HSRC
Human Sciences Research Council

Human Sciences Research Council
Lekgotla la Dipatlisiso tša Semahlale tša Setho
Raad vir Geesteswetenskaplike Navorsing
Umkhandlu Wezokucwaninga Ngesayensi Yesintu
Ibhunga Lophando Ngenzulu-Lwazi Kantu

Operations
Information Services

HSRC Research Output Submission Template

Please complete this template and submit it – along with the print or electronic copy of the research output concerned – to Hanlie Rossinger (hrossinger@hsrc.ac.za). The research output will be added to the research outputs database and published on the Internet and Intranet, as well as in the HSRC Annual Report and other reports where appropriate.

Please note that research outputs cannot be added to the database if this form is not completed and submitted.

Is this output project related?	Yes		No	X	If yes, provide the project number		
Title	Evidence-based Impact Studies of Innovation on Human and Social Dynamics & Development in South Africa						
Authors	N Mustapha, MM Sithole, YD Davids, D Labadarios						
Type of output	Select the appropriate output type from the list below						

	Monograph/book*	
	Peer reviewed	
	Non-peer reviewed	
	Chapter in Monograph/book*	Title of monograph/book in which chapter appears
	Peer reviewed	
	Non-peer reviewed	
	*(For monographs/chapters, a letter from publisher must be submitted as proof of peer review.)	
	Journal Article	Title of journal in which article appears
	Peer reviewed	
	Non-peer reviewed	
	Newspaper Article	
	Review in Journal	
	Research Report- Client	Client name and month in which report was submitted
	Research Report- Other	Month in which report was submitted
X	**Conference or Seminar Papers**	Name, date and place of conference/seminar: HSRC Conference, 2011, Johannesburg
	Other, please specify	

Confidential?	Yes		No	X	
Submitted by:	Nazeem Mustapha				

www.hsrc.ac.za

Pretoria Office
134 Pretorius Street, Pretoria, 0002, South Africa. Private Bag X41, Pretoria, 0001, South Africa.
Tel: +27 12 302 2177 Fax: +27 12 302 2041

Cape Town Office
Plein Park Building, 69-83 Plein Street, Cape Town, 8001, South Africa.
Private Bag X9182, Cape Town, 8000, South Africa. Tel: +27 21 466 8000 Fax: +27 21 466 8001

Durban Office
750 Francois Road, Intuthuko Junction, Cato Manor, Durban, 4001, South Africa.
Private Bag X07, Dalbridge, 4014, South Africa. Tel: +27 31 242 5400 Fax: +27 31 242 5401

Port Elizabeth Office
44 Pickering Street, Newton Park, Port Elizabeth, 6055, South Africa.
PO Box 34115, Newton Park, 6055, South Africa. Tel: +27 41 399 8700 Fax: +27 41 399 8711

HSRC
Human Sciences
Research Council

Human Sciences Research Council
Lekgotla la Dinyakisišo tša Semahlale tša Setho
Raad vir Geesteswetenskaplike Navorsing
Umkhandlu Wezokucwaninga Ngesayensi Yezintu
Ibhunga Lophando Ngenzulu-Lwazi Kantu

