Assessing the fiscal impacts of development

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1 Introduction

The way that South African cities are being planned and built is changing. The Spatial Planning and Land Use Management Act was passed in 2014, providing municipalities with far greater powers over spatial planning decisions. In addition, the review of local government infrastructure grants undertaken by National Treasury, DCoG, the Financial and Fiscal Commission (FFC), SALGA, and the Department of Performance Monitoring and Evaluation (DPME) is recommending greater fiscal decentralisation and autonomy for metros. Despite the increased planning powers and control over resources, metros are still faced with severe housing backlogs and pressure to deliver housing solutions at scale. These dynamics provide a strong motivation for rational and evidence-based spatial planning decisions. The South African Cities Network and the National Treasury's City Support Programme commissioned this study to investigate the development of a tool to assist metros with this task.

This report presents the findings of the study into tools to assess the fiscal impacts of developments. The Terms of Reference for the study required:

1. The review of existing models and tools available to the municipalities to calculate and assess fiscal impact of land and residential developments;
2. An assessment of the whether these tools are adequate to determine costs to government, households and the environment with a key focus on costs to government, and whether they inform planning and development decisions, and therefore the need for the development of a new tool;
3. Engagement with a metro to unpack the development process and identify potential gaps and opportunities that a new tool could address;
4. Proposing recommendations for changes or enhancements to a metro tool; and
5. Developing a demonstration model in partnership with the selected metros that could be used by other metros.

This report is the second of the two reports produced for this project. The first report, the Evaluation Report, covered the detailed findings from activities 1 and 2 (above). **This evaluation concluded that metros do not have comprehensive methods of assessing large scale residential development proposals that take into account the total (or close to) fiscal impact (capital and operating) including the cost of provincial infrastructure required for greenfields projects**. This finding then required that the research project proceeded with activities 3, 4 and 5 (above).This report only summarises activities 1 and 2, but covers the remaining three activities in detail, as well as presents overall conclusions that can be drawn from the research project, including recommendations for further work.

2 Methodology

The review of the existing tools and practices for assessing fiscal impact of development was undertaken in two parts. The first part involved a survey of key officials in each of the cities, supplemented with documentation regarding the tools, where available. The second part involved a desktop review of other existing tools that have been applied in South Africa more generally by parties external to municipalities (provinces, research bodies, consultants). Following from this review, which was previously presented in the Evaluation Report, the eThekwini metro was selected as the case study municipality in which to pilot the development of a new tool to determine fiscal impact. Three engagements were held with the eThekwini Municipality to scope and design the Fiscal Impact Tool.

2.1 Metro survey and evaluation of tools

The survey targeted key officials in each metro as identified by the City Support Programme (CSP) but was supplemented by other relevant officials in the case of one metro. The survey questionnaire is attached as Annexure A. Contact was initiated with the officials on 21 July 2014 and the survey was completed on 29 July 2014. The telephonic survey was supplemented with a selective literature review and the author's own knowledge and experience of urban spatial and financial models.

The analysis of the metro tools is structured according to the following research questions and criteria for evaluation:

1. What tools are currently being used to assess the long-term costs to the municipality associated with development applications or development in general?
2. Do any of the tools factor in:
    a. Capital costs of infrastructure (bulk, link, internal);
    b. Long term operating costs to the municipality (service costs – over what period);
    c. Revenue generating potential of the development;
    d. Costs to external parties (province, national (i.e. subsidies) and state owned companies);
    e. Costs to households living in the development; and
    f. Environmental impacts?
3. What are criteria, methods and procedures for testing the costs associated with the development application?
4. What are the criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

A general discussion of the relevance of the tools and experiences in each of the metros is then provided.

2.2 Desktop evaluation of existing tools

For the research on other available tools external to the municipality, a brief desktop review of existing South African academic literature was undertaken. In addition, the author's own experience in developing, applying and interacting with existing tools in South African metros was heavily drawn upon.

2.3 Selection of a case study metro

The following criteria, ranked by importance, were used to assess the metros for suitability for use as a case study:

- Experience with similar costing methodologies
- Motivation and buy-in of the municipality
- Capacity of officials
- Ease of data collection

2.4 Development of a Fiscal Impact Tool

The first engagement with eThekwini Metro introduced the project and presented the findings of the evaluation of existing tools. Possible options for the structure and outputs of a fiscal impact tool were debated and a general concept was agreed upon. The model concept was then refined by the project team. A second engagement was held to finalise the concept and to gather data for the Cornubia development, which would be used to populate and test the model. The final engagement with the metro involved a presentation of the draft model at which the usefulness and potential improvements to the tool were discussed. These discussions were then taken into the model finalization stage.

