *Model 2* there needs to be an enhancement of the local SLTC to facilitate more effective information dissemination, such as the creation of local and regional databases, that tanneries can tap into.

3.7.2.2 Research and innovation

The research and innovation within SA would be delivered through an enhancement of the existing capability, such as that offered through the ELRC, in collaboration with international partners. Specific government funded projects could be identified that are targeted to enhance the SA leather industry, and then structured for delivery through SA organisations in collaboration with international expertise.

3.7.2.3 Testing and consultancy

The SABS, NFLC, and ELRC could both enhance their service provision to include testing and consulting services available to the SA industry. Where these two organisations are not able to deliver, further support and options would be available through working with international testing and consulting organisations.

3.7.2.4 Business case

For the *Model 2* scenario, **the dti** would have to include the above structures in the IPAP intervention as a cost-effective option that would acknowledge the existing

training capabilities and resources at ISTT and consulting and testing potential in the SABS, NFLC and ELRC. The business case is predicated on optimal use of organisations that are already in place rather than investing in new ventures that have a chance of failing if initiated.

The new IPAP iteration could be managed by industry programmes, such as the national cluster and sub-national clusters and could be funded from various programmes from **the dti** and other relevant Government departments.

Savings made from the lack of infrastructure investment could be used to invest in people development and business development.

3.7.2.5 Strengths

The *Model 2* option would not require the construction and equipment to provide a dedicated facility including the maintenance, and on-going cost of running a facility.

The finances could be recapitalised into the people-skill development that the industry requires. The funds already allocated through the FP&M SETA could be added to the funds saved from the IPAP and could be used broaden the training provision and to provide capital investment in the improvement of local training facilities for those learners.

Local infrastructure, including regional training centres (at leather hubs) would make use of central classrooms (with facilities/equipment) that could allow on-site training. An excellent example of how this could work is seen at the Eddels Footwear Cluster in Pietermaritzburg. Local training centres would allow a small number of national trainers to move to the learners and not the other way around.

Further to regional training centres there could be leather sub-national cluster facilities that have marginally more paraphernalia and training equipment that could be in places that allow convenient transport of learners for block release courses (with or without visits to local tanneries for real world examples of the technology in motion, see Figure 3-6.)

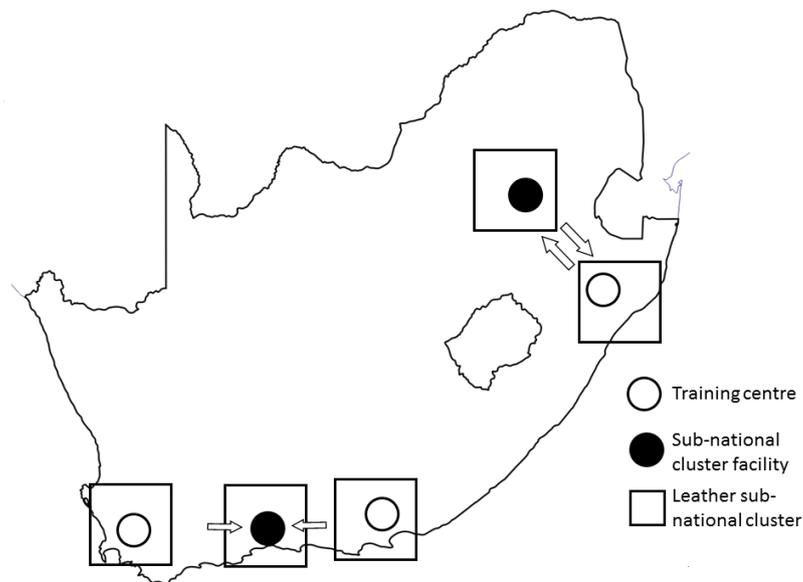


Figure 3-6 A map of South Africa showing how sub-national cluster facilities could link the four major industrial centres of the country.

The facilities within the VUT and the UP could be used to coordinate activities from within the remit of the NFLC and the ELSA and host research supporting the SA leather trade industry. Their existing research facilities and staff would form the backbone of the leather *Model 2* support structure rather than developing an institute-based core of leather experts, research facilities and equipment.

Students studying abroad will learn international examples and will widen the connections and networks that people value so highly in the leather trade. Students learning in a European tanning school will understand EU compliance and will assist them in their ability to export to Europe. SA learners would often be hired abroad and the international reputation of the SA leather industry could be enhanced.

A final strength is that a new structure of trainers and LRI institutional staff will not have to recruited (with the expense that that would bring). The *Model 2* option would not require more governing bodies than what is currently represented in the country which would allow the existing organisations to grow and mature.

The existing research facilities in current structures could be enhanced and improved using current interventions, using current employees and the result could be an immediate response to current industry needs.

3.7.2.6 Weaknesses

A major weakness of this option is that the SA infrastructure and innovative knowledge will not improve, except for the establishment of the training centres and the sub-cluster facilities. There will not be a focal point for the national industry, in the form of a facility, that could allow the industry to collect and meet. Leather resources and experts would have to exist as a virtual collection that would move around the country and work in collaborative models from within disperse organisations.

The education of learners outside of the country would have the negative impact of resulting in the purchasing of foreign exchange and the effective contribution to the national trade deficit. The exposure of students to international companies could act as a conduit for the continuation of skilled workers leaving the country.

A virtual education and training platform is challenging to market to overseas students, so the *Model 2* option would be expected to miss out on revenue from potential international students.

The lack of focussed research and consultancy skills would mean that there would be no direct conduits for research funding and targeted institutions that could handle national/strategic projects. The reliance on private contractors and high barriers to entry for research laboratories would result in fewer, possibly biased opportunities.

3.7.2.7 Opportunities

More people would be trained and up-skilled using the *Model 2 option* in comparison to the *Model 1 option*, and the local leather trade would receive a more immediate boost in technical ability. The technology level would also increase in the short term as the influx of overseas expertise would accompany the students back to SA.

Network opportunities made through the international connections would help to boost the leather and final leather article export opportunities. International chemical and machinery contacts would help to boost the SA technical abilities.

Regional training centres could be used by the communities they are in as community venues and other opportunities/programmes could be facilitated.

A virtual infrastructure is a cheaper long-term option in terms of maintenance and it could be franchised into the southern African region or further north into sub-Saharan Africa.

A focus on the up-skilling local people rather than infrastructure allows the movement of those national assets temporarily into other parts of the world as service providers. The effective exportation of these services will enhance the balance of trade and would act as an effective marketing opportunity to other countries, encouraging potential skilled leather workers to work in SA.

The improvement of the basal education of the leather workforce allows for greater quality and efficiency in tanneries. The SA leather producers, given enough resource and backing, could begin to lead the global leather industry in certain niche areas.

Model 2 results in support for existing local companies. The research, consulting, and testing capabilities of the private companies could be enhanced. Less government money could have been spent on these companies, with possibly better returns on investment, in shorter time periods.

3.7.2.8 Threats

Investment in people without corresponding infrastructure investment is a risky strategy as ultimately personnel seek the best possible opportunities for themselves and will often leave an industry (if they are capable) or will leave the country if international demand is high enough. Two counters to this are: 1) that SA geographically makes migration more difficult (and the exchange rate makes it costly); and 2) that if an international surplus of trained people occurs then the overseas demand will dwindle.

There is a risk that the leather and footwear industry would view the adoption of *Model 1* and *2* as a deficiency in government support, and as evidence that it is unable to re-energise an industry in need of help.

Failure to invest in the SA leather testing, consultancy, and research will result in the SA academic knowledge falling further behind international standards.

3.7.3 Model 3 – Leather Research Institute

In this model, the industry will rally around and champion a leather research institute, in the same manner as the inception of FABRI at the University of Pretoria. Lessons can be learnt from the historical execution and running of LIRI and the new institute will be industry led (preferably by a Board of Control).

The LRI would be a bespoke hub for leather research, focussed on challenges specific to the SA industry, such as rural hides harvesting, exotic leathers, and maximising the value of products within SA before export. The LRI would collaborate with existing organisations such as the NFLC, the entrepreneurship hub in KZN, chemistry departments, economics departments, and manufacturing and engineering departments throughout the industry to deliver a cohesive programme of delivery for the industry.

3.7.3.1 Education and training

The data received from the industry interviews overwhelmingly showed that the highest demand training priority was for NQF 4 and below. The LRI would have the opportunity to collaborate with ISTT and/or develop bespoke NVQ level training, as well as develop programmes with SA universities to allow degree “top up” facilities to create leather-specific modules for science, engineering and commerce degrees. This would instantly create a strengthened leather education capacity within SA by drawing on the expertise and know-how already embedded within the economy.

An initial role of the LRI would be to coordinate or direct the creation leather specific training material at a range of educational levels, along the lines of those developed by research and education facilities that operate on an international level and described in

The majority of leather companies cannot find the expertise they need

Section 5.3, and ensure that they are tailored to the SA economy, hides and skins, and technologies to allow maximum benefit to be realised within and for the growth and success of the SA leather industry.

3.7.3.2 Research and innovation

International leather research resources are slowly declining. Departments that have the expertise and infrastructure to undertake leather research are in slow decline. Covington (2012) illustrated that a slow global decrease in the number and calibre of leather scientists is contributing to meaningful impact from leather research.

The funding streams for large leather projects are smaller than what they were 20 years ago. There have been Framework 7 EU projects undertaking leather research work on biodiesel from fleshings, footwear developments (memory leather, end-of-life recycling of shoes) and waste management projects. Current Horizon 2020 funding for leather projects include:

- Intelligent footwear for common footwear problems
- The use of enzymes in manufacture
- Leather composites in perfect fitting footwear

The economic situation in SA has resulted in many consultations on the need for highly specific research and understanding. **The dti** have identified in IPAP 2016/17 2018/19: a local need for natural or vegetable dye for leather; an understanding of increased regulation of hides and skins; and greater beneficiation of raw materials in value chains.

In the future, other national priorities will arise, and it is in the national interest to ensure that local expertise is available for consultation, advice, and as a source of know-how. There are many examples of instances where local industry expertise is required for national emergencies or government interventions some are given below:

3.7.3.3 Case study 1 – Avian flu (2011/12)

In 2011/2012 the SA ostrich industry was devastated by an outbreak of avian influenza. The H5N2 strain outbreak resulted in an estimated 50 to 100,000 birds that were destroyed and due to export bans the loss to the industry had a serious impact on the local economy.

The trade of ostrich skins was also affected due to the age of the birds and the size of their skins, and the exportation of correctly tanned skins was hampered by a lack of information on the effect the processing would have on the virus.

Both the farming and manufacturing industry were affected by the bird flu outbreak and the Western and Eastern Cape, where most the ostrich tanneries are located were greatly affected by the loss of revenue. Consequently, major ostrich tanneries have diversified their product range to ensure that safeguards against substantial loss of revenues in the future will be in place.

3.7.3.4 Case study 2 – Hide/skin export strategy

As outlined in **the dti's** IPAP 2014/15 2016/17 document and the Silimela (2011) report, a need has been identified for hide export controls to be able to provide incentives for the value addition to SA raw materials.

The report gives good evidence of customs controls that many countries enact: from the imposition of taxes (up to 60% levy), through to outright bans. The Silimela report is very comprehensive in explaining the situation and has done excellent background research. Strategic consultations with the industry on the restriction of raw material have also been made. The implementation of government policy on an export ban is complex and would always benefit from further leather research, particularly economic and market research. The hide/skin export strategy is also a symbol for the need of continuous industrial research that helps progressive governments make informed and sustainable policy.

3.7.3.5 Testing and consulting

Table 3-1 gives a list of the major accredited test laboratories for the leather and footwear industries. Of course, there are smaller laboratories that provide testing services, but they are generally not accredited, renowned, or large enough to cope with international level demand. Testing, particularly high performance testing, requires specialist equipment that is expensive to purchase and maintain.

The support services that accompany any manufacturing industry are often downplayed in the importance of their role. The industry will need assistance in many areas that are not classified as direct industry functions.

To be able to increase the number of service providers in any industry, a national strategy must be to create an oversupply of skill, so that highly skilled people see running their own businesses as an alternative personal strategy. If human resources are in too high a demand the financial attraction of the factories will take them back into manufacture.

Table 3-1 A list of accredited international and national test houses

Country	Name
Global offices	Intertek
UK/China	BLC
India	Central Leather Research Institute
New Zealand	Leather and Shoe Research Association
USA	Leather Industries America
USA	United States Hides, Skin and Leather Association
UK/China	Shoe and Allied Trades Research Association
Germany/Global	TUV SUD
Germany	FILK
South Africa	South African Bureau of Standards
Brazil	BIMEO
UK	SGS

University and research institutes that are distributed globally will have testing equipment, or teaching test equipment that could be used for indication purposes, but they are generally not accredited or provide a commercial service. Many African institutes advertise testing services on the web pages, but during the SA tannery interviews none of the respondents interviewed said they use African test houses commercially.

A SA LRI would benefit from being able to offer a commercial, accredited, test facility offering the services described below.

Environmental services and testing

The SA environmental industry has an international reputation as having high quality, up-to-date methodologies and excellent research abilities. The Water Research Commission has done outstanding work, together with the Department for Water Affairs (now Department of Water and Sanitation, DWS) on improving tannery emissions.

Before its closure, LIRI attracted a lot of Water Research money and worked closely to improve tannery performance.

Leather performance testing and services

This is wanted particularly by the automotive companies, but could also benefit the shoe companies. Having access to reliable and consistent leather performance

testing services would allow tanneries to understand their leathers and opportunities to boost performance through production to specification. Performance testing services would also allow innovative tanning technologies and recipes to be tested and quantified.

Health and safety and labour relations services

The LRI could create an environment where the bargaining council, the employer's association and the trade unions operate together to boost productivity of tanneries. An opportunity for SA tanneries do more to improve their CSR/CSI effectiveness by collaborative work.

Export compliance services

The LRI could curate opportunities for SA tanneries to export into Africa and further afield, potentially providing legal, advisory or even financial support to help businesses realised these opportunities. The LRI could have staff who could go about advising tanneries on how to do this.

CITES services

With the rise of exotics in SA the LRI could work with conservation groups to ensure that natural species are still being protected, while providing certification for hides that are legitimately tanned. There's scope for the LRI to provide or support the development of forensic and scientific infrastructure to support the protection of endangered species. Further, the LRI could develop working partnership with key conservation groups and tanneries to provide exotic leather specific tourism opportunities, perhaps linked with the wild game and hunting industries.

Leather mark and leather legal dispute services

The LRI could provide additional support to industry bodies like SHALC which would benefit from more government support in terms of how they go about enforcing the leather mark. Forensic training and facilities are being used on the international leather markets, and a SA LRI could put these in place to allow retailers and leather suppliers go to an independent ombudsman who can settle legal disputes, such as the legal definition of leather and the measurement of area in a hide.

Government advisory services

With active memberships from industry and ongoing liaison with key players, the LRI would be ideally placed to provide industrial advice on Government policies.

The LRI would be able to help inform interventions and then test the effects the interventions have independently, contributing towards transparency of interventions and competitiveness.

Retail and consumer advisory services (or protection)

The consultants and technical experts at the LRI would be actively engaged with the Consumer Science department at UP and they collectively could form an invaluable service for retail consortia and retail SMME.

The provision of advice on leather types, material expectations, restricted substances, international trends, aftercare, and circular economy can all form part of an income-generating service. If necessary, these services can extend to legal duties in cases of arbitration or in civil dispute between retailer/consumer; or supplier/retailer.

3.7.3.6 Business case

For *Model 3*, **the dti** has set aside a fund which would become available to the development of a LRI should the industry decide that it is appropriate.

The FABI Business Case, particularly in the first years, relied heavily on the research funding streams, both from industry and government. Similarly, the LRI would need to start off with a well-constructed research programme fully supported by government and industry to allow a conservative start from which it can develop a reputation and build on success, steadily building a solid research, educational and advisory expertise.