Operations
Information Services

Submission date:	29 August 2012

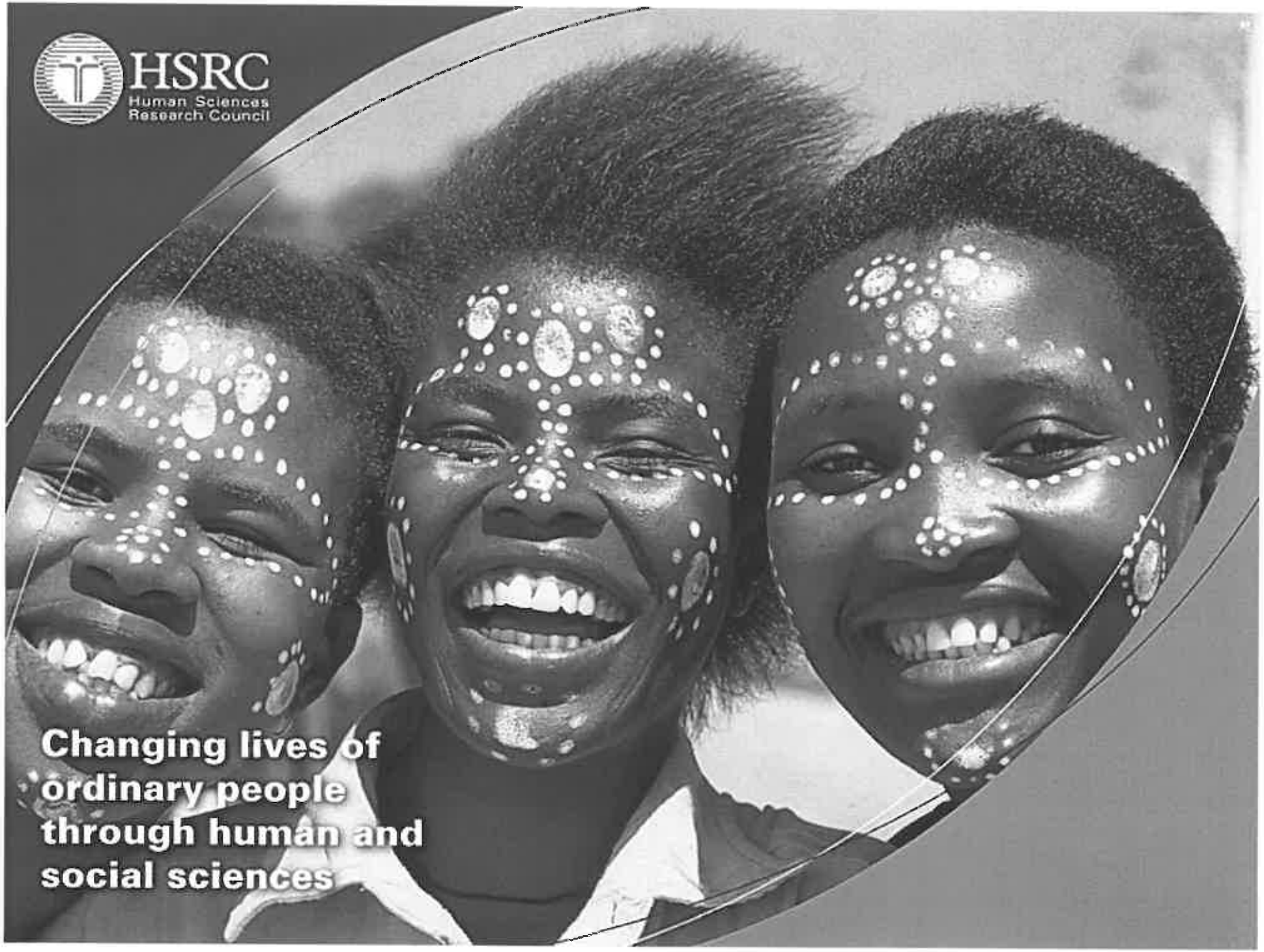
Pretoria Office
134 Pretorius Street, Pretoria, 0002, South Africa. Private Bag X41, Pretoria, 0001, South Africa.
Tel: +27 12 302 2177 Fax: +27 12 302 2041

Cape Town Office
Plein Park Building, 69-83 Plein Street, Cape Town, 8001, South Africa.
Private Bag X9182, Cape Town, 8000, South Africa. Tel: +27 21 466 8000 Fax: +27 21 466 8001

Durban Office
750 Francois Road, Intuthuko Junction, Cato Manor, Durban, 4001, South Africa.
Private Bag X07, Dalbridge, 4014, South Africa. Tel: +27 31 242 5400 Fax: +27 31 242 5401