3 Results from the metro survey

3.1 Buffalo City

Current tools in use

There are no specific 'scientific tools' for assessing the long term cost of development.

Consideration of requisite factors

Factor	*Currently considered?*	*Comment*
Capital costs	Yes	Draft Development Charges formula is contested and the interviewee felt that more work was required for it to be 'more scientific' as it was currently inequitable for developers. BCMM could use some support in developing this further.
Long-term operating costs	Partially	Long term municipal operating costs and revenues are projected by the finance department – assumed at city scale
Revenue generation	Yes	
Costs to external parties	No	
Costs to households	No	May be considered in 'the odd project' but is not a common feature of their assessments.
Environmental costs	Partially	Environmental sensitivity overlays and EIAs in some cases

Criteria, methods and procedures for testing costs associated with development applications

The most detailed considerations of long term impact are undertaken for municipal projects, particularly the 'big ticket' projects. These investigations are undertaken at the feasibility stage and checks are made on how the project will impact on long term revenue. However, there is no standard methodology for these assessments. For private sector applications there are 'a few checks and balances', but no rigorous assessment process.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

For the determinations of the urban edge, the municipality considers:

- population density and growth;
- current land use zoning;
- topography and physical boundaries (mountains, rivers, etc.);
- environmental sensitivity;
- accessibility (the municipality has a VISUM transport model, linked to the pavement management system); and
- the urban serviceability edge

The urban serviceability edge is a technical determination made by the engineers in which they specify where they are able to extend their services (mostly sanitation). For an area to be defined as urban the municipality needs to be able to provide waterborne sanitation; outside of the urban edge alternative technologies apply. The factors that determine this edge are capacity, network configuration and cost.

General discussion

The tools evident in use in Buffalo City were the transport model, GIS systems for normal spatial planning and land use management applications, and financial models to project expenditure and revenues at a city scale. None of these are suitable for the purposes of this project.

3.2 Cape Town

Current tools in use

The City does not have any tools that assess the long term cost of development on an application by application basis but it has completed a series of studies to try and quantify the long term costs associated with developments. An example of this is the **Medium and Long Term Growth Options** project, concluded in 2012. In this project the future capital cost of engineering and transport infrastructure was calculated for three different 20 year spatial growth options. A **Multi-Criteria Analysis** (MCA) process was then followed to equate costs to other non-financial decision criteria. The City has since developed a **Land Use Model** that is a GIS and MS Excel-based projection of land use changes in 5 year increments over 20 years. The model only considers new development on vacant land and not re-development or densification, and aggregates data at a transport zone scale. It was developed primarily to inform the transport modelling for the Integrated Public Transport Network being undertaken using an **EMME4 transport model**. Neither the land use model nor the transport model incorporate any cost considerations, but do provide very useful base data through which to calculate cost.

Following from these two processes, a significant amount of engineering modelling was undertaken as part of the **Development Charges Policy** process to develop a capital cost estimate of the bulk engineering services required to service the 20 year Land Use Model. These costs were spatially referenced for some services, but not for others. The capital costs calculated were then used to derive average unit capital costs for bulk infrastructure for various types of development in order to levy Development Charges. For the estimation of future operating expenditure and revenue, the Performance Budget department operates a fairly sophisticated Excel spreadsheet-based '**MTREF' model**, but this model is aspatial and is driven by incremental adjustments to annual figures based on a number of non-spatial drivers. In addition, tariff modelling is done by all the utility services to determine and motivate annual tariff increases, but as tariffs are uniform across the city, these too are non-spatial calculations. The **Municipal Services Finance Model** was applied in 2010 to assess long term financial sustainability at a city scale, but this is not spatially referenced.

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	Yes	Detailed modelling for new DC Policy
Long-term operating costs	Partially	Sophisticated modelling undertaken at city scale
Revenue generation	Partially	
Costs to external parties	No	
Costs to households	No	
Environmental costs	Partially	No tools mentioned in the interview, but standard EIA procedures apply

Criteria, methods and procedures for testing costs associated with development applications

The City does not currently have any explicit criteria for testing the costs associated with a development. An application is usually approved with conditions, such as the requirement to pay a Development Charge. It is possible that this could change for large developments such as Wescape since the Council has specifically requested that operational costs be quantified for this particular project. The City does not have the tools to determine the operational costs for the development and the developer is providing a model on the financial viability of the project. It was noted that a tool that could evaluate projects testing different locations and costs would be useful for the city.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

The following criteria and guideline are listed in the SDF for consideration to any amendments to the urban edge:

- City's urban growth management strategies
- Development trends
- Availability of bulk infrastructure inside and outside the urban edge
- New information related to natural, cultural and heritage resources
- Take-up of land inside the urban edge
- City's forward planning imperatives and desired phasing of development
- Availability of public transport

General discussion

The City of Cape Town does not have a specific tool that is relevant for this study, but has expressed interest in developing such a tool. However, the City has invested in a number of studies and processes that provide substantial amounts of data that could be used to populate a fiscal impact tool.