3.7.3.7 Strengths

The LRI would offer immediate strengths to the SA economy by providing security to the SA industry that Government has a long-term vision for the growth of the leather industries. The LRI would be able to tailor the education (as well as research and consultancy) to the specific cultural and industrial settings within SA. Similarly, research and Education would be tailored to the hides, skins and exotic leathers unique to SA.

The LRI would facilitate the development of an international reputation, drawing in potential interest, business and clients from other currencies. The support that a stable LRI would provide would enable the link between tourism and the leather industries to be exported and exploited.

The LRI would be able to create educational links with schools, helping to draw school leavers into the industry as well as help to create an educated staff base for the SA tanneries. These activities, and opportunities would be supported and informed by research that the LRI could undertake.

3.7.3.8 Weaknesses

Challenges facing the institute are primarily around finances and skills and would include that the LRI will need to become self-funded in time. This will mean that the financial feasibility will need to address potential income sources such as student fees, industry memberships, consultancy, international research collaboration and grants.

A board of suitably skilled and interested experts will need to be drawn together to run the LRI. The diminishing skills within the SA and global leather industry will make this a challenge.

In order for the LRI to succeed, it will need to gain industry buy-in. The survey indicates that most tanneries would support a LRI for training, consultancy and/or testing services were it available, subject to costings.

The LRI would therefore need to ensure that it is financially deliverable while remaining competitive enough to repel the inevitable competition from overseas facilities. This would be offset by the specialism in exotic leathers, particularly African leathers that the LRI would create. It may be challenging to recruit and find the skilled staff to head and run the LRI.

3.7.3.9 Opportunities

The LRI would be able to attract African students from southern Africa or even further afield. International students may be attracted to the exotic leather training, bringing foreign currency into the country and further strengthening an international reputation from within the LRI.

The LRI would be able to help steer and guide the future of the SA leather industry, ensuring that the activities within the industry are collaborative, bringing mutual benefit to all sectors within the SA industry.

The LRI would be able to advise government on future and current policy development, ensuring the best for industry and the country as a whole, and it would

be the focal point of contact for the collection and disseminating of trade statistics and information, either through subscriptions or through consultancy services.

The LRI would be able to provide information, advice, training and support for tanners to improve and increase their own productivity and profitability, and/or to ensure that the services are available within SA by the strategic development of coordinated activities tailored to the SA economy.

In time, the LRI should develop into an international centre of expertise. The institute may be called on to provide training and consultancy expertise to countries outside Africa, further boosting the profitability of the Institute.

3.7.3.10 Threats

If a longer-term strategy (*Model 3*) is adopted in favour of a capital injection into people and existing assets (*Model 2*) the industry may find that it continues to decline in the short term while the staffing and infrastructure is established.

Further threats to the success of the LRI would be:

- The ability to find a suitably qualified and skilled leader
- Failure to sustain itself beyond the initial funding period.
- The slow start and initial challenges in finding staff and developing skills/expertise may result in a risk that it is cancelled before benefits realisation has a chance to kick in.

3.8 Technical conclusions

The technical details of the educational, research, and technical services have been covered above. A rational assessment of the resources available in SA have been given. It is fair to assume that, as **the dti** have identified, the resources have been threatened, but timely interventions are now in place to address these. Three models that advise on technical strategies are identified and will be fleshed out in the Operational Section below. They are summarised below.

Model 1 would possibly demonstrate a lack of action, even though it may be economical. The *Model 2* is an option with more action than the *status quo* option, but it still lacks the long term thinking that countries with industrial ambitions need to have. *Model 3* offers the best long-term developmental action, but with a high lead-in time and investment requirement.

4. Part B - Legal

4.1 SA statutes outline relevant to this feasibility

The level of attainment, quality control and standards of education in South Africa are maintained by the SA Qualifications Authority (SAQA).

SAQA enforces the National Qualifications Framework Act 67 of 2008 and ensures that all formal and informal education establishments conform to nationally prescribed standards. SAQA is also responsible for the National Skills Development Framework, which include the National Qualifications Framework (NQF) levels. SAQA publishes the level descriptors to training authorities for implementation. The NVQ Framework is provided in Appendix 4.

The DHET also enforces and facilitates the Skills Development Act, 1998. General reference will be made to the standard of education and an outline of NSDSIII and the NQF structure in general.

4.2 Educational and research statutes and guidelines

There are several statutes and guidelines that affect the operation of research organisations in SA.

4.2.1 Higher Education guidelines and operating frameworks

SAQA is well-recognised nationally and internationally, focuses on upholding the principles of the National Qualifications Framework, including ensuring access, quality, redress and development for all learners through an integrated national framework of learning achievements.

National Skills Fund (NSF) is a public entity that is set up to give guidance to the Minister of Higher Education and Training on:

- policy, strategy, implementation and NSF allocations
- liaising with SETAs about policy, strategy and sector-skills plans
- implementing the NSDS
- reviewing the accounts and balance sheet of NSF annually
- receiving and using information from the Skills Development Planning Unit.

A positive growth in employment of registered employee from 13,296 in 2012 to 15,996 in 2015 in the leather and footwear sectors was registered due to the efforts of the government and Industry (Fig. 4-1). Such growth in employment signifies the need for developing sector specific skilling systems and infrastructure in SA.

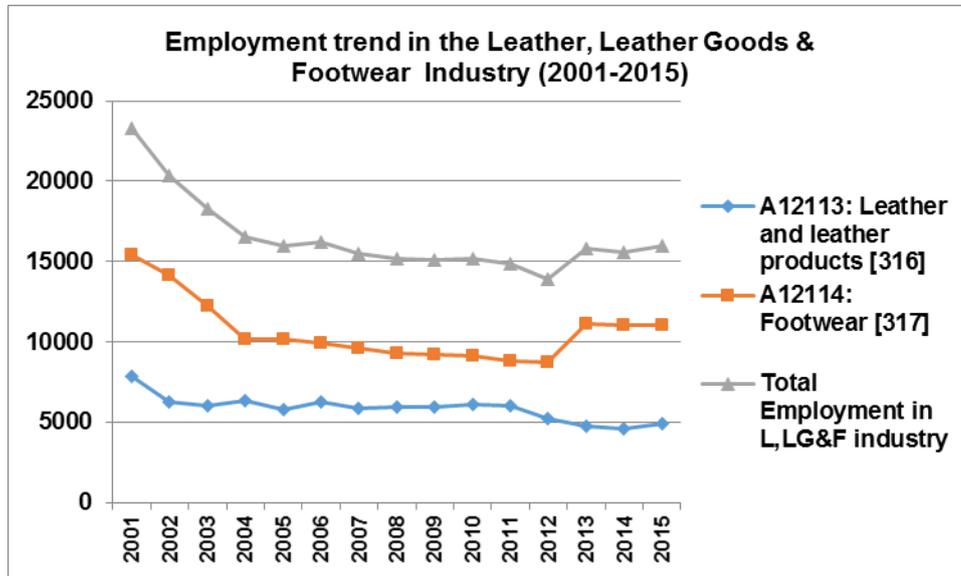


Figure 4-1 Employment Trend in the Leather, Leather Goods and Footwear Industry of South Africa (2001- 2015). Source: The dti.

As per **the dti** sector data the annual value added by the leather and footwear industry grew by 46.8% from R 1.96 billion in 2011 to R 2.88 billion in 2014 (Fig 4-2).

4.2.2 Sectoral Educational and Training Authority

Skills development has been identified as a key requirement for economic growth in SA and for the economic empowerment of the previously disadvantaged majority.

SETAs are responsible for the disbursement of training levies payable by all employers in the country. Part of the objective of the SETAs is to ensure that the skills requirements of the various sectors are identified, and that the adequate and appropriate skills are readily available. They are required to ensure that training is of the appropriate quality and meets standards as laid out by the national framework.

Leather falls under the Fibre, Processing and Manufacturing (FP&M) SETA, and as such certain activities of the LRI would need to become accredited by the FP&M SETA.

4.2.3 National qualifications framework (SAQA requirements)

The functions of SAQA, and the ambit of its authority, are set out in Section 13 of the National Qualifications Framework Act 67 of 2008. The objectives of the NQF are as follows:

- To create a single integrated national framework for learning achievements;
- Facilitate access to, and mobility and progression within, education, training and career paths;
- Enhance the quality of education and training;
- Accelerate the redress of past unfair discrimination in education, training and employment opportunities.

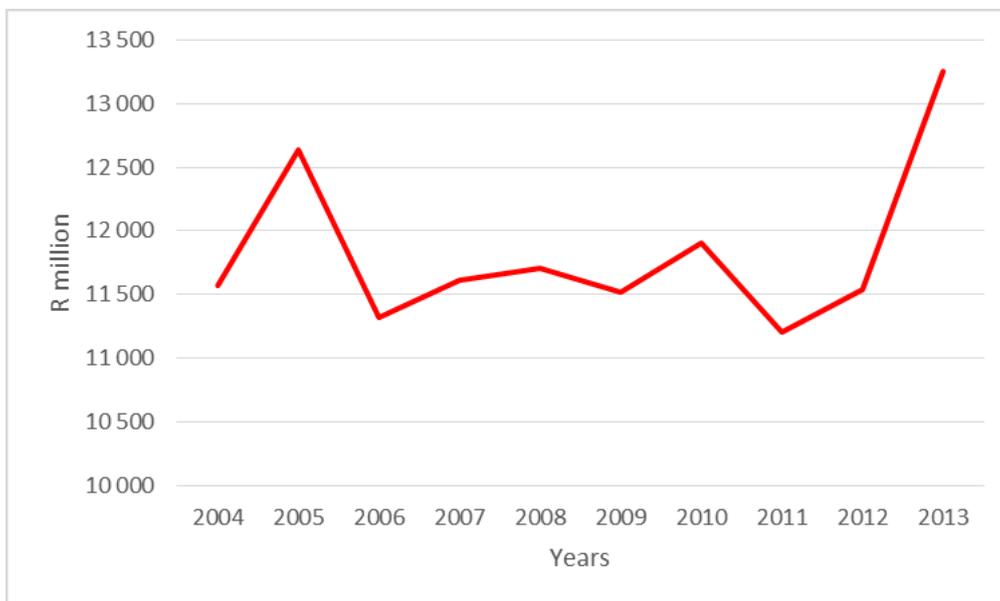


Figure 4-2 Annual value added by the clothing, textiles, footwear and leather industries and GDP figures (2004-2013).

The objectives of the NQF are designed to contribute to the full personal development of each learner and the social and economic development of the nation at large.

Part of SAQA's remit is to provide verification of qualifications and achievements, other than short courses, foreign qualifications and professional designations. As such the LRI would need to seek accreditation for any NQF-related courses.

4.2.4 Umalusi

Council for Quality Assurance in General and Further Education and Training. UMALUSI is the quality assurer in the general and further education and training bands of the national qualifications framework (NQF). The Council ensures that the providers of education and training have the capacity to deliver and assess qualifications and learning programmes and are doing so to expected standards of quality.

4.2.5 Adult basic education and further education requirements

For official purposes, the Department of Education has defined ABET as follows:

Adult basic education and training is the general conceptual foundation towards lifelong learning and development, comprising of knowledge, skills and attitudes required for social, economic and political participation and transformation applicable to a range of contexts. ABET is flexible, developmental and targeted at the specific needs of audiences and, ideally, provides access to nationally recognised certificates.

ABET grew out of adult literacy work. The adoption of ABET rather than adult literacy work was the result of political struggle informed by research. In spite of fine achievements of adult literacy work in the struggle, literacy alone was not considered adequate to support real social transformation. ABET was meant to offer an appropriately adult route to a general education aimed at making a significant improvement in quality of life.

The LRI would be able to qualify as an ABET trainer, particularly for NQF level 4 or similar courses and short courses.

4.3 Legal conclusions

SA has a well-developed educational framework to support education within the country at all levels from basic literacy through to postgraduate levels. The framework therefore exists to support and potentially part-fund the LRI training courses and activities, particularly where they are demonstrated to provide value add to the national GDP.

5. Part C - Operational

5.1 Leather institute operating frameworks

The way in which the institute was to operate was one of the most commonly dealt with topics discussed during the surveys and interviews. To assist with this, it is useful to look at other people's standards and see if they can apply to a local context.

5.2 Benchmarking

Benchmarking in the leather industry is not a common occurrence. Very few benchmark standards, particularly for leather education exist. In their 5-yearly periodic subject review, ICLT is given exemption by the university quality assurance team, for not having a reference to industry benchmarks - because none exist.

5.3 Leather education benchmarking

One way in which industrialists/educationalists can get around the relative lack of leather education benchmarks is the use of materials science benchmarks. The 2008 Quality Assurance Agency (QAA) materials subject benchmark is provided at Appendix 6 or can be accessed from the QAA website (QAA 2008).

This benchmark includes materials related knowledge and skills, scientific and engineering related knowledge and skills, general engineering principles, and generic skills.

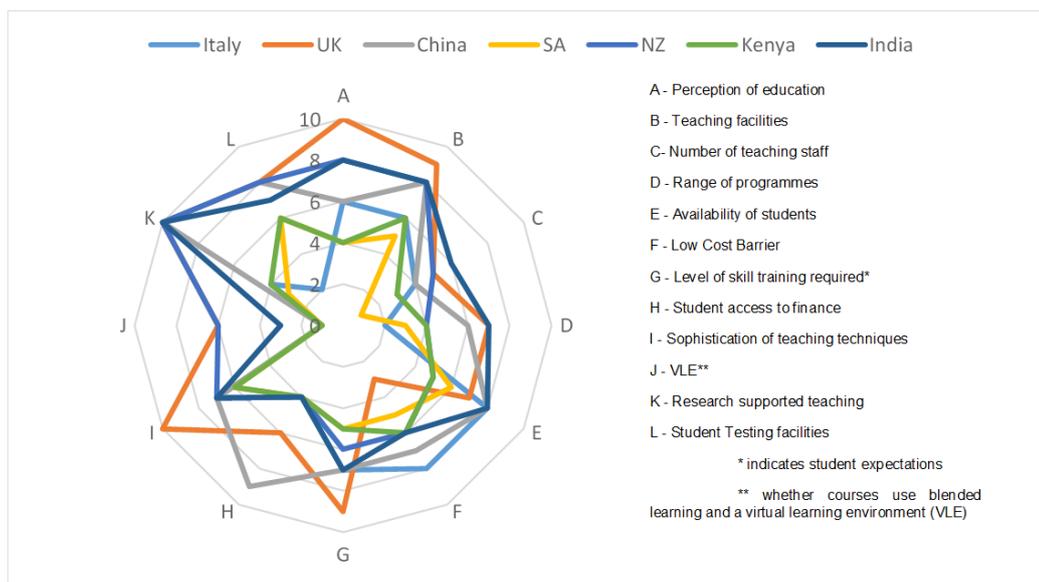


Figure 5-1 Benchmarking and gap analysis of SA's current leather education and training facilities. (Based on modified Delphi method)

The benchmarking gap analysis in Figure 5-1, illustrates that SA has a marked gap in the number of teaching staff, and a low uptake of virtual learning environments. By comparison, SA's strengths are in teaching and student testing facilities, and the availability of students.

This gap analysis, combined with level of interest from the leather industry during survey, indicates that staffing will be one of the biggest challenges to the success of the LRI in SA.

5.3.1 Leather research benchmarking

The Forestry and Agricultural Biotechnology Institute's (FABI) highly successful model, could be used as the way in which the UP could run the LRI.

The institutional objectives of FABI, taken from their last biennial report, could be used to help formulate the benchmark objectives of the LRI (quoted from FABI 2015).