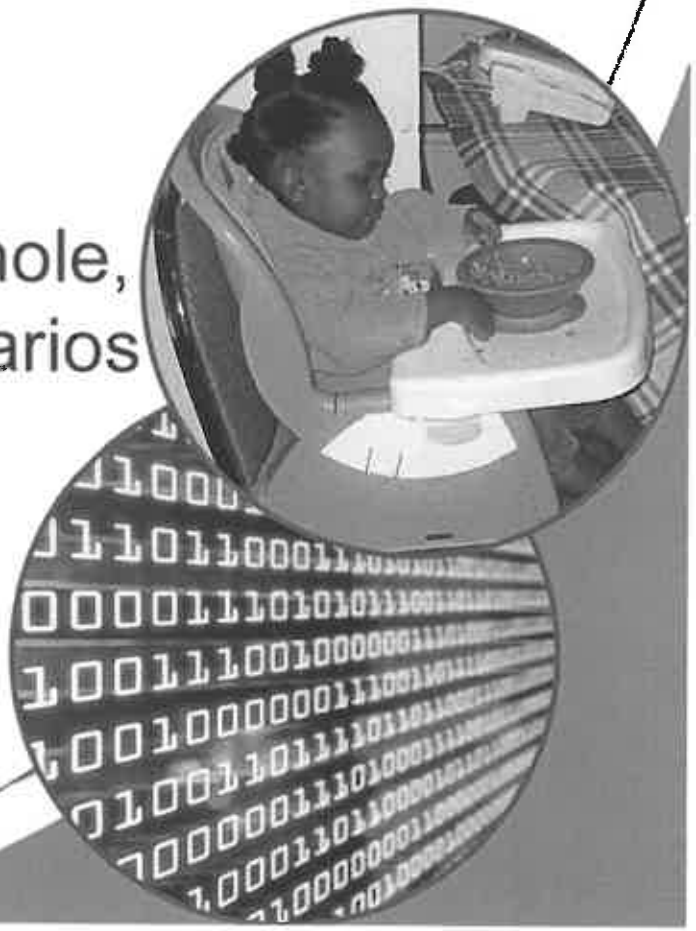
www.hsrc.ac.za

Port Elizabeth Office
44 Pickering Street, Newton Park, Port Elizabeth, 6055, South Africa.
PO Box 34115, Newton Park, 6055, South Africa. Tel: +27 41 399 8700 Fax: +27 41 399 8711


HSRC
Human Sciences
Research Council
Changing lives of
ordinary people
through human and
social sciences

Evidence-based Impact Studies of Innovation on Human and Social Dynamics & Development in South Africa