3.3 Ekurhuleni

Current tools in use

There are no specific tools used to assess the long-term costs of development to the City but there were a number of plans that have been developed. These plans include the **Asset Management Plan (AMP)** and **Capital Investment Framework (CIF)**. The Asset Management Plan is based on a detailed asset register and projections of the capital and operating cost required for maintenance, rehabilitation and asset renewal. Long term costs are provided by the service departments based on the level of service that will be provided and is included in the asset management plan. The CIF is a higher level strategic document that is a tool that guides the capital budget. It identifies focus areas, particularly related to the different service departments and prioritises projects that can provide revenue to the metro. However, the CIF is a new plan and the metro is still struggling to integrate the CIF and the capital budget. Both these plans speak to municipal capital projects and not to the costs resulting from a single development. **UrbanSim** has been applied by the CSIR in Ekurhuleni as a pilot project, but this has not been continued due to a lack of funding or support for this initiative.

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	No	Only at a city scale through AMP

Long-term operating costs	No	Only at a city scale through AMP
Revenue generation	No	Only at a city scale through AMP
Costs to external parties	No	The metro would want to take costs to other spheres of government into account, but often the data is lacking.
Costs to households	No	Costs to households living in developments are not factored in as a consideration of a development application. Studies for the BRT and by PRASA are trying to quantify transport costs to households.
Environmental costs	No	Only considered in the SDF

Criteria, methods and procedures for testing costs associated with development applications

No criteria, methods or procedures were mentioned in the interview. However, the City has sought to address this by acknowledging that there are higher transport costs involved with living on the urban periphery.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

No criteria were mentioned in the interview.

General discussion

The tools mentioned in the Ekurhuleni interview are not appropriate for the assessment of fiscal impact of development, and the lack of any initiatives in this regard, with the exception of the current transport studies, would tend to indicate a lack of consideration of these impacts on the part of the municipality.

3.4 eThekwini

Current tools in use

The capital cost of infrastructure is considered through the **Cost Surfaces Model** and **Accessibility Model** (Breetzke, 2009). The Cost Surfaces Model was developed in 2004 as a high level GIS-Based estimate of the cost of servicing housing developments in different locations across the metro. It generated a static 'cost surface' of bulk infrastructure cost (R/unit) in each unit of analysis (polygons). The model does not consider operating costs. The model has proved useful in raising awareness as to the spatial differentiation of costs and has informed how the housing department identifies new sites for greenfield housing developments. However, this has not prevented peripheral development being approved.

The Accessibility Model was developed in conjunction with the CSIR 14 years ago and is focussed on social services. It uses GIS overlays and FlowSim micro-simulation to assess where social services capacity is available in relation to demand and where there are backlogs. Johannesburg and the City of Cape Town also have this model. The model is more often used to verify requests from various stakeholders for new facilities, as it determines the need for the development of the social service in that area in a bid to avoid fruitless expenditure.

In an extension of the Cost Surfaces model, a **Spatial Analysis of Investment** was undertaken in 2012[1] using information from the Cost Surfaces Model, the valuation roll, municipal GIS, the travel survey and the Municipal Services Finance Model to generate operating and capital costs to households, the city and other spheres of government for 45 specific areas and housing typologies around the city. The methodology employed drew heavily from Biermann & Van Ryneveld (2007), Venter et al (2004) and PDG et al (2010), discussed in Section 4 . The results were intended to be indicative and not used for any further costing work. This process was not taken forward, largely because the assumptions that had to be made around transport distances and costs were not accurate. The number of assumptions made in this Excel spreadsheet-based 'model' make this an unreliable source of data, but the concepts incorporated in this tool could serve as a useful basis for the current project.