"The primary objectives of the Institute are to:

- Promote the broad field of plant biotechnology through an interdisciplinary approach and with close linkage to a wide range of academic departments.*
- Undertake research of the highest possible calibre, while at the same time providing short and longer term benefits to the forestry and agricultural sectors of SA.*
- Establish partnerships with industries linked to agriculture and forestry, both nationally and internationally, to produce new and improved products and thus to promote competitiveness in trading.*
- Promote the education, particularly of South Africans, in the fields of forestry and agriculture."*

Similarly, the objectives of the LRI could be to:

The Leather Research Institute (LRI) is located on the campus of the University of Pretoria. The primary objectives of the Institute are to:

- Promote the broad field of leather technology through an interdisciplinary approach and with close linkage to a wide range of academic departments.

- Undertake research of the highest possible calibre, while at the same time providing short and longer term benefits to the leather and footwear sectors of SA.
- Establish partnerships with industries linked to leather and footwear, both nationally and internationally, to produce new and improved products and thus to promote competitiveness in trading.
- Promote the education, particularly of South Africans, in the fields of leather and footwear.

In 1998, when FABI opened, the research output was as to be expected, modest (see Figure 5-2), but indicative of the intentions of growth in years to come. FABI was formed out of a need to help improve the Forestry and Agricultural sector through scientific inputs. This seems like an appropriate correlation with the re-establishment of a LRI, which follows the reason for the establishment of LIRI in 1941

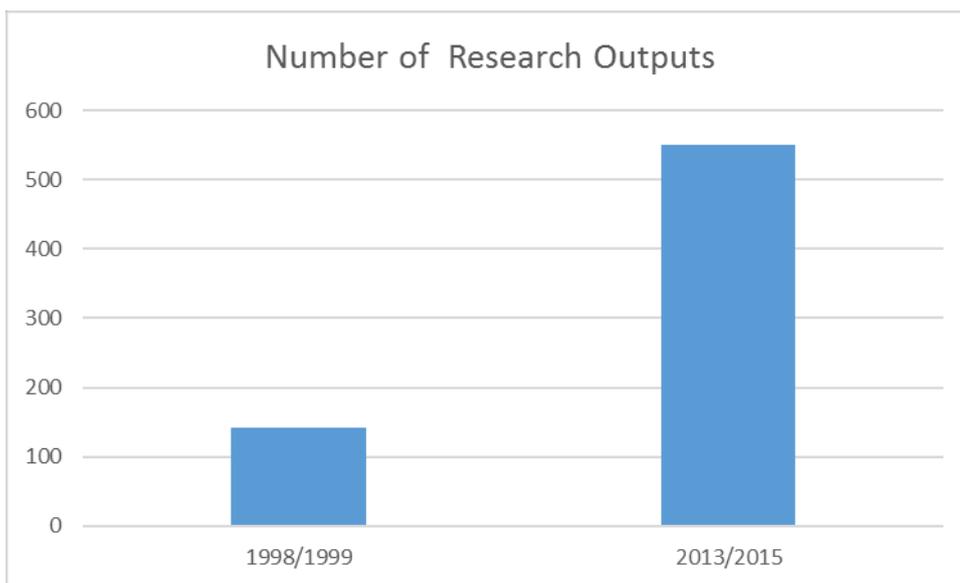


Figure 5-2 A comparison of the research output of the Forestry and Agricultural Biotechnology Institute (FABI), University of Pretoria, showing data from the start (1998/99) compared to the latest report 2013/15 (FABI 2015)

5.4 International and national education/training markets

Not long after the turn of the 20th Century, the UK had three establishments that handled the national and international education and training of leather technologists and technicians. The Leather Department (later known as the Proctor Departments) at Leeds University; the Leathersellers Training College (located in Bermondsey, London); and the Northampton Technical College.

After the leather activity in the Proctor Department ceased in 1977, the industry refocused the leather school activity in Northampton. The Leathersellers College and the equipment from the Avenue Campus of Northampton Technical College moved to a custom-built school at the Park Campus of the new Nene College.

Nene College, later became the University College Northampton and were then allowed to award Bachelor's degrees, with their MSc awards being awarded by Leicester University. The University College established the British School of Leather Technology which ran from 1997 till 2009. In 2005, the University College was awarded full University status by the Queen's Privy Council.

The University of Northampton, now uses the Institute for Creative Leather Technology as its departmental name and can award all qualifications from Bachelors through to PhD.

A direct competitor for students, particularly in Europe, was the Lederinstitut Gerberschule Reulingen (LGR). It ran a very successful certificate and diploma programme and many Leather Engineer's qualified through its programmes. The Institute ceased to operate in 2010 due to financial difficulties. In the later years, it ran a programme for its diploma that included top up into a BSc at the University of Northampton.

The last major player in the leather education arena is the Central Leather Research Institute, CLRI – a department of the Council for Scientific and Industrial Research. With satellite campuses in Chennai and Kolkata it hosts numerous students and has a highly productive research team. Anna University, also in Chennai, run a Bachelor of Technology which also covers leather technology.

The UK, and Indian programmes would have on average between 20-30 new students on the Bachelor's programmes. The UK does not currently run any FET or ABET courses. Both India and the UK run CPD training, and companies tap into these programmes.

In the late 90s, LIRI was training between 60 and 250 students in its NQF 2-4 programmes. The numbers picked up in 1997 when LIRI was training, around 220 SA leather students, 40 Kenyan leather students, 20-30 Environmental students, 10-15 leather-crafting students and 20-30 executives on a leather awareness course.

From 1999 to 2015, ISTT has trained 3100 leather students through its basic, intermediate, and advanced students.

5.5 International and national research and services markets

The opportunities that exist for research in the international leather industry are numerous. The level of research that the new LRI is prepared to commit resources to will be the determining factor for the success of any collaborations. In the beginning phases, realistically the following sort of collaborations may materialise:

- Africa – leather services and animal research
- US – waste minimisations, leather industry by-products
- Nigeria – goat market development
- India – alternative materials – non-bovine leathers
- LASRA – sheepskin (especially Dorper) breeding and skin utilisation
- China – market research into products for the rising Chinese middle class
- UK – Education and training / post Brexit opportunities – commonwealth possibilities
- Italy – fashion and exotics
- Germany – automotive original equipment manufacturers (OEMs), offcut projects

5.6 International programmes and curricula (outlines)

In this section, a very brief outline will be made as to how international programmes are run and an indicative content is given. The information made available is the public information from the provider's web sites. Full details of the curriculum and specifications of programmes are classified as commercially sensitive, except for the details given in the LIRI section.

5.6.1 UK

ICLT currently runs a three-year BSc(Hon) programme, and a 12-month MSc programme (in a 3-month professional mode or in a 12-month residential mode). The University also runs its PhD programme and several bespoke short courses (CPD). The indicative content for the BSc programme is given in Table 5-1.

Table 5-1: Leather Coursework in the UK

UK	
Stage1	Leather Technology and Materials Evaluation – Raw to Tanned
(NQF 5)	Leather Technology and Materials Evaluation – Tanned to Crust
	Raw Materials and End Use
	Surface Coatings 1
	Leather Science 1
	Foundations of Marketing
	Introduction to Marketing Communications
	Introduction to Management
	Enterprise and Opportunity
Stage 2	Enterprise and Opportunity
(NQF 6)	Leather Technology 2
	Materials Evaluation 2
	Surface Coatings 2
	Cleaner Leather Manufacture
	Leather Science 2
	Integrated Marketing Communication
	Operations Management 1
	Information Technology for Business
Stage 3	Project
(NQF 7)	Leather Technology 3
	Leather Manufacture and Sustainability
	Leather Science 3
	Supply Chain Operations Management
	Principles of Marketing Management

5.6.2 India

The undergraduate and postgraduate programmes run at the CLRI are given in Table 5-2. It can be seen that the Institute runs some FET programmes which are suited to secondary school delivery. It is not impossible that some of the very large SA tanneries could run secondary schools as corporate social responsibility ventures, and they could tie in educating some of the pupils in SETA accredited leather diplomas.

These secondary students could then tap into University of Pretoria degree programmes or SETA accredited learnerships or leather-specific NQF Level 2-4 providers.

Table 5-2: Leather coursework in India

India			
Undergraduate	BTech (Leather Technology)	10+2 (School Higher Secondary course) MPC (Academic Stream)	4 Years (8 Semesters)
	BTech (Leather Technology) (Part Time)	Diploma in Leather Technology	3½ years (7 Semesters)
Postgraduate	MTech (Leather Technology)	BTech (Leather Technology)	2 years (4 Semesters)
	MTech (Footwear Science and Engineering)	B. Tech (Leather Technology) (or) B.E. (Mechanical Engineering)	2 years (4 Semesters)
	M.S. (by research)	BTech /B.E. in the Concerned discipline	2 years (4 Semesters)
	PhD (Leather Technology)	Master's Degree in the concerned discipline	Min: 2 years Max: 6 years
	PhD (Footwear Science and Engineering)		Min: 2 or 3 years Max: 6 years
	PhD in different streams of science and chemical engineering (Anna Univ. and other universities)		

Table 5-3 shows the range of diploma programmes at CLRI that include leather based topics that focus on leather products. The national footwear leather cluster, may not be covering leather product design, or manufacture and this may be an excellent opportunity for the University of Pretoria's Consumer Science department or other areas to become involved.

Table 5-3: Range of diploma programmes at CLRI

CLRI Diploma Programme	
Diplomas	Diploma Course in Leather Processing at CSIR-CLRI, Chennai and Jalandhar.
	Diploma Course in Leather Goods at CSIR-CLRI, Chennai and Kolkata
	Diploma Course in Leather Garments at CSIR-CLRI, Chennai
	Diploma Course in Footwear at CSIR-CLRI, Chennai
	P.G. Diploma Course in Leather Processing at CSIR-CLRI, Chennai.
	Leather Processing Raw to Finish
	Leather Goods Design and Construction
	Leather Garments Design and Construction
	Footwear Design and Construction
Post Graduate Diploma	Leather Processing Raw to Finish

5.6.3 New Zealand

In New Zealand, some very simple correspondence courses with block release, in a manner very similar to the old LIRI design, is used. The topics are simple and the course is more for basic understanding of factory employees. Table 5-4.

Table 5-4: Leather coursework in New Zealand

New Zealand – Introductory and Advanced National Certificate Course Content
Hides and skins used in leather.
Hides and skin structure.
Hide and skin faults.
Stages of leather manufacture.
Environmental pollutants in tannery discharges.
Tannery chemical hazards.
Principles of quality assurance.
Practical quality control.
Chemistry of leather manufacture
Chrome tanning
Hides and skins used
Vegetable tanning
Hide and skin structure
Pre-tannage processes for bovine hides
Hide and skin faults

New Zealand – Introductory and Advanced National Certificate Course Content

Pre-tannage processes for woolskins
Environmental pollutants discharged
Chrome leather wet post-tannage
Tannery chemical hazards
Woolskin post-tannage
Principles of quality assurance
Vegetable leather wet post-tannage
Chemical testing
Leather drying
Physical testing of leather
Miscellaneous tannage
Leather colour
Measurement in leather manufacture
Leather finishing

Table 5-5 shows the indicative content of the fellmongers course. The SA sheepskin industry would highly benefit from a sheepskin specific course that allows the deepened understanding of sheepskin production.

Table 5-5: Indicative Fellmongers Course Content

New Zealand - Fellmongers Course Content

Raw material types.
Preparation and classification.
Structure of skin.
Skin faults and their influence on leather quality.
Pre-treatment.
Depilation and liming
Deliming, bating and pickling
Grading and packing
Wool drying and grading
Health and safety
Wastewater treatment.
Principles of quality assurance.

5.6.4 SA (LIRI)

The focus of the LIRI programme was to have tannery employees enrol on the correspondence courses in the beginning of the academic year, to be sent printed notes of the particular module (see Table 5-6) they were on and they would then submit their assignments back to LIRI who would then mark it and return the comments. Once a year the students would attend a one-week residential (block release) and they would get detailed practical training on the module they were taking.

Table 5-6: Indicative historical LIRI course content

LIRI Qualifications (Historical)	
N-Prelim:	Took the student from raw to finish – very simple content
N-1:	Focussed on skin, curing, beamhouse and tanning, the post tanning and finishing were briefly covered
N-2:	Miscellaneous tannages, retanning and finishing (basics) and properties of leathers, testing
N-3:	Focussed on vegetable tannage, and leather science
N-Chem:	A detailed chemistry course for the tanning industry
Diploma Yr 1:	Leather Science- Raw to Finished Article
Diploma Yr 2:	Leather Technology- Details of manufacture, effluent.

5.7 Mapping possible leather programmes

It is important to realise that the curriculum used at the Indian, New Zealand, leather education providers, particularly the lower NQF level provision suit most the training needs that SA tanners/taxidermists identified during the survey.

Many of the “demand” training needs will be satisfied by a system comparable to what is seen in these countries. To satisfy the “supply” education (and training) needs, the industry will need to look beyond what is needed in the industry and should build increased capacity of human resource.

Increased human resource will result in an oversupply and will help to control rising wage costs, decreasing productivity, and will lower the risk of SA leather worker mobility. This oversupply of human resource can be done at any NQF Level, but it could focus on the Bachelor’s programmes at universities that can then be topped up at NQF Levels 8 and 9 with leather specific content.

These high levels will encourage entrepreneurial development; will stimulate new leather factories; use of alternative raw materials; and will allow an increase in the number of consultants (that the survey identified were very difficult to find).

Only India and the UK provide NQF Level 8, 9, and 10 level education. The creation of postgraduate programmes (in possible partnership, or not, with overseas providers) would be manageable within the institutional model that the University would seek to create. Universities in SA get paid for student's completion, and the publication output of post graduate researchers (Estimates include: R360 000 for PhD; and R120 000 per student for effective completions). This is very lucrative for a research institute model.

5.8 Tanning school building and equipment requirements

The following lists given below are the minimum requirements that a leather education, training, and research facility will require:

The satellite training centres:

- Main hall with tables and chairs
- Office
- Small kitchen
- Toilets
- Trainers can bring their own information technology

Main school:

- Tannery (18 x 40 metres)
- Lecture rooms (20 x 6 metres)
- One tannery office (6 x 6 metres)
- One store (6 x 6 metres)
- Leather laboratory (20 x 10 metres) – including demarcated areas for wet chemistry, physical testing, and preparation area.
- Raw hide handling/warehouse examples
- Beamhouse and effluent treatment
 - Paddles
 - Fleshing machine
 - Lots of small drums

- Lime splitting
- Tanyard with chromium segregation for chrome recycling and recovery
 - Tanning drums with heating
 - Need to show membrane closed loop systems and float recycling
- Machine thinning
 - Shaving (school policy that all leathers are wet-white pre-tanned and then chromium retanned, so wastes are chromium-free)
- Crusting department
 - Good temperature control
 - Matched drums
- Inspection Tables
- Drying department – including horse up area
 - Vacuum, toggle
- Softening
- Milling and staking
- Finishing
 - Spray booths
 - Roller coater
 - Curtain coater
 - Driers
- Embossing
 - through feed
 - hydraulic
- Buffing
- Colour booths
- pH meters
- Scales
- Thickness gauges
- Measuring machine

5.9 Institutional research model

The operation of the research institute would ideally be part of the other activities described in this feasibility as the three levels of activities explained interrelate and are generally linked in all known leather institutes globally.

Table 5-7 below gives a list of research-active leather institutes, as defined as institutes that have published in either of the two main leather journals, or have submitted papers to the International Union of Leather Technologists and Chemists (IULTCS) more than once in the last five years.