N Mustapha, MM Sithole,
YD Davids, D Labadarios



Population Health, Health Systems and Innovation

Introduction and Objective

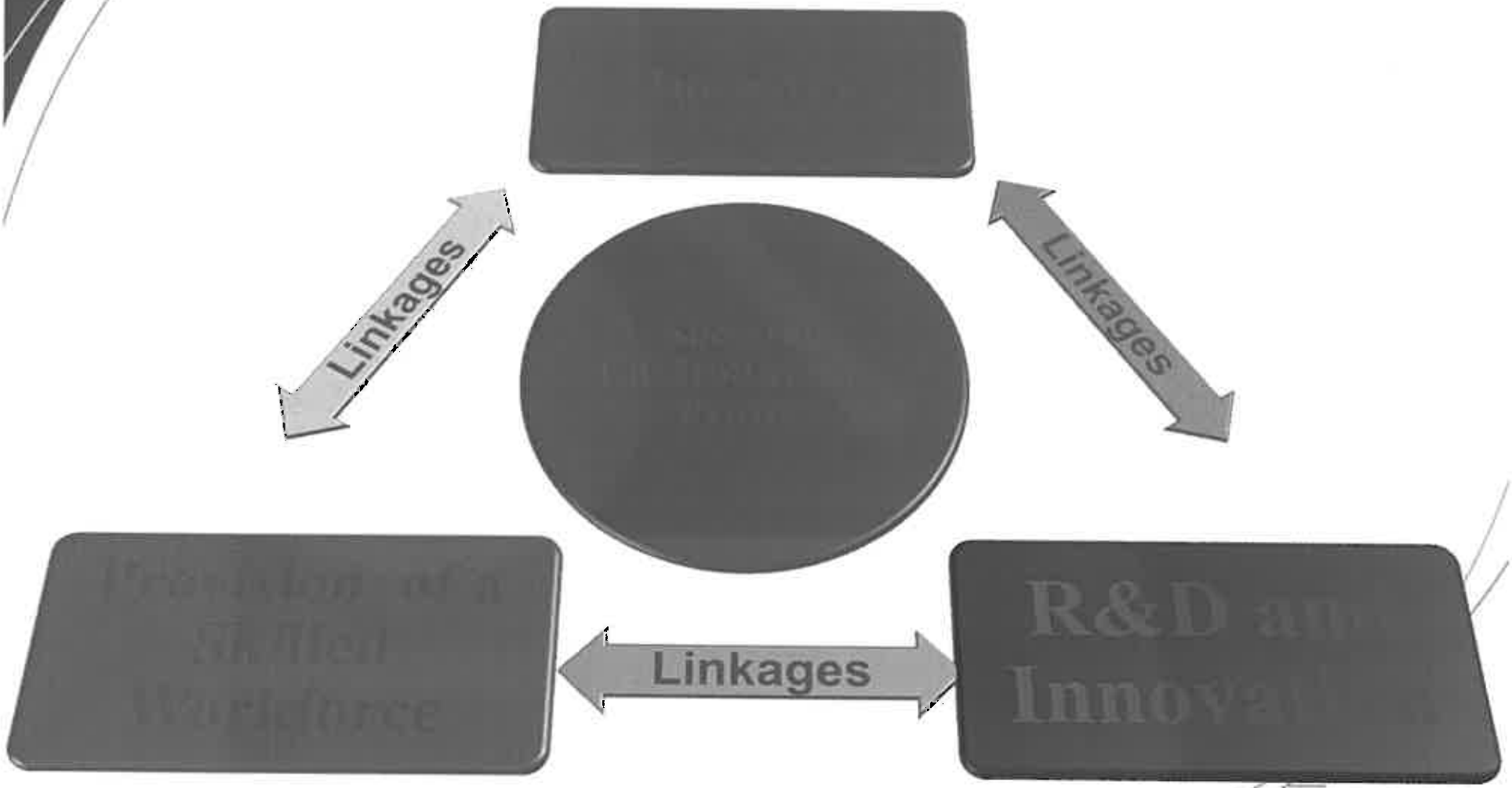
- Addressing inequalities with respect to development indicators such as access to basic necessities, health, and education has been one of the key concerns of the South African government since the inception of democracy in 1994.
- This work proposes a research framework within which to investigate the impact of South Africa's national strategic efforts on the well-being of all South Africans in terms of inequalities with respect to access to basic necessities, health, education and all other well-being indicators, incorporating especially the Millennium Development Goals (MDGs).

Introduction and Objective

- Medium Term Strategic Framework (MTSF, 2009-2014) is linked to the MDGs
- The following strategic initiatives of the MTSF with regard to the MDGs may be picked out for the context considered here,
- This work intends to inform on strategic priorities 1, 4, 5, 7, 8 and 9; that is collectively all eight MDGs. In addition, the Ten-Year Grand Challenge Plan (DST, 2008) emphasises the Knowledge Based Economy (KBE) in which 'the production and dissemination of knowledge enriches all aspects of human endeavour' also forms part of the basis of the framework.