A more recent development of the Cost Surfaces and Accessibility models is the eThekwini **Housing Prioritization Model**. This is a GIS-based database query tool that is used to prioritise city housing projects, based on a number of factors, which are scored and aggregated into a total project score. These factors include distance to bulk infrastructure networks (with sewerage networks being weighted the highest), personal travel costs, access to the Integrated Rapid Transport Network (IRPTN), access to employment and economic activity, access to basic social facilities, community safety. The model is based on a matrix of data points that are spaced in a 50m x 50m grid across the entire metro area. The additional data is overlaid on top of this grid, so that any data point can derive attributes from the other layers. The limitations of this model are that it only factors in accessibility and proximity measures (as proxies for capital cost) and does not include operating costs.

eThekwini has a **transport model**, but it appears that this is only used for transport planning and is not used to generate costing information or used in spatial planning decisions. The municipality has explored the principle of cost sharing for the provision of infrastructure, particularly for road infrastructure between the metro and the province, but there have been discrepancies in the respective costs that have been calculated by the two parties.

eThekwini has recently been through a process of developing a sophisticated asset register using the V-Smart system that is able to project capital and operating costs of existing infrastructure assets into the future, to inform an **Asset Management Plan**.

Property rates revenue modelling is undertaken using MS Excel spreadsheets. Property rate categories and the valuation roll are used, rather than specific spatial categories.

eThekwini has a **Social Accounting Matrix (SAM)** to assess the benefits of developments but this is not currently being used. For the development of Cornubia, eThekwini's largest recent mixed-use development, a **Cost Benefit Analysis (CBA)** was undertaken by a consulting firm and the social accounting matrix was updated. Although this was not applied for decision purposes, the intention was to illustrate:

a) the financial viability of the development for the developer,

b) the economic benefit of the project to the local, regional and national economy, and,

c) the financial cost or benefit to the municipality.

The analysis considered capital and operating costs, project revenue streams, employment creation and economic multiplier effects.

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[1] This was undertaken by PDG as part of the work on the eThekwini Municipal Services Finance Model.

UrbanSim was piloted in eThekwini by the CSIR starting in 2009, but this initiative was not supported by the municipality, who did not believe it had any immediate application, and the process did not continue.

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	Yes	Cost Surfaces and Accessibility Models
Long-term operating costs	No	Interviewee believed this to be short-sighted
Revenue generation	Yes	
Costs to external parties	No	
Costs to households	No	
Environmental costs	No	The costs of environmental assets are very difficult to determine, and this is not routinely done in development applications.

Criteria, methods and procedures for testing costs associated with development applications

The current process of project approval based purely on capital considerations is believed to be short sighted. When the municipality decides to approve large applications that impact on bulk infrastructure an impartial assessment of the benefits and drawbacks of each development should be considered. However, it is difficult to determine what the actual usage and uptake of the development will be as applications are often over inflated and the actual development proceeds in phases; therefore the short term usage will be different from the application. It was also noted that any model that was developed to assess the long term costs to the city would have to include the uptake rate of the development during periods of high economic and low economic growth.

The generation of revenue for the City is a consideration in the approval of development applications. However, the metro does not impose development charges on a consistent basis between the various line departments. There is a belief that this cost is factored into service tariffs and a development charge would impact most heavily on the lower end of the residential market.

The interviewee stated that the long-term operating costs are not considered in development applications. A tool to calculate this would be beneficial, but the interviewee also raised a number of challenges in developing such a tool, specifically around quantifying transport costs into the future. The socio-economic benefits of the development also need to be considered.

The process to test the costs associated with a development is disaggregated and not rigorously assessed. At the moment each department does their own assessment and then a decision is taken. This allows for political manipulation of the decision. The Municipal Manager has requested the formation of a unit in his office which can advise on development applications.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

Whilst eThekwini does not have a growth and development strategy, it has spatial plans positing the growth potential of an area without indicating a project [cost and] benefit schedule. The City has started working on this, but the interviewee believed that the plans were ambitious and not supported by the right tools.

General discussion

eThekwini has been the most proactive in developing models to cost the spatial impact of development. Unfortunately, these models were all developed some time ago and are not currently used to assess development applications. However, the experience gained through the Cost Surfaces Model, the Accessibility Model, the Spatial Impact of Investment and the Cornubia CBA would provide a solid base from which to begin the development of a fiscal impact assessment tool.

3.5 Johannesburg

Current tools in use

The City has the **Consolidated Development Plan** in place, which includes the long term capital costs to the municipality. The plan is a broad overview of infrastructure and focuses on water, electricity and solid waste services. The consolidated development plan currently has a 10 year planning horizon. Phase 2 and phase 3 of the project will move this to a 20 year and 30 year planning horizon respectively. Costs are derived from the **Asset Management Plans** and from sector **Master plans**, which in turn are informed by spatial growth plans.