Table 5-7 A list of research active leather institutes that are actively publishing

Country	Name
UK	Institute for Creative Leather Technologies
India	CLRI
New Zealand	LASRA
USA	Eastern Regional Research Centre (ERRC)
China	Sichuan University
China	Wenzhou Vocational and Technical College
China	Shaanxi Research Institute
Germany	FILK
Turkey	Istanbul University
Turkey	Ege University
Nigeria	Federal University Ndufu-Alike Ikwo
Kenya	KIRDI
Ethiopia	LLPI
Ethiopia	University of Addis Ababa
Brazil	Federal University of Rio Grande de Sol
Brazil	SENAI
Lithuania	Kaunas University of Technology
Slovakia	Technical University in Zvolen
Iran	Art University of Ishafen
Bangladesh	Institute of Leather Engineering and Technology
Spain	Igualada School of Engineering
Spain	IQAC-CSIC
Czech	Thomas Bata University
Italy	University of Pisa

Country	Name
Pakistan	Leather Products Development Institute
Poland	Technical University of Lotz
Tunisia	University de Tunis El' Manar
Argentina	CITEC

The most superficial model of leather research activities is one or two individuals inside a university with either a passing interest in leather or has a permanent research interest, that does not seem to increase to the establishment of a research unit.

Other University departments have a leather specialism and periodically obtain University or government funding to address a leather industry specific issue. For example, Turkish Universities will often address some complaint that is affecting the output of the Turkish double face or sheepskin industry.

As the research intensity increases the size of the department and the extent that it is equipped increases. Institutes that have dedicated tannery facilities and are not only research active, also use their research expertise to engage in training or education. Institutes like this include: TUoN, CLRI, LASRA, Sichuan University, ERRC, SENAI and Igualada.

With all these wide-ranging activities, it is hard to pinpoint a number of models that can be used to describe what the new LRI could look like. It is also very difficult to access these institutes governance and records as they are seldom in the public domain. What can be very easily said is that the majority are associated with universities and the current international practice of how global universities fund their research activities is pretty much how the LRI could be funded.

5.10 SA leather research priorities

It is important to identify some of the potential technical funding streams that could contribute to the financial case of a LRI. These streams would be the priorities that the institute research function could focus on, and some possible resourcing issues are provided:

5.10.1 Raw material utilisation – overview (informing the SA government’s potential ban of material)

The potential of adding more value is a national priority for the development of the SA economy. Understanding the effect it will have on the current trade practices, the effect it will have on current SA trade agreements, and the impact on hide/skin prices, are vital areas of research. The issue is more complex than simple intuition will dictate. The Silimela (2011) report addresses most of this, but five years later, the effect of the USA Donald Trump policies, newer EU restrictions, and the effect of Brexit on the exportation of goods is new territory.

To be able to expand the research of this area, experts from the areas of animal husbandry/meat industry, international trade offices, and the current leather associations will all need to be consulted and detailed analysis made of their economics.

5.10.2 Hide improvement schemes

One of the common threads throughout all current African sector development plans is the issue concerning improving the quality of raw hides, whether it is the slaughter/flay quality, the preservation quality, or the farming practices.

The research facilities required for this include vehicles to travel to rural slaughterhouses, or farms. Educational materials, infrastructure for in-depth training and behaviour adjustment. Human resources that understand farming, slaughter, hide/skin preservation.

5.10.3 Use, collection, utilisation of alternative raw materials

SA has raw materials other than cattle, sheep, goat, ostrich, crocodile that enter the leather industry. The collection of pigskin, antelope, buffalo, elephant, rabbit, hare, springhare, fish skin, and other bird (turkey, goose, chicken) have not been fully understood or exploited. Better collection of goatskin can also be achieved in the rural communities.

International shoe and automotive brands are actively seeking out alternative sources of material that may have lower green-house gas emissions, have lower impact on the carbon footprint, or have animal signatures that can form part of their marketability.

The research facilities required for this are very similar for improving the quality of raw materials and could quite easily be dove-tailed into the improvement schemes. Personnel and transport will form the main requirements.

5.10.4 Skin physical properties of alternative raw materials including exotics and ostrich

The exotic skin area of the SA leather industry is most certainly one of the unique selling points of the industry. SA has established itself as leaders of the supply of ostrich into the global market and is currently developing rapidly into a leader of the supply of crocodile leathers. The development of these value chains allows a perfect opportunity for the LRI to develop as a world authority on the wear and durability characteristics of these exotic leathers.

The testing facilities that a LRI will need to have to conduct effective research of these materials will need to include the physical and chemical test equipment that would typically characterise the leather. Technicians and technologists that could run the diagnostics and interpret the results will be fundamental to the success of establishing authority as world leaders in this field.

5.10.5 Value addition to semi-processed material

A major part of the success of the implementation of raw material export control will be to ensure that effective value can be added to that raw material. A research priority would be to assess and enhance the value addition. The research would centralise around the most productive, efficient methods, that result in the highest quality leather.

Tannery equipment, diagnostic instrumentation and collaboration with Productivity SA, possibly the Trade Unions, industry would result in fruitful research outcomes.

5.10.6 Pest resistance in SA cattle breeds

Tick, lice, mite, and fly damage constantly reduce the quality of SA raw materials. There is very little financial reward for farmers to reduce the pest damage to hides and skins, as the hide forms such a small component of the revenue return to the farmer. The economics and efficacy of natural lower more cost effective treatments are always of interest to the farming community. Meat quality and animal welfare are further considerations that could bring in other disciplines.

The veterinary services, Department of Agriculture, Forestry and Fisheries could be tapped into for funding to help improve resourcing.

5.10.7 DNA forensics for the determination of CITES controlled materials

The control of endangered species movement in and out of the country are complicated by the fact that CITES protected leathers are difficult to identify after processing. The chemical treatments very often remove indicative pigmentation or characteristics that could help identify the species. The development of alternative diagnostics could help the customs/excise, or wildlife agencies with policing/prosecution of illegal activities.

DNA laboratory or alternative diagnostic services and the research personnel who could use the equipment would be research resourcing priorities.

5.10.8 Determination of restricted substances in SA leathers

The international community are working rapidly to register, authorise, evaluate, and characterise the types of tanning chemicals that are used in modern manufacture in the EU and the USA. The low- and middle-income countries use imported chemicals and would benefit from the research that is currently taking place in the high-income countries. Very little is known about the locally manufactured chemicals, the contaminants they may contain, or the restricted substances they may impart to leathers being exported internationally. This kind of project would attract international funding to be able to execute.

UP's chemical testing facilities would be highly beneficial in the analysis of local materials and chemicals and would the knowledge of the leather's performance would give greater confidence to SA companies looking to export their materials abroad. Non-compliance with restricted substances would worsen the outlook for export of value added goods into high income countries.

5.10.9 Novel leather chemicals based on locally available materials

As already mentioned one of the research commitments in IPAP 2016/17 2018/19 is the interest in developing natural or vegetable dyes. These will form a part of the potential number of local products like oils, chemicals, found in local plants and animals. Research into more sustainable resources could prove highly beneficial for a chemical industry that could export cheaper, greener chemicals into the surrounding region, or possibly into markets further afield.

The chemists and the facilities at the University could be utilised to help develop these areas.

5.10.10 SA related surface coatings – including Techtan

Novel surface coatings or laminates are ways in which drastic upgrading of poor quality materials can take place. SA raw material surface qualities tend to be challenging for aniline and full grain finishes. Most SA finishing relies on corrected grain finishing or the attachment of a polymer laminate that covers damage.

Many SA tanneries are currently using Techtan to improve the grain quality. What is not so clear is whether there are better laminate/foiling systems that could enhance the grain quality of SA leathers without many of the negative aspects that Techtan brings.

Coating specialists, chemical companies that specialise in polymers can co-operate in researching alternatives using the UP or LRI chemistry facilities to be able to develop this. The chemical engineering department would also be valuable partners that could result in powerful research output.

5.10.11 PU developments – high priority of shoe companies

During the interviews, many shoe manufacturers spoke about the demise of knowledge in polyurethane (PU) technology. The producers of high grade PU were not able to satisfy the shoe companies in terms of economics, supply, or support. The expertise was often lacking on lower end PU applications

Again, the chemical engineering, coating expertise of the University and national industry can be attracted to good research funding and research opportunities.

5.10.12 Determination of water and carbon footprint of SA leathers

Many international brands are looking at the sustainability of their products and are asking questions about the overall sustainability of the products. Life-cycle analysis and the environmental scientists that perform these analyses are not difficult to find in any industry and SA has the expertise to do these. Consumer study is a regular occurrence at most universities.

5.10.13 Assessment of APDP's effectiveness

In the export manual for this year, the Automotive Industry Export Council confirmed that: "... the APDP, implemented in 2013, represented some of the most innovative and successful programmes to retain a domestic vehicle and component manufacturing industry" The automotive sector is vitally important for the greater economy (7,5% of GDP, 33.5% of manufacturing output, and 14.6% of all SA exports in 2015)) and in turn this would mean the automotive leather tanneries are also important.

It vital to understand how effective the intervention is and how it can be improved to result in much greater impact on reducing the trade deficit and increasing employment. Both the motor industry development plan, and the APDP have enhanced the industry and the lessons learnt from them could be used to possibly invigorate other value chains.

To be able to understand this research area a collaboration between government, academic economists and the automotive representatives need to examine the trade data and commission an assessment of the performance of these policies. Looking forward to the future, what good elements can be derived from these policies?

5.10.14 Waste minimisation in SA tanneries

One of the most successful ways in which high income countries have managed to keep competitive has been to save cost by eliminating or beneficiating waste. Low and middle income countries have looked into the increasing extent of waste in their industries and this will continue as profit margins get threatened.

A large degree of the raw material entering the SA leather industry is wasted through production inefficiencies. There are currently dti incentives in place to increase efficiencies, such CIP, CTCP, and PIP.

To do further research into how national efficiencies can be improved, the solid and liquid waste streams can be researched to find waste products that can be beneficiated to help with company revenue. Examples of beneficiation in high income countries include: cutting yield improvements (through technology and training); fleshing production into biodiesel; buffing and shaving dust into hydrolysates and

composites; and hair utilisation in compost and as a filler. The engineering facilities at UP could be mobilised to assist with these projects.

5.10.15 Productivity improvements to SA workforce

Any industry is always interested in striking a fine balance between increasing labour force productivity, whilst maintaining worker motivation and effectiveness. There are many industry bodies in SA that would gladly engage in research activities that look at methods of increasing the general productivity of the workforce to be able to see direct benefits in the GDP. **The dti** carry stimulation of GDP, particularly the manufacturing GDP, as a national priority, and this will be an area that the leather industry can work together to improve.

Research by social, business, and leather industrialists could be found in several places and with the correct grant funding structure could do some ground-breaking studies.

5.10.16 Effectiveness of taxidermy “dip” for export – bacteriology

The microbiology and veterinary implications of untanned, tanned material has been investigated in the 1970s and more recently in the early 2000s. Recent research suggests that recontamination of the substrate occurs as processing develops. It is not clear how many pathogens remain, and are carried through the export process, and whether those contaminants effect animal and human health in countries receiving those exports.

Leading specialists in these field could do research, specifically for the taxidermy sub-sector to elucidate the mechanisms and effectiveness of various practices seen in SA factories.

5.10.17 Effective removal of cartilage in zebra and giraffe.

Two of the most difficult animal hides to process through to soft articles are the giraffe and zebra trophies. Both these animals contain cartilage which makes the final article virtually unworkable if it is not effectively removed.

Mechanical and enzymatic studies could result in effective best practice being disseminated across the sub-sector allowing a boost in quality, competitiveness, and export value.

Mechanical engineers, biochemists, biotechnologists would be interested in research in these areas.

5.10.18 Chromium-free tannage for hunting/tourism trophies

A growing trend in international leathers is the investigation of chromium-free tannage and taxidermy is no exception. Leather that is chromium tanned has a few characteristic properties which make it sometimes too soft or stains the hair of the trophy. By finding alternative technology these problems could be eliminated.

Pure leather research, through experimental trials to find optimal levels and high performance recipe would need to be undertaken in the model production facilities that the LRI would contain.

5.11 Global leather research priorities

There are several high-profile research activities that the leather community is currently engaged in. The document by UNIDO *Benchmarking in the leather industry* is one the most comprehensive guides on what developments are taking place in the global community (UNIDO, 2012). The following list are the broader categories of inquiry:

- Production parameters
- Cleaner tanning technologies
- Energy
- Product development
- Occupational health and safety
- Environmental aspects
- Human resource, staff welfare, and corporate social responsibility

As an overview of the leather journals of the last five years shows, the focus is the development of: new techniques that can help characterise leather properties; the creation of new chemicals; the decrease of harmful substances; chemistries that will help with the increase of productivity; machinery developments for quality improvements; and fundamental understanding of existing techniques.

5.11.1 LIRI research strategies

It is useful to note that over its 60 years of operating, LIRI grew steadily as a major contributor to leather research. The advice that the wattle growing industry

received helped to equip, staff, and gave national credibility to the researchers who worked there. In time, the experience, number and abilities of the department grew until a few projects were bringing in a steady stream of income.

The research output of the institute meant that research bulletins were steadily being received by the members. The value of the membership from the 1960s through to the late 1980s provided good retention of member numbers and like with FABI meant sustainable development in the activities of the institute. Whilst the overall contribution of the member's fees was low (similarly seen in the FABI income stream breakdown shown in Figure 5-3), the follow up research and donations from the industry was proportional to the success the member's perceived in the quality of the research bulletins. In the late 1990s the research output and the quality of the research bulletins started undermining the trust the membership had in the value-for-money proposition that LIRI held.

The projects that LIRI ran resulted in many publications and the credibility this brought fed back into the financial success from donors, grant allocations, and capital investment from government sources.

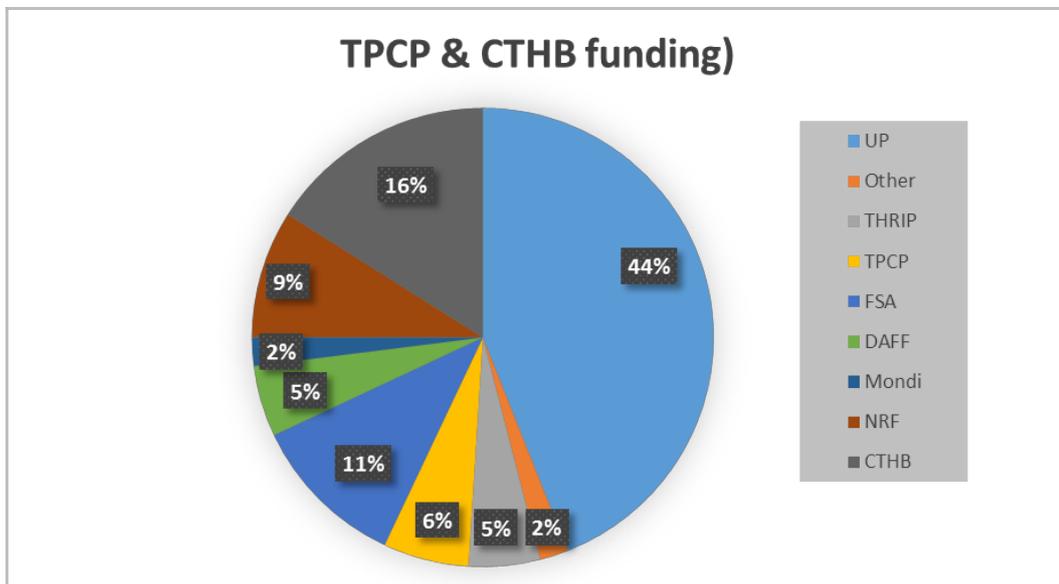


Figure 5-3 The funding stream breakdown that the Forestry, Agricultural Biotechnology Institute (FABI) had at the University of Pretoria in 2014.

5.11.1.1 Strengths of LIRI research

The strengths of LIRI's research was that it was appropriate, trustworthy, relevant, and was perceived by industry to be good value-for-money. The department

ran quite efficiently and the equipment and the resources that Rhodes University offered resulted in efficiencies that similar sized institutes did not seem to benefit from.

The staff were highly competent, proficient scientists and technologists who generally came from solid classical training and then specialised in the leather field.

5.11.1.2 Weaknesses of LIRI research

Particularly in the latter years the interaction with industry became desperate and reactionary. The diminishing numbers of post-doctoral, PhD, and Masters students meant that senior staff were left to do most the research work.