HSRC
Human Sciences Research Council

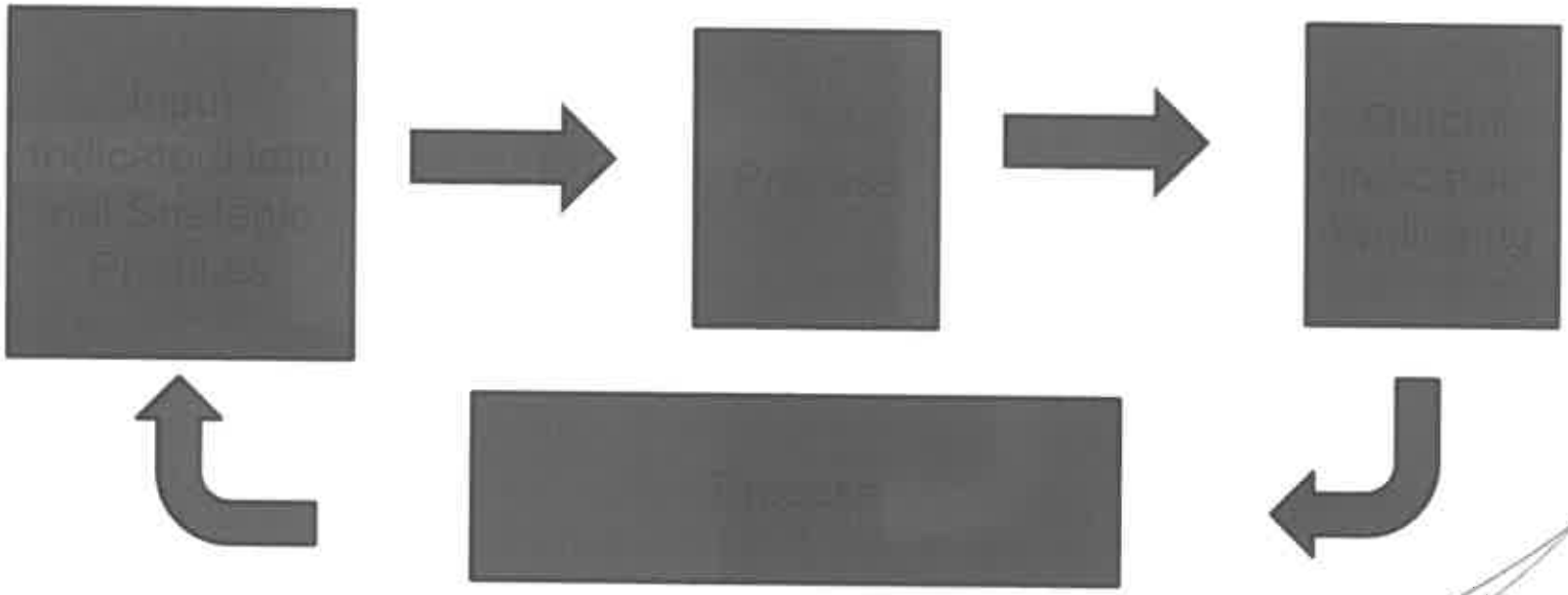
Systems Description: Key Dimensions for Innovation Studies



HSRC
Human Sciences Research Council

A Proposed Methodology

- studies of this type will inherently be non-linear and complex
- first order approximation would then be to consider a single input/output model but with feedback loops



Utility of the Approach

- Inputs can form clusters, in which factors in one cluster explain a certain underlying construct and influence the output indicator differently from factors in another cluster.
- In reality, one factor tends not to act alone in influencing a given outcome indicator, rather a group or groups of factors tend to jointly influence it.
  - For example, it is not realistic to expect that income inequality is only influenced by employment, but rather employment could influence it jointly with education, as well as other factors. The effect of one factor may then be assessed, while controlling for the other factors by keeping them constant.

HSRC
Human Sciences Research Council

Utility of the Approach

- The techniques needed to assess the impact may require applied mathematical tools, other than statistical (based on linear or non-linear programming operations research).
  - Factors in one cluster can influence factors in another cluster, and so on, in a hierarchical fashion, and eventually, factors in the highest hierarchy can, in turn, influence the output factor. Mathematical tools exist to describe this type of situation; for example, recursive regression models for spatial data, state space models for time series.
- To adequately inform policy, simulations are envisioned, including forecasts of scenarios to achieve set goals.

HSRC
Human Sciences Research Council

The Role of Case Studies, Interviews

- In some cases the process component of the model is ideally determined by investigation on a unit level. And whilst the MDG set and the MTSF are fundamental in all of this, the framework allows for studies not necessarily centered on national priorities or on a macro or country to country level. Instead the macro concerns could inform t
  - *An example*: Let us say one wanted to determine the impact of enterprise development interventions, for example innovation, in creating jobs. The information on the process operating for this system would require a micro-level investigation into how the process works (say a case study at firm level).

HSRC
Human Sciences Research Council

Illustration

The approach is utterly and entirely phenomenological; although this is perhaps not ideal. A more fruitful future approach would be to interrogate theories or even econometric hypotheses within the context of innovation or other related studies; and then choose suitable indicators depending on the theory or hypothesis being tested. For now we are more interested in a simple illustration of concepts.