The **City Investment Management System** (CIMS) is essentially a tool utilised to prioritise capital projects. It is an intranet based database where all departments capture their capital projects. The location, description, name and person responsible for the project are captured on the system along with the three year budget. The system can run a prioritisation list based on spatial needs based on the requirements of the city's growth and development strategy 2040 (and IDP). The approved projects are captured on the SAPS accounting system which allows a direct link between planning and accounting. This info is held by the finance department. The capital costs included in CIMS are determined by the sector departments. CIMS does not calculate costs per se, but can schedule capital expenditure in space based on the project duration and its ranking in the prioritisation process. CIMS does not incorporate operating costs.

Development applications are assessed on an individual basis. If a project is in a prioritised area it will be assessed to see if the design meets with the requirements of the area. If the developer wants to do something outside the strategic objectives then it will be assessed but will generally not be approved. The City has a policy, formula and spreadsheet calculator for the calculation of the **Engineering Service Contribution (ESC)** (development charge) for roads and stormwater but not for other services. City Power (electricity) charges standardised once-off connection fees.

In terms of financial tools, Johannesburg has budgeting tools and mechanisms based on expenditure. The city does not have any tool in place to forecast what impact a development will have on the revenue of the city. Long term operating costs are tied up in the asset management plans and the operational expenditure budgets. Water, electricity and roads take up a big part of the budget. Community facilities take up a smaller part of the facilities. A needs analysis on community facilities has been completed to determine where these are located. Some departments have tried to roll it out and directly fund these areas.

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	Yes	Considered through ESC spreadsheet and CIMS, although some services are excluded.
Long-term operating costs	No	
Revenue generation	No	

Costs to external parties	No	Some of this work is being undertaken at provincial level
Costs to households	Unknown	
Environmental costs	No	There is a biodiversity plan and a draft plan on emissions reduction through public transport

Criteria, methods and procedures for testing costs associated with development applications

The only cost considerations are the calculation of the development charge (ESC) and the automatic calculation of property rates through property valuation. The City does make every attempt to assess development in an integrated manner but is it not easy to determine what to prioritise or what the criteria should be. It is difficult to say that all funding should be directed to marginalised areas as departments will also need to refurbish existing infrastructure in order to ensure that these departments can continue to generate revenue. A tension was therefore expressed between spatial integration, revenue generation and infrastructure backlog priorities.

Assessing the revenue generation potential of a development was previously discussed by the City. There are different perspectives with some people wanting to develop projects which maximise their income whilst others have a perspective that focuses on addressing backlogs and on spatial integration through development corridors. The different perspectives can be summarised as a tension between the needs to generate revenue, spatial prioritisation and the infrastructure needs of a department.

It was also noted that the impact of a development will be dependent on the pace at which developers exercise their rights over time and the vagaries of market forces. For example, an interest rate hike will impact negatively on the ability of the development to generate revenue. The City is able to control the granting of land use rights, but not the take-up of these rights.

It was noted that any fiscal impact tool would have to take account of the fact that low cost housing developments have a large impact on bulk infrastructure, and that the upgrading of informal settlements is not part of the land use application process.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

The City has a spatial development framework to guide where capital investment will be directed. As Johannesburg is largely urban and constrained by surrounding metros, the urban edge is not a major issue. The growth projections for the Consolidated Development Plan are based on socio economic conditions and data is being refined. Data is sourced from the strategic areas framework based on corridors of freedom. The focus is on transit orientated development (ToD) and the prioritised development areas.

General discussion

The City of Johannesburg does not have any existing tools that would be appropriate for the assessment of fiscal impact of development. While the CIMS is well developed and is an effective tool it only assesses the impact of municipal capital projects.

3.6 Mangaung

Current tools in use

The only tools that were mentioned were the **Built Environment Performance Plan (BEPP)** and the **Spatial Development Framework (SDF)**. All linkages between capital expenditure and investment are detailed in the BEPP Report. This report speaks to the long term vision and details how the budget is linked to that vision. A Development Charges (DC) Policy is also in place to calculate capital impact of development.