In an interview with Prof. Mike Wingfield, the point was made very clear that a high leverage model has contributed to the success of FABI. Another way of looking at high leverage is the saying: “*finders, minders, and grinders – keep your pyramid flat with more grinders and minders, while letting your finders do their work*”. LIRI had a very tall pyramid during the last few years. The initial and middle success of LIRI was dependent on a high leverage model. Low cost of researchers executing the research meant the research proposals/quotations were competitive and had boasted a high success rate.

5.11.1.3 Opportunities of LIRI research

LIRI was always able to bring in small (low income) applied projects that resulted in slow trickle of cash into the institute. The network with industry and the mutual trust that both parties shared was unique and resulted in continuous success. The reputation, political power, and influence LIRI had in the leather and allied industries was formidable, which resulted in funding success and succession planning.

The latter years resulted in diminished influence, trust, and very poor succession planning.

5.11.1.4 Threats of LIRI research

The largest threat to LIRI research was the difficulty to recapitalise the infrastructure. Rhodes University’s slow disengagement and the failure to plan for re-investment in facilities and equipment meant that the accuracy of the research began to dwindle. The lack of post graduate research is probably an indication that students did not see the value of the research results.

The hardship in the industry and over-reliance on easy-win funding streams meant dwindling reserves and staff redundancies were imminent. LIRI failed to diversify in its sources and innovation to win funding. Institute losses drained research coffers resulting in dwindling output with an additional knock-on of prominent researchers/technologists moving on.

5.11.2 International examples

There are several examples of global leather research organisations. There are no research-only models, as the nature of academic/private research funding means that alternative sources of income need to be used to supplement the main finances. It is also important to note that the nature of any research generates learning and teaching opportunities, as well as opportunities to provide technical service to industry and government. It is unheard of in the leather industry for a research business to stay completely focussed entirely on fundamental or applied research.

Like all research funding streams, research in the last 50 years has become highly competitive, and funding for fundamental research has been drastically cut, when compared to applied research.

The leather research organisation with the highest number of publications internationally is the CLRI. Publishing in journals inside and outside the leather industry, a tally for 2016 shows an output of 21 publications in prominent journals and 11 patents (this seems to be the average output for the institute over the last 5 years).

LASRA is also a prolific research unit (at the same level as the University of Northampton) and they fund themselves through industry membership, continuing professional development and government funding.

BLC Leather Technology Centre, a private organisation, provide technical services and testing, have a membership based model, and bid for medium sized to large grants. The BLC also manages the Leather Working Group and they perform audits for the LWG, take a management cost, and work with brands to help partner with responsible tanneries. BLC also do continuing professional development.

In Ethiopia, the Common Market for Eastern and Southern Africa's Leather and Leather Products Institute (LLPI) is another strong research model for the operation of a SA LRI.

5.11.3 LRI alignment with FABI model (and others)

One of the ways in which the research activities of the LRI could be made to work would be to use the operating model of FABI to run their operations. FABI is a full institute and as the regulations state in Appendix 5, the type of activities/governance is well-defined, and the type of people who are part of the institute must be of a certain type. It may well be that the initial aspirations of the LRI are to be a research centre, but then will be later classified as an Institute of the University of Pretoria if the criteria of the University are met.

For the sake of this feasibility, it is assumed that the goal is to be a full institute and thus the activities of FABI will be overlaid to see if there is a technical viability (through overlap)

Table 5-8 A possible overlay of Forestry, Agricultural Biotechnology Institute (FABI) funding model onto a new LRI.

Funding	FABI use	Possible LRI Overlay
University of Pretoria	Running costs (some – salaries, infrastructure, amenities)	Would be similar staff would spend 50% of their time on UP activities and 50% on LRI
Centre of Excellence in Tree Health	DST/NRF funded	A centre of excellence for leather could be established, in time and could attract grants
DTI -THRIP	Supports institutes	Would help the running of a full institute
NRF	Staff are rated and attract grants	Similar activity would occur for LRI
Tree protection co-operative program	Membership fee from forestry industry	Would come from tanneries and allied industries, possibly even the meat industry
Forestry South Africa	Targeted projects	Leather industry bodies would fund projects
Department of Agriculture, Forestry and Fisheries	Match funding of Forestry South Africa funding	Could be like FABI in that leather industry associations are match funded
Mondi	Large paper company sponsor	Large multinational tanneries could be approached to give an annual grant.
Other	Institute staff bring in grants for their work from other sources	Staff would be expected to bring in revenue for research, especially overseas funding

The funding streams shown in Figure 5-3 indicates that the source of funds is varied and in general cover a wide range of activities ranging from satisfying member's interests through to satisfaction of national strategic aims. In Table 5-8, the overlay of the FABI model onto the possible funding that LRI could attract is attempted. The two industries are similar in the type of industrial-related issues they face and the same funding appeal could be used.

5.11.3.1 Strengths of alignment

The exact extent of funding acquired by FABI was not made public. Or is not known by the authors of this feasibility. It is fully in the scope of the financial feasibility to see how viable the extent of funding presented in the FABI model alignment (see Table 5-8) would be to the business case. Technically, there is a strong alignment between the types of funding streams attracted by FABI, to leather industry equivalents available for the LRI.

The breadth of the LRI research activities, and the impacts that will research will have on the SA leather industry, are as strong as the FABI model. Below in Section 5.13 a comprehensive list of the types of leather research required by the sector and the resourcing they will require is given.

5.11.3.2 Weaknesses of alignment

The current FABI alignment is a bit unfair for an institute that is in its infancy. FABI had a humble beginning and built its way up after it had established its credibility and had gained its momentum. The tipping point for FABI and its continuous success is linked to its post-graduate success and a high leverage model which can only come from a point where critical mass is obtained.

The establishment of an LRI will most likely have to go through the same development cycle as FABI – as the development of know-how, establishment of business systems, and recruitment of researchers proceeds.

5.11.3.3 Opportunities of alignment

The list given in Section 5.13 provides a vast number of important projects that need attention in the SA leather and taxidermy industry. The industry specific opportunities and the national strategic projects identified by **the dti** can be easily dovetailed into a model like the FABI model presented in Table 5-8.

The opportunity to attract post graduates, industry-led projects, consultancy-type projects, and government funding streams is high and could invigorate a knowledge-deficient industry.

5.11.3.4 Threats of alignment

The SA forestry sector is different to the leather industry. The industry size, profit margins, average size of companies, nature of the value chains are fundamentally different. The international research profile of forestry, and agriculture biotechnologists are drastically different from the leather industry academia. The reaching of critical mass for the LRI may be difficult with some of these fundamental differences.

The acquisition of a Director like Prof. Mike Wingfield may be one of the hardest stages to overcome for an LRI.

5.12 **Leather research/service infrastructural requirements**

Below is a list of instrumentation, chemical and physical testing, and laboratory equipment needed for effective research. This does not include glassware and consumables that individual projects will require. It also does not consider any teaching equipment requirements (which will change when curricula are established)

The University of Pretoria, may already have a substantial representation of the equipment described and inter-departmental arrangements will need to be negotiated.

- Differential scanning calorimeters
- Nuclear magnetic resonance
- Atomic force microscopy
- Fourier transform infra-red with attenuating total reflectance
- Environmental scanning electron microscopy
- Transmission electron microscopes
- Light microscopes
- Microtomes – freezing
- Centrifuge
- Furnace (1000°C)
- Microwave Digestion

- Inductively coupled plasma (ICP) with optical emission spectroscopy – linked to ion exchange for chromium VI determination
- Leather testing room
- Tensile tester with lastometer and friction testing attachment
- Humidity boxes
- Freeze drier
- Water baths
- Soxhlet extraction (reflux, with electric bulb heating)
- Kjehldahl determination apparatus
- Penetrometers
- Clicking press (and knives)
- Fogging apparatus
- Water vapour permeability
- Taber tester
- Gakushin rub fastness
- Wyzenbeek rub fastness
- Spectrophotometers – UV-Vis
- Spectrophotometers – surface reflectance
- Gloss meters
- SATRA rubfastness
- Veslic rubfastness
- Climate testers -incl. light testing
- Flexometers
- Thickness gauges
- Rheometers – Brookfield
- Dynamic mechanical thermal analysis

5.13 SA leather and taxidermy service priorities

The LRI will have many elements that can contribute to the development on a sector based on know-how. To give an idea of the resourcing required for the technical services required by the industry, the following priorities that the institute service function could focus on, with a brief description of what is entailed, is given:

5.13.1 Automotive/Shoe testing

Without competing with the existing structure provided by the SABS, a co-operative agreement could be established between the two organisations, whereby the interests of the industry are served in an independent, effective, and in a manner, that could significantly contribute to the increase in productivity of SA tanneries.

A full suite of leather specific testing equipment that can cover all leather types from shoe upper, through leather goods, and into the high-performance end of the leather industry (including major car brand requirements). These independent services could prove quite valuable to the tanneries, especially if test turn-around is rapid.

Testing technicians would be difficult to come by, but could form a significant priority in the understanding the training need of the LRI itself. Leather testing technologists will also be difficult to acquire as they are not skill sets that tanners usually possess.

5.13.2 Effluent advice and guidance

Using existing chemical analytical suites, and within the existing framework for chemical study at the University of Pretoria, the LRI could work, test, consult and advice government and industry on compliance with national and international standards. Both the physical and chemical testing could co-operate with international test houses to arrange for increased service delivery through training or service provision.

Most of the existing UP equipment could be used for the majority of diagnostics that the leather industry would require. Standard test methods would need to be purchased, particularly the International Standards Organisation's test methods for leather (as they will not probably be present in the current UP collection).

Chemists/analyst human resources would be present in the national economy, but they may need sector specific training, particularly when the practical advice on compliance with effluent regulations is needed.

5.13.3 Single leather tests

At the moment, the testing services for SA leather companies do not provide a full suite of tests. The tanneries, manufacturers, and retailers voiced a dire need for

the SA test houses to perform single tests, e.g., tear tests on a shoe, instead of having every physical property of that shoe being tested at the same time. Full testing, is very often not required, expensive, and slows down the generation of performance reports. International test houses over affordable single tests.

The technicians and equipment required for single tests are slightly simpler than a technician that has to do all the tests as they focus on mastering one or two tests and could perform that on a day-to-day basis.

5.13.4 Import/Export assistance

The movement of a complex material like leather around the international trading markets can be problematic to local companies. The trade agreements, international definition, customs and excise, and compliance with restricted substances can be daunting and difficult (particularly into the EU and USA). A central resource of knowledgeable advisors would significantly help manufacturers and tanneries.

The restricted substances that the leathers would contain, would need to be chemically determined. The effluent testing, outlined above, would have overlap, as the testing is usually similar with slight differences for liquid versus solid analysis. The equipment and technicians would be interchangeable. The analysis and interpretation of results on restricted substances is highly specialised and would require not only chemical knowledge, but would also require national and international legal knowledge.

Resourcing of technical services for import/export compliance would require expertise that could understand legal documentation, the technical understanding of the leather-making process from hide/skin to article, and they would need to be able to operate with port authorities and industry.

5.13.5 Public Information

The level of leather awareness and product knowledge is low. Dangers associated with certain leather chemicals, sensitivity, and the mistreatment of leather can result in the safety of consumers, particularly in illegal, unregulated leather practices. The consumer safety and understanding is actively researched at the University of Pretoria and leather would fit very naturally into this field of work. Working with the media and retailers could become a core function for the LRI.

Media knowledge, equipment, and access to the retail network would be high priorities for personnel working in this area. Consultants that work in this area would need to be social media experts and will need to understand brands, retail, and marketing.

5.13.6 Liaison with SLTC

The Society of Leather Technologists and Chemists, as a trade organisation encourages the co-operation and dissemination of best practices. The SLTC provides a professional grade structure that can provide structure to continuing professional development. The SLTC also provides a journal that allows members to keep up to date on current leather research.

A member of the board could be seconded onto the SLTC committee and could liaise activities with all the SLTC functions.

5.13.7 Organising of conferences

In addition to the core activities of the SLTC, the organisation also arranges for an annual conference where the industry can trade, discuss, and formulate tannery strategy, and work together to improve internal standards. The annual conference has always been an opportunity for networking and a chance to be exposed to news ideas, speakers, and to progress thinking. Other conferences, such as sustainability, CSI/CSR initiatives and interdisciplinary interaction will lead to innovation and the dissemination of best practice.

Personnel who organise and run the national conferences would be a mix of administrators who have experience in hospitality, the technical team who would arrange the technical programme, and the catering. The use of suitable venues would also be included in resourcing.

5.13.8 Annual workshops and demonstrations

To embed best practice, one of the best methods is by demonstration. A fixed facility that allows the practical demonstration of leather processing/manipulation would be a significant asset to a positive a growing industry. It will also significantly contribute to increase of know-how.

The LRI facilities, equipment, attendance packs, media, would need to be organised for effective delivery. The workshops and demonstration's success would

need to be carefully planned for and monitored or the events would not be attended by industrialists whose time is precious.

5.13.9 Consultancy and problem-solving services

The original LIRI was created to provide consulting problem-solving services to the leather and allied industry. The current model used by FABI achieves similar research aims. Industry would benefit from cost-effective access to industrial experts that can solve big problems that SA tanneries experience on a day-by-day basis. A core source of funding can be obtained from the constant delivery of valuable services to an industry that needs rapid problem-solving.

Specialist technology and equipment would need to be motivated and budgeted for on a project-by-project basis.

5.13.10 Overseas commitments – leather fair delegations

The LRI would need to continuously attend international meetings, trade fairs, conferences, and seminars to proudly demonstrate SA products, services, and innovations, as well as keeping up-to-date with other international developments.

Organisational personnel, marketing materials, and overseas support facilities would need to be tapped into to make the overseas commitment services a success.

5.13.11 Academic conferences – delivery of SA research

The academics at the LRI would need to maintain/develop a NRF rating. To do this there is a serious commitment to attending, presenting, and publishing in academic circles (including conferences). The attendance of non-leather conferences is not only advisable, but actively encouraged to ensure that new techniques, ideas, and technologies make their way into the leather industry.

Like the industrial conferences, the academic publishing through conference or written work needs to have the help of editorial, graphic, and design facilities. The statistics, mathematical modelling, and typesetting expertise of UP will be needed.

5.13.12 Dissemination/distribution of funded research findings

The research models, presented above, rely heavily on the dissemination of publicly funded research findings. Government and national research funding, demands that the findings of research are shared in the interests of the nation. The research output of academics would be carefully monitored and the core technical

service delivery of each academic would be balanced with the impact their research has in national and international communities.

The publication of LRI research bulletins and research findings will need the expertise of media, editorial, and administrators who can post paper copies or can disseminate electronic formats of the findings to the membership of the LRI.

5.13.13 Leather hub and cluster work

Corporate social responsibility is a significant part of modern company sustainability. It is also important to ensure that the impact that tanneries and manufacturers have on their local communities is minimised. It is currently very common to have leather industries cluster together for purposes of shared know-how, common services (like machining and effluent treatment). The LRI would actively work with communities to grow existing structures and to work with government in the future to develop further hubs.

The resources needed for the activities of the hub vary from: engineering to help with building projects; social workers, business support, and tannery technical knowledge.

5.13.14 Veterinary monitoring of trophies for export

An important element of the taxidermy business is compliance with veterinary regulations for the exportation of trophies out of the country. Completed trophies that require no further work will ultimately be the aim of the industry, but currently a large proportion of the trophies are “dipped and shipped” without all the safeguards to ensure that the skins do not contain pathogens that are undesirable to international customs authorities. The LRI could work closely with taxidermists to ensure that they are compliant.

Veterinary support, pathological knowledge, coupled with specific taxidermy chemistry know-how would be vital for the support of taxidermy export. Intimate knowledge of the export requirements would also be required.

5.14 Management structure

5.14.1 Existing international arrangements

As has been made clear from Appendix 5, the management of a UP research bureau, unit, centre, or institute, is clearly defined. The type of manager/director and

the experience the director must contained is well defined. However, the envisaged LRI will not be a research only facility and must include the educational and technical services elements as well.