Indicator	Description
Trade	Sum of merchandise exports and imports divided by the value of GDP,
Trademarks	Trademark applications filed are applications to register a trademark with a national or regional Intellectual Property (IP) office.
Fertility	Number of children that would be born to a woman if she were to live to the end of her childbearing years
Pollution	Carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring.
Labour	All people who supply labour for the production of goods and services during a specified period.

State Space Model

State vector

$$z^t = \left[x_1^t \quad \cdots \quad x_r^t, \quad x_1^{t+1|t} \quad \cdots \quad x_r^{t+1|t}, \quad x_1^{t+k|t} \quad \cdots \quad x_r^{t+k|t}\right]^T$$

Transition equation: Markovian

$$z^{t+1} = Fz^t + Ge^{t+1}.$$

k-step ahead expectation of the input vector give information of the input vector at k=0 (think of this as a forecast k steps into the future)

$$x^{t+k|t} \ (k > 0)$$

Analysis Steps and Results

- Pick a form of the state vector (canonical correlation).
- Find the best fit of parameters for matrices ***F*** and ***G*** (maximum likelihood).

$$x_4^{t+1|t} = F_4{}^7\, x_3^{t+1|t} + e_4^{t+1}$$

$$x_5^{t+1|t} = F_5{}^3 x_3^{t|t} + F_5{}^7 x_3^{t+1|t} + e_5^{t+1}$$

$$x_3^{t+2|t} = F_7{}^3 x_3^{t|t} + F_7{}^6 x_2^{t+1|t} + F_7{}^7\, x_3^{t+1|t} + \sum_{j=1}^{5} G_7{}^j\, e_j^{t+1}$$

$$x_2^{t+3|t} = F_8{}^3\, x_3^{t|t} + F_8{}^7\, x_3^{t+1|t} + \sum_{j=1}^{5} G_8{}^j\, e_j^{t+1}$$