Consideration of requisite factors

Factor	*Currently considered?*	*Comment*
Capital costs	Yes	Applications are circulated to departments to assess impact and DCs are applied.
Long-term operating costs	No	Service departments are looking at developing a maintenance plan
Revenue generation	Yes?	The revenue generating potential must be considered when applications are assessed but this should also require articulation in the revenue announcement strategy.
Costs to external parties	No	Costs to external parties (e.g. Province) are not considered by the municipality as the developer has to speak directly to the external party.
Costs to households	No	But do have an indigent policy
Environmental costs	Partially	Environmental unit gives comment on development applications

Criteria, methods and procedures for testing costs associated with development applications

All development applications are evaluated against criteria in the SDF.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

The following criteria are used to decide on parameters for long-term growth, such as defining the urban edge:

Distance from work opportunities

- Land use intensification issues
- Availability of bulk infrastructure
- Time taken to travel to work
- Economic opportunities
- Proximity to urban edge

General discussion

Currently only capital costs of development are considered through the DC policy. The fact that the respondent considered the BEPP and SDF as relevant tools would seem to indicate that the municipality has not yet undertaken any initiatives to quantify the fiscal impact of development.

3.7 Nelson Mandela Bay

Current tools in use

The municipality has a **draft Development Charges policy**. Currently only a traffic development levy and an electricity bulk contribution are being charged; the others are minimal. The DC policy is therefore not yet fully developed and implemented.

Nelson Mandela Bay is in the process of developing a **Long Term Financial Sustainability Plan** to try and address the financing mechanisms to fund future growth. In addition, the municipality has undertaken a second round of urban growth simulation using **UrbanSim**, which builds on the initial pilot work undertaken in the first round. The purpose of the second round is to start looking at scenarios – i.e. the development implications of further growth, i.e. what the implications for bulk and other infrastructure requirements are and how these translate into costs. The UrbanSim will produce the spatial growth patterns and distribution of income groups and typologies within these. The results will then be passed on to engineering consultants to calculate the cost of transport and engineering infrastructure requirements, capacity, cost and shortfall of certain development scenarios. **The Long Term Financial Sustainability Model** (LTFSM) is a model into which UrbanSim will feed. It will look at the financing to cover development scenarios, and is therefore more of a financial model, but with spatial informants. The LTFSM has not yet been developed because they are waiting for the UrbanSim modelling to be completed. There have been a number of delays in obtaining results.

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	Yes	Via a multi-purpose technical task team
Long-term operating costs	No	
Revenue generation	No	
Costs to external parties	Partially	In one development they are looking at cost implications for essential social facilities operated by the province. For costs to the national government, they consider housing and public transport subsidies.
Costs to households	No	But will be evaluated when the results from the 2nd round of UrbanSim are available
Environmental costs		

Criteria, methods and procedures for testing costs associated with development applications

For small developments the municipality does not consider costs in detail, but for big developments an inter-departmental technical task team has been established to give comment and inputs. This has opened up an integrated, cross-directorate understanding of impacts. Understanding long term cost implications has developed organically with each successive project or development node. Costing is done by each directorate and then aggregated. Individual developments can trigger bulk infrastructure that unlocks other development.

At present the focus is on the capital cost implications of development. The question of operating costs is being considered, but has not yet been addressed. One of the big challenges is operational funding for social facilities and amenities. They also need to look at the potential to generate different types of revenue, but this has not yet being quantified.

The municipality feels that UrbanSim can be taken further to answer some of the longer term cost implications, but do however, have concerns around their own capacity to run the UrbanSim model, which they would like to see addressed in the second phase of the model's development.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

Nelson Mandela Bay is fortunate in that they are getting very few development applications outside the urban edge. In most cases extensions sought are the logical continuation of existing development patterns. In 2012 they started looking at the big picture. It was a simple model initially: What is the demand and what is the supply? Once this had been established in some detail, they then looked at where it will happen and what land is needed, etc. The results indicate sufficient land inside the urban edge up to 2030 because of a low growth scenario, but this is not guaranteed.

General discussion

The municipality currently does not have an appropriate tool that could be used to assess fiscal impact of development. However, such a tool would be useful and would have strong linkages to the work that is being done using UrbanSim to feed into the LTFSM. In addition, the CSIR has offered to provide the results of the UrbanSim modelling to assist with the development of a tool. However, the interviewee noted that whatever tool was developed would need to be usable by officials.