The institute should be run by an industry Board of Control, as is the case at the LLPI. The leather and taxidermy trade needs firm representation on this Board. There needs to be a reporting mechanism of important industrial components: raw materials (red meat, ostrich, hunting and crocodile interests); export councils; industry development; environmental emission monitoring and control; chemical and machine support; labour relations; an education/training sub-committee.

The Director of the Board must be a strategic member of the organisation whose primary function is to attend meetings, influence funding possibilities, and to promote the general strategy of the SA leather industry, its research/services, and the vision of the industrial and economic development of tanneries and taxidermists.

Deputy Director is in charge of day-to-day operations, and the number of deputy directors can be expanded as the organisation grows. The following are the deputy director's focus areas:

- Institute procurement
- Institute transparency including institutional and industry anti-corruption activities.
- The setting/monitoring of divisional managers with performance targets and annual reviews.
- Execution of the institutional plan (research, education, and services)

There also needs to be a tier of team leaders who head up the sub-divisions of the institute, and will be responsible for the day-to-day function of the team (including budgetary control and performance monitoring).

5.15 Operating conclusions

Some of the operational considerations for the practical design, execution and the running of the institute have been given. Detailed lists and expertise, helping to inform how the institute needs to be created have been given. Several models of

international, African, and local institutes have been provided and an alignment with the successful FABI is shown.

For an effective institute to be created the international standards, curricula, and examples of best practice need to be consulted. The operation of the institute may be one of the most difficult parts to achieve in the future sustainability of the organisation.

There are many elements given in this section that show that many of the Institutional requirements given by the University of Pretoria can be met. There are some details outside the scope of this technical feasibility that will need to be considered, however.

6. Part D – Schedule

6.1 Next steps

The following sections will help to outline what the sequence of events will be for successful determination of the overall feasibility of the LRI will be.

6.1.1 Timing of *Model 1* – education/training *status quo*

If it is determined that the *status quo* is to be the most preferred option, then the sequence of events is the easiest. All industrial entities will continue with their immediate operational plans. ELSA and **the dti** will record the decisions of the industry as an open docket that can be revisited in an appropriate revision timing.

As part of the ELSA and **the dti** final conclusion a report should be submitted to national and international publications for public record, and possible appeal.

6.2 Timing of *Model 2* – education/training local enhancement and international scholarship

If it is decided that enhancement of training is the correct option, then the following questions become pertinent:

- What needs to happen with ISTT and other industry relevant training organisations?
- How can the SETA and the industry work closer to better serve the training needs?
- What about the development of NQF 3,4,5 unit standards?
- How can the SETA learnership programme be more effective?
- Who are writing the industry education standards and are they the most credible representatives to be doing this – should the industry at whole be collectively consulted on standards and curriculum?

If the international scholarship for higher level employees is prioritised, then the following questions become important:

- Which international education and training options will serve the needs of the SA leather industry most effectively?

- Can this technical feasibility be used as the background information for education providers to ensure that the programmes are tailored specifically for the SA industry?
- Can memorandums of understanding be established outlining an effective plan for how the future high level technical leather education of the SA industry will be handled?

It is important that the operational review timeframe of *Model 2* is established and the industry feeds back important information about the performance of the model.

6.3 Timing of *Model 3* – Leather Research Institute

It is felt that the SA leather industry needs to be consulted with findings of this technical feasibility. ICLT suggests that the report gets loaded onto **the dti** web-page and the links (to the download of the report) get emailed to all tanneries and taxidermists.

If *Model 3* is determined to be the most practicable option, then the following questions will need consideration:

The most important considerations for the financial feasibility:

- Determine what is the value to the industry if the LRI is going to be built (and does this outweigh the capital and ongoing running costs)
- What is the value adding realistically going to be?
- Sensitive information that was not made available during this research needs to be formally requested by SHALC from the companies:
 - What is the staff turnover rate at companies?
- What are the meat industries development plans – how much are they planning to increase/decrease herd size (and its effect on hide/skin take-off rate):
 - Can the SA leather industry take greater quantities of raw material into factories? Does industry statistics cover capacity levels for the leather producers?
 - Does the SA industry want to increase its herd size – work with RMIF to increase beef and mutton export etc. If the herd size increases and take-off remains the same, then more hides will enter the market.

- Can SA buy increasing quantities of raw material?
 - What about trade agreements with Ethiopia to buy raw material?
 - Zimbabwe (and other African countries) are looking to open an LRI, can there be a collaboration?
 - Can there be Eastern and Southern African (especially Ethiopia and Kenya) collaboration on bovine leather projects and training to incentivise or monetise the LRI?
 - Can there be Western African collaboration (especially Nigeria) on ovine and caprine leather projects and training to incentivise or monetise the LRI?
- What is the exact market data and what are the economic indicators that support an intervention like LRI?
 - Next the land and building costs need to be determined for LRI building and satellite training offices.
 - The exact prices from machinery suppliers in SA can be obtained for equipment on second hand or new equipment.
 - Lab equipment not currently owned by UP needs to be priced up.
 - An industry commitment could be obtained from leather and taxidermy companies to allow concrete student number prediction.
 - What are the salary and running costs of the institute staff going to be?
 - Who are the staff going to be (given the current skills analysis)?

6.4 Industry buy-in and risks

It cannot be overstated how important it is that the leather and taxidermy industry backs the new LRI, or it will be an organisation not used by the industry, for the educational, research, and leather services they will perform.

It is also vital that the institute is headed up by the correct leader. These are the personality and professional traits, that are felt by many interviewed, needed in the successful candidate:

- Natural leader
- Highly connected with national and international networks
- An experienced taxidermy/leather professional with upper management experience

- A scientific, or technological understanding of the taxidermy or leather industry
- High moral, ethical qualities that embellishes the trust in the LRI
- A dynamic, entrepreneurial, positive management style
- Excellent political abilities

It is important that before the final signature is placed on the establishment of the LRI that a blueprint of the mechanism of the institute is presented to the industry, at a public consultation, so that the industry can be convinced that: 1) There is a sustainable plan of the LRI that they can buy into; 2) That the LRI has political power, and will be able to exert the correct influence across government, trade bodies, and consortia. If the LRI does not have more political power than the existing trade organisations, then it will be helpless to influence anything in the leather trade.

6.5 Schedule conclusions

In this section the three models are given, some pertinent questions concerning the next steps of those models given; and it is hoped that through the satisfactory answering of the questions (surrounding those next steps), then a final decision about which model is best for the interests of the SA leather and taxidermy industry

The section also makes very clear the importance of the leadership and management of the institute. The importance of industry engagement and support is outlined.

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8. Appendices

Appendix 1: Format of survey questions

The format of questionnaire used for the tanneries/service/customers (with some minor changes depending on the choice of the three companies questioned):

1. Do you currently use a local company for training/education? (Yes/No)
2. What is the reason for not using a local company?
 - Accreditation (not credible or absent)
 - Cost
 - Turnaround
 - Incompetent
 - Other
3. How many students do you train on average per year? Please give approximate NQF levels.
4. What kind of technical skill development do you require?
 - Operator basic training (incl. machines)
 - Management supervision
 - Quality control (incl. testing)
 - Materials handling (incl. forklift)
 - Record keeping
 - Health and safety
 - Environmental awareness or management system training
 - Full technologist (incl. RD and I)
 - Full technical (incl. problem-solving)
 - Purchasing/Procurement
 - Technical management
 - Production/Operation management
 - Financial
 - Marketing
 - Compliance (legal, RSL, CITES certification)
 - Meeting customer specifications
 - Project management
 - Time/motion study
 - Customer service
 - Inventory control
 - Forecasting
 - Supply chain logistics (import/export)

5. Do you currently use a local company for testing? (Yes/No)
6. What is the reason for not using a local company?
 - Accreditation (not credible or absent)
 - Cost
 - Turnaround
 - Incompetent
 - Other
7. Do you currently use a local company for consulting or research? (Yes/No)
8. What is the reason for not using a local company?
 - Accreditation (not credible or absent)
 - Cost
 - Turnaround
 - Incompetent
 - Other
9. How many chemical companies does your tannery currently use?
 - 1
 - 2-3
 - 4-5
 - More than 5
10. Do you use any international chemical suppliers? (Yes/No)
11. Do you use any local chemical suppliers? (Yes/No)
12. Do you use any international machinery suppliers? (Yes/No)
13. Do you use any local machinery suppliers? (Yes/No)
14. Would you in principle (subject to commercial decisions) use a SA University backed research institute for:
 - Research (Yes/No)
 - Consultancy (Yes/No)
 - Services (Yes/No)
15. Please give some general comments about the current state of the tanning industry.
16. Please give some general comments about the future of the tanning industry.
17. Outside of the tanneries, what do you think needs development in the leather allied industries (e.g., chemical, machinery, testing and training)
18. What do you think government can do to increase jobs, competitiveness and profitability of SA tanneries?
19. What role do you think the SA leather industry plays in sub-Saharan Africa?
20. What in your opinion are technical development priorities for the SA leather industry?
21. What in your opinion is the role of trade representations in SA? (SHALC, SLTC, SATEA)
22. Do they need to change the way they relate to industry? (Yes/No)
23. If YES, how do the trade representatives need to change to improve the industry?
24. Optional (to remain anonymous, not for publication):
 - Staff numbers
 - Expected growth (year on year, for next 5 years)
 - Other financial information
25. Please give some comments on what role your company plays in the SA leather industry.

Please supply us with any marketing information, web links about your company that you think is relevant to this feasibility.

Thank you for your time

Appendix 2: List of leather education/training/SD providers

(Including footwear, Leatherpanel.org 2016)

Table 8-1: List of Leather Education, Training and SD providers

Name	Country	URL
Centro Formación Recursos Humanos y Tecnología Industria Calzado	Argentina	http://www.calzadoargentino.org.ar/cefoteca-acercade.asp
UNIDO (e-learning)	Austria	http://leatherpanel.org/e-learning
The Institute of Leather Engineering and Technology	Bangladesh	http://www.du.ac.bd
Centro Tecnológico do Calçado SENAI	Brasil	http://www.senairs.org.br/ctcalcado
Centro Tecnológico do Couro SENAI	Brasil	http://www.senairs.org.br/ctcouro
Serviço Brasileiro de Apoio às Micro e Pequenas Empresas	Brasil	http://www.sebrae.com.br
Centre des Métiers du Cuir de Montréal	Canada	http://www.cmcm.qc.ca
Commission Scolaire de la Région de Sherbrooke	Canada	http://www.csrq.qc.ca
Universidad Diego Portales	Chile	http://www.udp.cl
Servicio Nacional de Aprendizaje	Columbia	http://www.sena.edu.co
Escuela de Química U.C.R	Costa rica	http://www.quimica.ucr.ac.cr
Wenzhou Vocational and Technical College	China	http://www.wzvtc.cn (link Broken)
Tomas Bata University in Zlín	Czech Republic	http://www.utb.cz
Universidad Central del Ecuador - Escuela de Calzado	Ecuador	http://www.uce.edu.ec

Name	Country	URL
Servicio Ecuatoriano de Capacitación Profesional/Centro de Formacion Industrial Ambato	Ecuador	http://www.secap.gov.ec
Hämeen Ammattikorkeakoulu	Finland	http://www.hamk.fi
Association Nationale pour la Formation Professionnelle des Adultes	France	http://www.afpa.fr
Association pour la Formation dans la Maroquinerie	France	
Association pour la Formation Professionnelle des Industries du Cuir	France	http://www.afpic.com
ITECH	France	http://www.itech.fr
Fachhochschule Kaiserslautern	Germany	http://www.fh-kl.de
Fachschule Textil and Schuhe	Germany	http://www.ldt.de
German College of Footwear Design and Technology	Germany	http://www.english-dsf.info
International Shoe Competence Center	Germany	http://www.isc-pirmasens.de
Elkede Technology and Design Centre SA	Greece	
Modell Divatiskola	Hungary	http://www.modelldivatiskola.hu
Central Footwear Training Institute - Agra	India	http://www.cftiagra.org.in
Central Footwear Training Institute - Chennai	India	http://www.cftichennai.in
College of Leather Technology - Kolkata	India	
CSIR – Central Leather Research Institute	India	http://www.clri.org
Footwear Design and Development Institute	India	http://www.fddiindia.com
Indian Institute of Leather Products	India	

Name	Country	URL
Indonesian Footwear Design Development Institute	Indonesia	
Accademia Riaci	Italy	http://www.accademiariaci.info
Centro Ricerca e Scuola Internazionale Calzaturiera	Italy	www.cercal.org
Istituto Professionale di Stato per l'Industria e l'Artigianato	Italy	http://www.ipsiaconegliano.gov.it
Istituto di Certificazione della Qualità per l'Industria Conciaria	Italy	http://www.icec.it
Istituto Tecnico Industriale for Tanning Chemistry "G.Galilei"	Italy	http://www.istitutoconciario.com
Politecnico Calzaturiero	Italy	http://www.politecnicocalzaturiero.it
Politecnico Internazionale per lo Sviluppo Industriale ed Economico	Italy	http://www.pisie.it
Training and Production Centre for the Shoe Industry	Kenya	http://www.kirdi.go.ke/centers/t-p-c-s-i
Centro de Investigación y Promoción Educativa y Cultural, A.C.	Mexico	http://www.cipec.org.mx
Kennis- en Opleidingencentrum	Netherlands	http://www.svgb.nl
Leather and Shoe Research Association	New Zealand	https://www.lasra.co.nz/training
Leather Products Development Institute	Pakistan	http://www.lpdi-skt.com
Osan College - Footwear Department	South Korea	http://eng.osan.ac.kr/department

Name	Country	URL
Facultatea de Textile Pielărie și Management Industrial	Romania	http://www.tuiasi.ro/facultati/tex
Moscow State Academy of Light Industry	Russia	
Moscow State University of Design and Technology	Russia	
Footwear Design and Technology School of South Africa	South Africa	http://www.shoedesign.co.za
International School of Tanning Technology	South Africa	http://www.tanschool.co.za
Escuela Superior de Negocio y Gestión Empresarial de Ámbito Nacional	Spain	http://www.csdmm.upm.es
Igualada School of Engineering (EEI)	Spain	https://www.upc.edu/learning/courses/masters-degrees/leather-engineering
Scuola Universitaria Professionale della Svizzera Italiana	Switzerland	http://www.masfmt.supsi.ch
Centre Sectoriel de Formation Techniques Appliquées au Cuir	Tunisia	
Istanbul University – Centre for Research and Practice in Development and Education in Leather Trade	Turkey	http://dericilikarastirmalari.istanbul.edu.tr/en
Anthony Vrahimis Ltd	UK	http://www.avstudioslondon.com/
BLC, Leather Technology Centre Ltd	UK	http://www.blcleathertech.com/leather-training-courses.htm
De Montford University	UK	http://www.dmu.ac.uk
Institute for Creative Leather Technologies, University of Northampton	UK	http://www.northampton.ac.uk
Leather Conservation Centre	UK	http://www.leatherconservation.org

Name	Country	URL
LTT Leathercare	UK	http://lttleathercare.com
Leather Wise Ltd.	UK	http://www.leatherwise.co.uk
Leicester College	UK	http://www.lec.ac.uk
State Academy of Light Industry or Enterprises	Ukraine	
Universidad República, Facultad Ingeniería, Instituto Ingeniería Química	Uruguay	https://www.fing.edu.uy/iiq/inicio
American Leather Chemist's Association	USA	https://www.leatherchemists.org/committees/course_info.asp
Shoeschool (Online School)	USA	http://www.shoeschool.com

Appendix 3: LIRI organogram



Appendix 4: NQF framework

Table 8-2: South African National Qualifications Framework mapped onto UK National Vocational Qualification Framework.