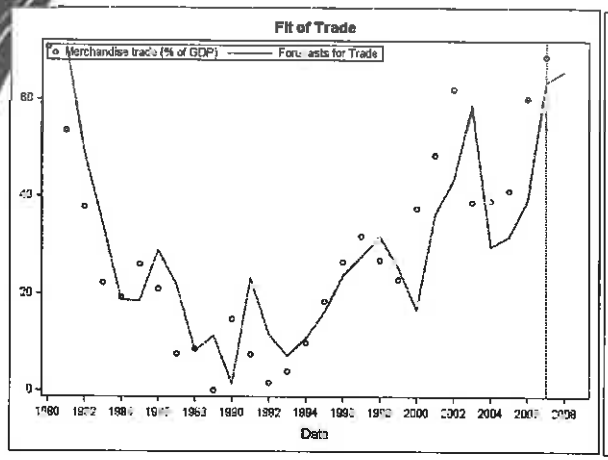
HSRC
Human Sciences Research Council

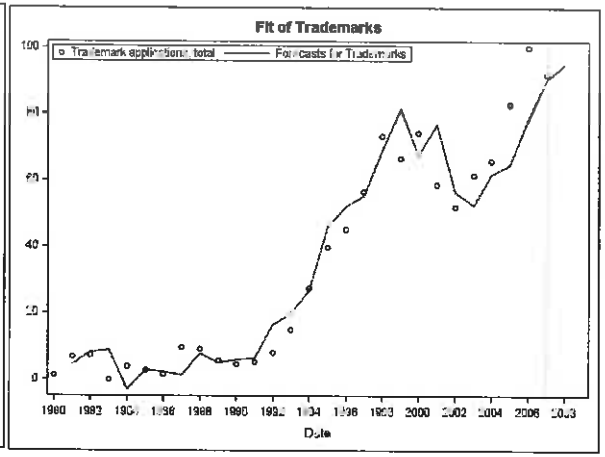
Analysis and presentation of findings

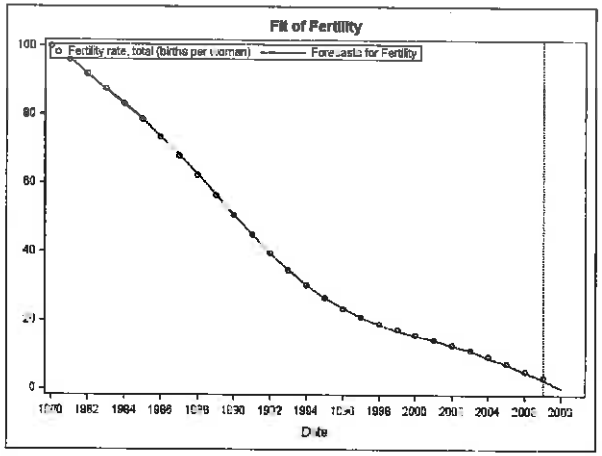
- Trade decouples (weakly) from the other variables
- Pollution is proportional to Fertility
- Labour is a weighted sum of Fertility and Fertility one year ago
- Fertility is a weighted sum of last years Fertility and Fertility two years ago and last years Trademarks
- Trademarks is a weighted sum of Fertility three years ago and Fertility two years ago
- Note the interplay in the last two equations

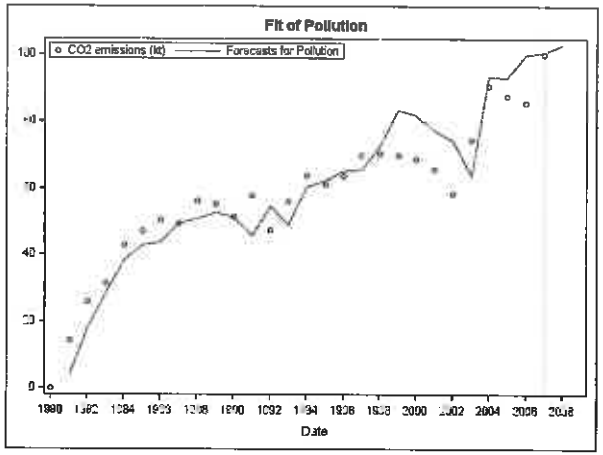
HSRC
Human Sciences Research Council

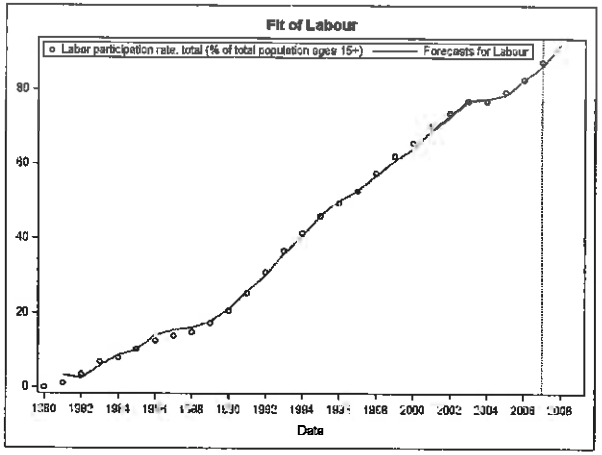
A Possible Use: Some Forecasts











- These forecasts are not weapon-grade, but are decent forecasts; the residuals are normal and iid
- Dynamical behaviour can be simulated also

Discussion

- The methodology proposed is to use a systems description to get at the linkages between phenomena that are thought to be related in a causal relationship, in a usually complex setting with potentially sparse data.
- The example used demonstrated that the proposal is feasible. Publically available national data for South Africa available from the World Bank was interrogated in this framework focusing on innovation and its impact on societal and environmental factors of human and social development. The results illustrated the power of the method in teasing out connections between dimensions that seem to appear only distantly linked.

HSRC
Human Sciences Research Council

Discussion

- The importance of longitudinal, especially panel, data is emphasised particularly for the understanding of causality, as this cannot be determined from a state space modeling approach. The results were definitive even at the macro level. But, generally speaking, unit level or local geographic or sector level investigations will provide better evidence for studies of this type.

HSRC
Human Sciences Research Council

Thank You