3.8 Tshwane

Current tools in use

Capital costs of infrastructure are considered by the various **infrastructure master planning tools** for each sector. The city is intending to acquire contracted services for an **integrated infrastructure master plan** during the 2014/15 financial year. **UrbanSim** modelling for long-term growth is scheduled to begin in 2014/2015

Consideration of requisite factors

Factor	***Currently considered?***	***Comment***
Capital costs	Yes	Through sector master plans
Long-term operating costs	No	The integrated infrastructure master plan is also expected to include the long term operating costs to the city.
Revenue generation	No	The City does not have a tool to assess the revenue generation potential of a development but has requested support from National Treasury via the CSIP to develop such a tool.
Costs to external parties	No	
Costs to households	No	
Environmental costs	No	

Criteria, methods and procedures for testing costs associated with development applications

The costs of development applications are not currently being assessed through the use of any tool.

Criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

The City is currently using spatial planning guidelines to decide on long term growth patterns. However, the UrbanSim model is due to be introduced in 2014/15 and this model is expected to provide the intelligence and rationale for spatial planning mechanisms.

General discussion

Although there are currently no tools being used to assess fiscal impact, Tshwane is initiating a process that will inform, but also be benefitted by, the development of such a tool.

4 Description of other existing tools

Internationally urban land use modelling is increasingly attempting to capture the complexity of dynamic urban growth processes. As a result, as models develop they necessarily become more complex. As a consequence, they require increasing amounts of data, computing capabilities and skills to operate. The focus of these models tends to be predictive – either of the pattern of spatial growth, or the implications of policy alternatives.

A comprehensive review has been undertaken by the Gauteng City-Region Observatory (GCRO) (Wray, et al., 2013), of urban spatial models, covering international model types, as well as an assessment of urban models used locally. The review included a survey of the five largest metros, although only Johannesburg eThekwini and Cape Town responded. The GCRO paper is a useful resource for further reading on the topic, but not all the model types will be discussed here. This report will only draw from the local experience that is documented in the GCRO report.

A key conclusion from the survey is:

> *"Apart from the UrbanSim project and limited academic urban simulation research, it can be argued that advanced modelling of urban spatial change within South Africa at an institutional level has not reached a high level of sophistication"* (Wray et al, 2013:23)

4.1 Transport models

All metros have transport models to assist with transport planning. These models are generally proprietary software and are often applied by external engineering consultants because of the specific skills required to operate them. The metro models display different levels of sophistication, depending on how recently they have been updated and the purpose for which they are used. There are two packages that dominate in South Africa, EMME and VISUM. These packages model traffic flows and modal splits based on pre-defined land use scenarios and transport network definition and output travel time and speeds. Adjustments can then be made to the size and location of infrastructure components so as to optimise the system. They incorporate the ability to generate capital and operating costs through the use of unit capital costs (per network element) and operating costs (per vehicle kilometre).

Transport models are often used to feed into other models. For example the MatSim, Open Trip Planner and FlowSim models have been used by the CSIR to provide inputs into the UrbanSim and Accessibility models. Similarly, the results from metro transport models in Cape Town were used for their development charge capital modelling and the City Efficiency Costing Model (see below).

The University of Pretoria and CSIR were appointed to set up a Gauteng Integrated Transport Modelling Centre (GITMC) to develop an open-source modelling approach to integrate and align macro and micro-level modelling in the province, on behalf of provincial and local municipal stakeholders. This is a long term project closely aligned to the UrbanSim and MatSim initiatives in the province. The GITMC was intended to be operational from April 2014, but has stalled due to capacity constraints and institutional changes at the Province. It may be integrated into the Gauteng Integrated Infrastructure Master Planning process that has recently been put out to tender.

Transport models are too sector-focused and specialised to be adapted for the purposes of this project. However, they provide essential inputs to determine road and public transport capital and operating costs.

4.2 GIS-based models

Geographic Information Systems (GIS) are essential spatial planning tools employed by all metros. The benefit of GIS is the ability to spatially display and overlay data that can then be analysed using spatially-determined criteria (e.g. buffers, areas of overlap, proximity, etc.). This is an essential tool for spatial planning, but also for infrastructure and social facility planning, where GIS can be integrated with other tools for specific purposes. Examples include the use of GIS for the eThekwini Housing Prioritisation Model and the IMQS (for Infrastructure Management Query System) infrastructure asset management system employed in many metros. GIS systems are not predictive in that they rely on inputted information and, unless they have specialised developer add-ons, do not project development. While they can include cost attributes to spatial elements, which can then be aggregated through database queries, they do not model costs and future financial implications.

Wray et al (2013) reports that the Gauteng Department of Economic Development has used a number of GIS-based models for the development of the Gauteng Spatial Development Framework (GSDF) comprising: urban profile, urban morphology, connectivity, bid-rent, and a 'virtual model room'. All but the last of these appear to be static overlays of existing data sets, perhaps with a number of queries run to illustrate zones of particular interest. The last of the five models mentioned was established to provide indicative 3-D visualisations of the nature of urban development planned in different areas. None of these appear to have any cost attributes.