UK NVQ Level	SA NQF Level	Descriptor	Example SA Qualification	Example UK Qualification
	1		Grade 9 (School)	
	2		Grade 10 (School)	
1	3	Competence that involves the application of knowledge in the performance of a range of varied work activities, most of which are routine and predictable.	Grade 11 (School)	GCSE (Grade D-G), Foundation Diploma.
2	4	Competence that involves the application of knowledge in a significant range of varied work activities, performed in a variety of contexts. Collaboration with others, perhaps through membership of a work group or team, is often a requirement.	Grade 12 (School), National Senior Certificate	GCSE (Grade A*-C), Higher Diploma.
3	5	Competence that involves the application of knowledge in a broad range of varied work activities performed in a wide variety of contexts, most of which are complex and non-routine. There is considerable responsibility and autonomy and control or guidance of others is often required.	Higher Certificates and Advanced National (vocational) Cert.	AS and A Level, International Baccalaureate, Advanced Diploma, BTEC Certificate (Level 3)
4	6.	Competence that involves the application of knowledge in a broad range of complex, technical or professional work activities performed in a variety of contexts and with a substantial degree of personal responsibility and autonomy. Responsibility for the work of others and the allocation of resources is often present.	Diploma and Advanced certificates	Certificate of HE, HNC
5	7	Competence that involves the application of a range of fundamental principles across a wide and often unpredictable variety of contexts. Very substantial personal autonomy and often significant responsibility for the work of others and for the allocation of substantial resources features strongly, as do personal account	Bachelor's degree and Advanced Diplomas	Diploma of HE, Diploma of FE, Foundation Degree, HND.

		abilities for analysis, diagnosis, design, planning, execution and evaluation.		
6	8	Bachelors/Honours degree level qualification.	Honours degree, Post Graduate diploma and Professional Qualifications	Graduate Degree, Graduate Certificate, Graduate Diploma.
7	9	Master's degree level qualification.	Master's degree	Master's Degree, PG Certificate, PG Diploma.
8	10	Doctoral degree level.	Doctorate	Doctorate

Appendix 5: University of Pretoria regulations

UNIVERSITY OF PRETORIA

DEPARTMENT OF RESEARCH SUPPORT

REGULATIONS FOR THE ESTABLISHMENT AND OPERATION OF UNITS, CENTRES, INSTITUTES AND BUREAUS

1. OBJECTIVE

The objective of the regulations is to provide a consistent and coherent framework to allow for growth, expansion and consolidation of current and past research activity within identified strategic research foci at the University.

2. PRINCIPLES

The regulations are based on the following principles:

1. Separation between basic research, services, social responsibility activities and activities which have primarily a commercial focus.
2. None of the entities whose formation is defined in this document should have the primary responsibility for offering degree programmes. Degree programmes should be offered by departments or schools, with the participation of the members of these entities.
3. That full or part-time members of the entities would normally be appointed within academic departments.
4. That research entities are evaluated at regular, pre-determined intervals to be determined by the Vice-Principal (Research) and/or in consultation with the Senate Research Committee
5. That entities already established prior to these regulations being approved are to be re-evaluated with a view to making their position congruent within the broader framework provided by this document.
6. The Research Office will be responsible for the maintenance of an institutional database of all active research entities and their status as determined by the Vice-Principal (Research) and/or the Senate Research Committee (SRC).

3. CATEGORISATION OF ENTITIES IN TO STREAMS

In order to make the University's current research profile more coherent and to give added shape and purpose to it, various research and research-based activities will be classified into different streams.

The first stream will be characterized by those activities focused on primary research and the development of new knowledge (Research Stream). The second stream will encompass activities which although not exclusively concentrated on the generation of primary data and the development of new knowledge, nevertheless embrace research-based activities addressing issues of contemporary social responsibility and, on occasion require training designed to enhance operating efficiencies within community-based projects. (Social Responsibility Stream). The third stream encompasses contract research and continuing education programmes that primarily target commercial activity (Business Stream).

Activities conducted by an entity in any one stream may contain elements of work that is characteristic of another stream/s. The defining characterisation of an entity in any

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particular stream would depend on the major activity within the entity. The University's regulations pertaining to contract research and the ownership of intellectual property will apply to members of all the entities described in this document.

4. ENTITIES WITHIN THE STREAMS

4.1. RESEARCH STREAM

The entities within the Research Stream will be involved in research including contract research that is either wholly defined by the academic or jointly defined by the head of the entity and his staff in consultation with the client. The entities will be established for an initial period of five years and subsequent cycles of renewal will be dependent on evaluation and approval of academic performance. The Vice-Principal (Research) may, after consultation with the SRC, determine the composition of the review panel who may have one or more outside experts in the field to help determine the level of the entities performance and arrive at a decision regarding the continuation of the entity.

Three different levels of research activity are envisaged to exist within the stream. In ascending order these are Research Units, Research Centres and Research Institutes. Under normal circumstances, academic progress and finances permitting, the Vice-Principal (Research) and the SRC, in keeping with UP's research strategy and Faculty Research Plans would envisage units developing into centres and where appropriate, centres of proven excellence, developing into institutes. The defining characteristics of each of these entities is given below:

4.1.1 Research Units

4.1.1.1 Characteristics

Recognises the achievement of researchers, usually at the start of their career or entering mid-career at the university. The individual academic will have achieved national recognition in a particular field and have established a research team of Masters and Ph.D. students and may have technical support. The individual will normally have been successful in attracting external funding to support the activities of the unit.

4.1.1.2 Establishment

The Unit would be headed by a Unit Director and established within a Department and approved by the relevant Faculty Board after having considered the constitution and business plan of the unit. The business plan of the unit will have to be approved within the overall framework of the Faculty Plan. The motivation for the establishment of the Unit and appropriate supporting documentation on which the Faculty Board based its decision to establish a unit will be sent to the Senate Research Committee for approval.

4.1.1.3 Governance

The Unit Director will be a member of a Department and report to the Head of Department. The constitution and strategic plan will be developed and recorded by the Department and Faculty. A copy of all the documentation should be deposited with the Research Office. The financial, budgeting and reporting procedures are outlined in Annexure A.

4.1.2 Research Centres

4.1.2.1 Characteristics

A centre will be developed around an outstanding researcher who has achieved national and international recognition working within a defined area. The centre will in addition consist of other academic staff members working in closely related cognate areas. The Head of the centre and the other academic members will have established teams of Masters and PhD students and may have technical support. The academic members of the centre will have been successful in attracting external funding to support the activities of the centre.

4.1.2.2 Establishment

A Centre is established within a Department, School or a Faculty. The business plan of the centre will have to be approved within the framework of the Faculty Plan. The Centre would be headed by a Director. It's establishment needs to be recommended to the Senate Committee on Research by the Faculty Board after having considered the motivation for the establishment of the centre, its constitution and business plan. The Senate Research Committee will consider the proposal and recommend the approval of the establishment of the Centre to the Senate.

4.1.2.3 Governance

The Centre Director will be member of a department, however he/she will report to the Chair of a School or the Dean of a particular Faculty. The constitution and a strategic plan will be developed and recorded by the Department and Faculty. A copy of all the documentation should be deposited with the Research Office. A Centre must have an Advisory Board whose composition is defined in its constitution. The financial, budgeting and reporting procedures are outlined in Annexure A.

4.1.3 Research Institutes

4.1.3.1 Characteristics

An Institute will be created in a particular research field where the University has exceptional and widespread competencies. Institutes will be built around a substantial core of talented research staff. The Director of an Institute will be an exceptional and highly regarded research leader within a particular field. The Institute will further consist of a number of research groups headed by established researchers. The activities within an institute however will be relatively broad. It will be highly advantageous for an Institute to span more than one Faculty but this will not be a requirement.

4.1.3.2 Establishment

An Institute will be established within a Faculty/s. The Institute will be headed by a Director. The head of an Institute will be a member of Senate. It's establishment needs to be recommended to the Senate Committee on Research by the Faculty Board after having considered the motivation for the establishment of the Institute, its constitution and business plan. The business plan of the institute will have to be approved within the framework of the Faculty/s Plan. The Senate Research Committee will consider the proposal and recommend the approval of the establishment of the Institute to the Senate. An Institute must have an Advisory Board whose composition is defined in its constitution.

4.1.3.3 Governance

Members of the Institute will have appointments in appropriate department/s. An Institute will have an advisory board with the Dean of the Faculty being the Chair of the board. The constitution and strategic plan will be developed and recorded by the Faculty. A copy of all the documentation should be deposited with the Research Office. The Institute will issue an annual report to the Senate Committee on Research which will recommend its adoption by the Senate. The financial, budgeting and reporting procedures are outlined in Annexure A

4.2 SOCIAL RESPONSIBILITY STREAM

Centres will be the only entity within the social responsibility stream. The mission of a centre will be structured around a basic research, training and services mandate that will define their mission.

4.2.1 Characteristics

A Centre will be created around a respected leader in a field that has high relevance to the society in which we live. The field of activity will be relatively broad. The Centre will also have a number of senior staff members with a track record in research and/or service and/or community involvement. It will be highly advantageous for the Centre to span more than one Faculty but this will not be a requirement.

4.2.2 Establishment

A Centre within the social responsibility stream will be established in consultation with the Executive of the University. The executive will determine its placement within University structures and its mode of operation. The Center will be headed by a Director. The Constitution and business plan of the Centre will be lodged with an appropriate administrative structure of the University which will be determined by its mode of operation.

4.2.3 Governance

The Director of the Centre will report to a Vice-Principal or a Dean and should have a status equivalent to a head of department. Members of the Centre will have appointments in appropriate department/s. The financial, budgeting and reporting procedures are outlined in Annexure A.

4.3 BUSINESS STREAM

A Bureau will be the only entity within the Business Stream operating within the academic domain.

4.3.1 Characteristics

A Bureau will be constituted around a senior academic in the University. The major function of a bureau will be to provide services, training and contract research where the research is defined largely by the client. A Bureau will also have a number of senior staff members. Members of the Bureau will have appointments in appropriate department/s.

4.3.2 Establishment

A Bureau can be established within a Department, School or a Faculty. The Constitution and business plan should be lodged with the faculty, BE@UP and the Research Office and approved by the Senate Committee on Research. It's establishment needs to be recommended to the Senate Committee on Research by the faculty Board. The Senate Research Committee will consider the proposal and recommend the approval of the establishment of the Bureau to the Senate. A Bureau must have an Advisory Board whose composition is defined in its constitution. The business plan of the unit will have to be approved within the framework of the Faculty Plan.

4.3.3 Governance

The Director of the Bureau will report to a Dean. Members of the Bureau will have appointments in appropriate department/s. The Bureau will have an advisory board chaired by the Dean of the Faculty. The constitution and a strategic plan will be developed and recorded by the Faculty. A copy of all the documentation should be deposited with the Research Office and with [BE@UP](#). The financial, budgeting and reporting procedures are outlined in Annexure A.

5. FORMATION OF AN ENTITY

The formation of a of a new research Unit, Centre, Institute or Bureau, must be motivated and reflect the past and expected outputs and expertise of the prospective members of the entity.

Submissions must be accompanied by a draft constitution containing the following:

- A mission statement
- The aims and purpose of the grouping
- How membership of the grouping is constituted
- The modus operandi of the grouping
- The manner in which its outputs will be disseminated
- A business plan of the grouping and the source of the resources required for its operation.

In the case of institutes, bureau's and centres it will be necessary to establish an advisory board, with at least two members from outside bodies of standing in the academic or wider community. The purpose of this board is to advise the institutes, bureaus and centres and to ensure that the activities undertaken by them are appropriate and comply with internationally recognized standards, and that they are functioning at an appropriate academic level comensurate with their standing in the university's research structures. The composition of the advisory board is defined in the constitution of the entity. The appointment of the members of an advisory board is undertaken by the Dean in consultation with the appropriate Vice-Principal and the Vice-Principal (Research).

5. EVALUATION OF ENTITIES

The evaluation of Units, Centres, Institutes and Bureaus will form part of the normal evaluation processes of schools and faculties. This evaluation will consider the role of the Units, Centres, Institutes and Bureaus within the overall framework of the school or faculty. In addition the Units, Centres, Institutes and Bureaus will be evaluated by a group of peers appointed by the Dean of the Faculty in consultation with the Research Office and the Office for Quality Assurance. The terms of reference for the review will be based on criteria appropriate to the activities of the entity being reviewed and will be used

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to make a decision regarding the continuation of the Unit, Centre, Institute or Bureau. It is anticipated that Institutes would have a longer lifespan than other entities defined in this document.

Entities already established will be evaluated after the regulations have been approved. The criteria for the evaluation of the entities will be determined by the Vice-Principal (Research) in consultation with the Senate Committee on Research. The protection of brand equity will constitute one of the criteria for the evaluation of the entities already established.

6. TERMINATION OF ENTITIES

The existence of an entity will depend on the outcome of the review processes that would be undertaken every five years. If the review recommends that an entity should be closed, a suitable period will be allowed for the winding up of the entity.

Appendix 6 – QAA materials benchmark

1 Introduction

1.1 Since the Stone Age the development of materials has been fundamental to the advancement of civilisation. Without an understanding of materials we could not fly the Atlantic, surf the internet or replace a heart valve. Tomorrow's developments await further advances in materials.

1.2 This statement is primarily concerned with undergraduate programmes with a major materials science or materials engineering component. However, parts will be applicable to interdisciplinary programmes with a minor materials component.

1.3 Accreditation of particular programmes by the professional engineering institutions, for their own membership requirements, is an entirely separate exercise, but this statement is intended to assist professional institutes during the accreditation and programme review process. This statement, revised in 2007, is primarily concerned with the bachelor's degree with honours and with integrated master's (eg MEng) degrees which are required to complete the academic requirements for the achievement of Chartered Engineer (CEng) status in accordance with the *United Kingdom Standards for Professional Engineering Competence* (UK-SPEC) published by the Engineering Council UK (www.engc.org.uk).

2 Materials as an academic discipline

2.1 The academic study of materials encompasses aspects of the physical sciences and of engineering (see figure 1). There are two central themes: the link between structure (on length scales from sub-nm to mm) and chemical, physical and mechanical properties; and how control of microstructure through processing can be used to optimise engineering performance. Modelling is increasingly used to predict both microstructure and properties.

2.2 The range of programmes to which this benchmark statement applies is diverse and extends from science-based to engineering-based programmes.

2.3 The study of materials science develops a basic understanding of the part played by selection of materials and choice of manufacturing process in meeting an engineering specification. The study of materials engineering must have its foundations in materials science. The respective weightings of these two aspects should be a conscious element of programme design.

2.4 Materials are central to the economic well-being of the country. This is reflected by developments in areas of materials such as 'smart' materials, layered materials, soft solids, nanotechnology, sensors and biomimetics. Materials scientists or engineers help to develop the materials required for new products, find better lower-cost manufacturing routes, and enhance the performance of existing materials. They consider the environmental impact and sustainability of their products. They discover how to optimise the selection of materials and create sophisticated databases from which properties and service behaviour can be predicted.

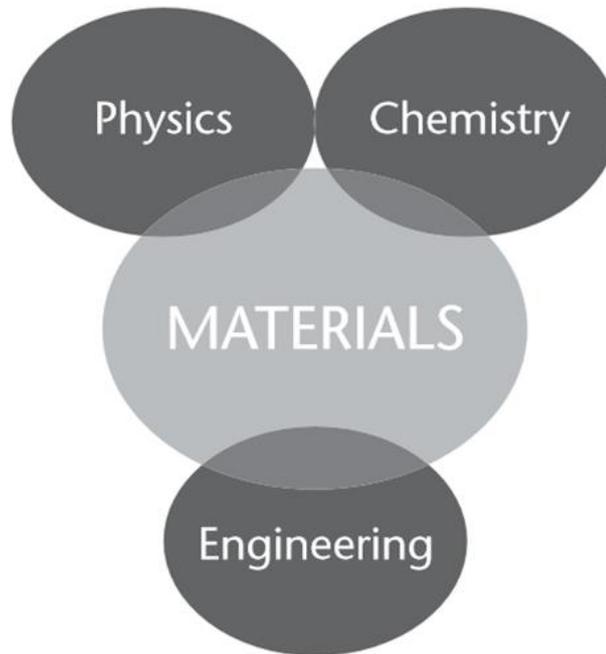
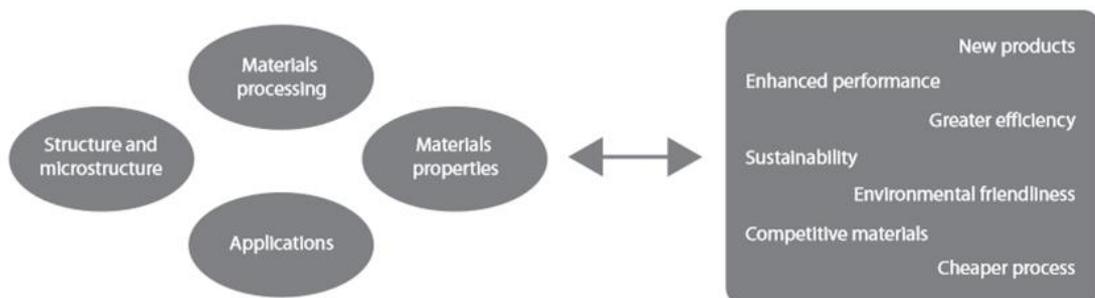


Figure 1.

2.5 Materials scientists or engineers may work in the manufacturing, processing or user industries, in research, production, management or in sales. They may be concerned with mass-produced artefacts such as cars, tableware, or building materials, or specialist products such as those needed for micro-electronics, sports equipment, replacement body parts, energy generation or aerospace. Some of the relevant themes and linkages between them are set out in figure 2.



3 Subject knowledge, understanding and skills

3.1 This section describes the knowledge, skills and attributes that a materials graduate would be expected to possess, and includes reference to materials-specific aspects, background science and generic skills. The knowledge and skills are grouped into materials, scientific and engineering, and generic.

Materials-related knowledge and skills

3.2 Materials programmes may be general or specialist, theoretical or applied. Degree programmes offered by individual institutions may vary considerably. However, it is anticipated that materials graduates will have an awareness of a range of materials, and some familiarity with relevant concepts associated with most of the following:

- **structure of materials** - electronic, atomic, bonding, crystalline, amorphous and multiphase; and structure on the nano, micro, meso and macro-scales
- **phase equilibria and phase transformations** - thermodynamic and kinetic aspects
- **characterisation of composition and microstructure** - spectroscopy; optical and electron microscopy; electron and X-ray diffraction; scanning probe techniques; thermal analysis; and some aspects of traditional chemical analysis
- **mechanical behaviour** - elastic and plastic deformation and fracture, for example, creep and fatigue; strengthening, toughening and stiffening mechanisms; mechanical test methods; and continuum mechanics
- **functional behaviour** - semi, dielectric and optical conducting; and magnetic materials
- **biomaterials** - materials that interact with biological systems; materials of biological origin; and biomimetics
- **processing and manufacture** - processing and synthesis of materials via gaseous, liquid, colloidal, powder, solid state and deposition techniques; joining and fabrication methods; surface treatment; heat and mass transfer; and fluid mechanics
- **degradation/durability of materials** - effect of liquid and gaseous environments on the performance of different material types; wear of materials; and biodegradation
- **materials selection** - consideration of all material types, including material processing methods, and product costs; selection criteria for materials and production processes
- **design with materials** - this area is key to the use of materials. Graduates in materials should have the ability to select appropriate compositions and use processing to achieve the required microstructure, hence the required structural and functional properties in a product, often in order to meet specifications
- **lifecycle analysis, sustainability and environmental impact**
- **interaction and application** - interaction between composition, processing, microstructure and properties, leading to appropriate application of materials.

3.3 Materials graduates should have had opportunities, through practical work, for first-hand experience of a range of techniques and materials (artefact analysis, characterisation, processing, testing etc) designed to develop the ability to plan, implement and interpret experimental investigations. Experience of computer modelling techniques is also desirable.

Scientific and engineering-related knowledge and skills

3.4 In order to understand the materials topics discussed above, materials graduates will need to acquire an adequate knowledge of mathematics and sciences to prepare a foundation for learning within the materials discipline. Examples of these requirements are given below. It is not expected that materials graduates will be required to study all of these (eg biology). Materials graduates will also need to acquire adequate engineering knowledge and skills in order to understand aspects of materials production and service and to be able to communicate effectively within the engineering profession at large.

3.5 Such requirements include:

- **mathematics:** the need to understand mathematics as a method of communicating results, concepts and ideas (eg apply a range of statistical methods to the planning of experiments and the interpretation of data); and use mathematical and computational tools (eg the modelling of structure, properties or processing of materials) for solving complex problems
- **chemistry:** the need to develop an adequate understanding of chemistry to support a range of materials disciplines. Aspects of organic, inorganic and physical chemistry may be required to varying depths. The chemistry content should be sufficient for the understanding of important topics such as thermodynamics and kinetics and the chemical aspects of materials production, processing, stability and degradation
- **physics:** the need to have a broad foundation in physics for the understanding of materials. This foundation will need to sustain the development of the understanding and characterisation of materials structure and properties (eg waves, optics and solid state physics). Many applications of materials will require additional topics, such as electronics and mechanics, to be developed
- **biology:** the need for an adequate understanding of biology (eg basic cellular structure and function, basic protein structure etc) in order to support aspects of biomaterials programmes.

General engineering principles

3.6 In addition to the above, materials engineers will be expected to appreciate the interrelationship between materials engineering and engineering design. In addition, students (particularly those studying for a four-year MEng) will need a foundation of engineering science in order to understand manufacturing/processing/fabrication methods and predict the service performance of materials (eg strength of materials and mechanics of solids; and principles of manufacture including computer-aided engineering and computer modelling).

Generic skills

3.7 Those graduating with a degree in materials will have good professional judgement, be able to exercise original thought, and, having gained experience, take responsibility for the direction of important tasks. In order to demonstrate these skills they will need to possess:

- the ability to communicate in writing, orally and using graphics
- the relevant mathematical and computational skills
- problem-solving skills
- the ability to exercise original thought
- competence in using information technology effectively
- the ability to work in a team
- the ability to manage time and resources
- an awareness of functions required for organisational success
- study skills needed for continuing professional development
- an awareness of sustainability and environmental issues
- problem-solving and creativity skills.

3.8 In addition to the above, graduates would be expected to have had opportunities to tackle open-ended problems which provide opportunities for the demonstration of problem-solving skills and creativity.

4 Teaching, learning and assessment

4.1 Existing materials programmes have been developed over many years and deploy a diverse range of teaching, learning and assessment methods to enhance and reinforce the student learning experience. The programmes covered by this statement encompass a wide range of types of material and are (or will be) offered through many modes and patterns of study. Teaching, learning and assessment methodology must always be justified in terms of the learning outcomes of the programmes and the background of the students. The methods used should be made explicit to the students taking each programme, and should be evaluated regularly (and modified where appropriate) in response to generic and discipline-specific developments⁸.

4.2 Curriculum design must be informed by research, scholarship and an understanding of the potential destinations of graduates. It is not possible for students to achieve a satisfactory understanding of materials science and engineering without significant exposure to laboratory work and without undertaking a substantial project. Many projects should be research-led and the curriculum would be expected to develop in graduates both independence of thought and the ability to work effectively in a team. Where appropriate, all teaching needs to be placed within the context of social, legal, environmental and economic factors relevant to the production and use of materials.

⁸ The UK Centre for Materials Education (the Higher Education Academy Materials Subject Centre established by the higher education funding councils) should be able to provide advice if this is required.

4.3 Methods of assessment should reflect the specified learning outcomes. A balance should always be struck between the need to test a student's understanding, knowledge and ability for the purposes of awarding a qualification and providing an appropriate and valuable incentive to student development. Where possible, assessment methods should reflect the demands that graduates are likely to face in their future careers, including problem-solving and the need to express technical material clearly and accurately in writing. An important element of assessment is that students are given feedback to allow continued personal development.

4.4 Examples of teaching and assessment methods which might be appropriate for use within the materials discipline are given in Appendix A. However, these lists are not intended to be either prescriptive or comprehensive, since imaginative innovation in teaching often plays a large role in motivating students and expanding their interest in the discipline.

Project work

4.5 Materials graduates would be expected to have carried out an individual research project. These projects would develop competence in investigating, managing and applying knowledge, usually in the solution of a complex materials problem. Such a project will be described in a report, which will demonstrate the abilities to:

- analyse quantitatively and assess the uncertainty of results
- understand the published literature on the topic of the investigation that demonstrates both what is known and the limits of current knowledge
- select the methodology to undertake investigation
- present findings in a clear and concise manner
- interpret and discuss findings in the light of current knowledge
- summarise the main conclusions and provide an accurate synopsis of the work undertaken.

4.6 It is also desirable that graduates will have participated in an activity involving teamwork. Such teamworking on a project is a necessary requirement for MEng and for CEng registration according to the UK-SPEC.

Industrial experience

4.7 This may be acquired via, for example, speakers from industry, industrial placements, industrial visits, and industrial projects. Many materials graduates will also be familiar with the organisation and structure of business, economic analysis, environmental issues (health and safety at work, the *Control of Substances Hazardous to Health* regulations, pollution, recycling etc) and ethical professional behaviour.

5 Standards and levels of student attainment

Honours degree

5.1 The standards of student achievement are divided into three attainment levels: excellent; typical; and threshold for an honours degree in materials.

Attainment level: excellent

- Understanding of the subject and techniques is extensive, extending beyond the information provided in the programme. Knowledge and techniques are applied quickly and readily to new situations, including any unseen or open-ended problems. Both the problem and the solution can be critically appraised. New knowledge is acquired quickly and accurately.
- Routine calculations, explanations, interpretations and analysis are executed swiftly and accurately. Understanding of relevant facts and techniques is excellent. There is a fluency and confidence in method of approach.
- Project or practical work is planned, executed and written up with little assistance. There is clear evidence of original thinking in the analysis and discussion of results, with excellent understanding of literature and of relevant practice. There is a clear plan of future work.
- Practical (or relevant) competence is clearly demonstrated. The ability to innovate is also clearly demonstrated.
- Students have excellent generic skills and time-management ability.

5.2 A graduate at this level would be a highly sought-after honours graduate. After an appropriate period of professional experience, the graduate would become an excellent practitioner capable of exercising sound judgement. Career prospects could include research, innovation or technical management with the expectation of significant managerial responsibility. There is likely to be rapid progress to a senior executive position.

Attainment level: typical

- Understanding of the subject and techniques is good, but may be more confined to the programme. There is an understanding of what knowledge and techniques can be applied to new situations. The methodology for solving problems can be clearly demonstrated. New knowledge is readily acquired.
- Routine calculations, explanations, interpretations and analysis are executed accurately. Understanding of relevant facts and techniques is good. There is a fluency and confidence in method of approach over most of the subject.
- Project or practical work is planned, executed and written up with guidance. Results are analysed and discussed in a competent manner. There is good understanding of literature and relevant practice with suggestions for future work.
- Practical or relevant competence is demonstrated over most of the range expected. The ability to innovate is demonstrated.
- Students have good generic skills and time management ability.

5.3 After an appropriate period of professional experience, the graduate would become a good practitioner capable of exercising sound judgement. Career prospects could include research, innovation or technical management, with the expectation of significant managerial responsibility and the possibility of achieving a senior management position.

Attainment level: threshold

- Understanding of the subject and techniques is basic and selective. There is a recognition of what generic knowledge should apply to a new situation, but there may be less confidence in how to use it. The methodology for solving problems can be explained even if it cannot be applied. New knowledge is acquired with perseverance.
- Routine calculations, explanations, interpretations and analysis can be identified but may require checking and assistance to complete the task. There is general competence in answering questions concerning routine aspects. There is selective knowledge of terms and their application. Some assistance may be required in explaining fundamental concepts. Mistakes can be identified, but not necessarily rectified.
- Project or practical work is planned and executed with reasonable success but writing up may require help. The full significance of the results may not be immediately identified and some assistance may be required in their interpretation and discussion. A list of essential literature may be quoted without critical analysis. There is an indication of future work.
- Practical or relevant competence is selective, but may be good in specific areas.
- Generic skills may be good in certain aspects.

5.4 A graduate at this level would be a good potential trainee for either a technical or general management position. After an appropriate period of professional experience, the graduate is likely to develop into a good practitioner in a specific field, where an awareness of materials is essential but without the need to apply fundamental knowledge on a regular basis, eg production control.

Integrated master's (MEng)

5.5 An MEng is an integrated master's programme in engineering which provides an extended and enhanced programme of study, it is usually designed with reference to UK-SPEC as a preparation for professional practice and attracts the more able student. The period of study is typically equivalent to at least four years of academic learning (five years in Scotland) and the programme of study should be both broader and deeper than a corresponding bachelor of engineering honours programme and have an increased emphasis on industrial relevance. MEng students are expected to undertake both an individual research/design project and a more wide-ranging group project with strong industrial involvement, and to undertake master's level work at the higher levels of the programmes. MEng students would also be expected to have good generic skills. Further guidance can be found in the subject benchmark statement for engineering (2006).

⁹ The subject benchmark statement for engineering can be found at www.qaa.ac.uk/academicinfrastructure/benchmark/statements/Engineering06.asp

5.6 There should be a clear distinction between the attainment levels of identifiable bachelor's and MEng cohorts when taking common modules within a programme. This may be done by establishing separate learning outcomes for modules taught in common.

Threshold performance for integrated master's (MEng)

5.7 As above, with greater attainment in fundamental knowledge and generic skills. It would be expected that MEng graduates would reach at least the typical attainment level.

Appendix A - Examples of teaching and assessment methods

This appendix contains examples of teaching and assessment methods which may be appropriate for specific elements of materials programmes. The lists are intended to be illustrative and not exhaustive.

Teaching/study methods

- Formal lectures
- Interactive lectures
- One-to-one tutorials
- Small group tutorials
- Laboratory classes, structured or open-ended
- Exercise classes
- Computer-based learning
- Video footage
- Guided reading
- Student study groups
- Peer tutoring
- Library/information retrieval tasks
- Field trips/works visits
- Training during work placements
- Case studies
- Problem-based learning
- Individual projects
- Team projects
- Reflective journals
- Concept mapping

Assessment methods

- Timed examinations
- Open-book or untimed examinations
- Laboratory examinations
- Oral examinations
- Computer-aided assessment
- Problem-solving tasks
- Essays
- Oral presentations
- Poster presentations
- Laboratory reports
- Workplacement reports
- Learning logs/portfolios
- Project reports
- Self-assessment
- Peer assessments

Appendix B - Membership of the review group for the subject benchmark statement for materials

The revision to this subject benchmark statement was coordinated by:

Professor Peter J Goodhew

University of Liverpool

Emeritus Professor Frank Robert Sale

University of Manchester

The review involved extensive consultation across the sector.

Appendix C - Membership of the original benchmarking group for materials

Details below appear as published in the original subject benchmark statement for materials (2002).

Dr Cris Arnold	University of Wales, Swansea
Dr Chris Bowen	University of Bath
Professor Robert Freer	University of Manchester Institute of Science and Technology
Professor Peter Goodhew (Vice-chair)	University of Liverpool
Dr Marianne Gilbert	Loughborough University
Dr Henry McShane	Imperial College, London
Professor Panos Tsakirooulos	University of Surrey
Dr John Parker	University of Sheffield
Professor Frank Sale (Chair)	University of Manchester
Dr Ray Smith	Queen Mary and Westfield University, London
Dr John Sykes	University of Oxford
Dr Michael Wise	Tetronics Ltd, Faringdon, Oxon (previously University of Birmingham)