While many of the GIS software programmes are proprietary, there are some basic packages available for free download. One innovative product on the market is 1Map – billed as "South Africa's first national online Geographic Information System" (www.1map.co.za). 1Map offers an online GIS platform, with free basic access to GIS data and tools, while more advanced functionality is available for a monthly subscription, including Surveyor-General data, road centrelines, street addresses, aerial photography data sets and the ability to link the GIS to a municipal financial system to manage assets, zoning, land use, valuations and debt management.

For the purposes of this project, a GIS-based system is not proposed because of the specialist skills required to operate it. While all metros have some GIS capability, it is not deemed necessary for the determination of fiscal impact, and would hinder the generic applicability of the tool. However, GIS capability is probably necessary to provide inputs to the fiscal impact tool, including the attributes of the development application being assessed (e.g. zoning, proximity to existing bulk etc.), and is considered an essential input.

4.3 Planning Support Systems

Planning Support Systems (PSS), according to Geertman and Stillwell (2003:6),

"involve a wide diversity of geo-technology tools (geographical information and spatial modelling systems) that have been developed to support public or private planning processes (or parts thereof) at any defined spatial scale and within any specific planning context. In particular, they are developed to support the derivation and evaluation of alternative futures".

Bierman and Van Ryneveld (2007), describe the process that was undertaken to compare the costs of low-cost housing in different locations in Gauteng. The sites were selected using a previous Multi-Criteria Analysis (MCA) process and then costed to develop the same number of housing units at different densities on the various land parcels. Multi-criteria evaluation, integrated with GIS, has been used to undertake a land suitability assessment in a major metropolitan area to prioritise land for low income housing development (Biermann, 1997; Biermann, 1999; cited in Biermann & Van Ryneveld, 2007).

The nature of the study was to assess the relative impact of spatial location on the various cost drivers of low cost-housing developments, and how these accrue to households and to government. The tool that is used is described as a 'Planning Support System' (PSS), which:

> *"consist[s] fundamentally of the following elements: conceptual framework (in written form, supplemented by diagrams, flowcharts etc.); database (spreadsheet-based); analytical tools (spreadsheet- and GIS- based); Spatial presentation of the outputs (GIS-based); output in the form of a brief report (supported and illustrated by graphs, annotated maps, diagrams, flowcharts etc.)."* (Biermann & Van Ryneveld, 2007:3)

The methodology included a costed norms approach for different development densities and typologies of the same number of housing units on 30 sites in Gauteng. The costing approach is described as follows:

> *"capital and recurrent costs to household and government were distinguished for housing and related service components: land, engineering services, social, amenities, travel, top structure, environmental resources, retail goods and services. Cost and services data was obtained predominantly from government sources, but considerable analysis was undertaken to determine existing levels of service within service catchment areas related to the selected sites, to calculate the additional services required to service the backlog allocated to those sites to the required levels of service and then to determine costs. Recurrent costs were calculated over a 20 year period and then converted to present costs".* (Biermann & Van Ryneveld, 2007:7)

It is not clear what has been included in the definition of 'environmental resource costs'. The fact that costs that accrue to government were considered means that the subsidy environment was incorporated, but details on how this was done were not provided. The costs to government were not differentiated by local and national government. The paper reports that the PSS was developed for the assessment of the location of low-cost housing developments in South Africa, and that similar approaches have been applied to the valuation of benefits (cf Venter et al, 2004), although these are less well developed. The advances that are included in the reported study include: predictive capability; the addition of density considerations in relation to locality; the rigorous reduction of potential costs of delivery to common monetary terms; and a GIS element for assessing spatial patterns of cost.

This tool is therefore of potential use for this study, but would need to be more nuanced in the allocation of government costs, would need to accommodate other types of development beyond low-income housing, and would possibly be de-linked from a GIS tool to simplify application in multiple metros.

4.4 Cost/Benefit models

Cost/Benefit analysis (CBA) is an economic tool that is employed to assess the long term financial, economic or social viability of a project in comparison to an alternative. Its benefits relate to the ability to equate up-front capital costs with longer term operating costs and revenue flows through the discounting of future values, and then to produce easily comparable indictors, such as Net Present Value (NPV), Internal Rate of Return (IRR) and Cost Benefit Ratio (CBR). CBA is primarily a financial tool, but can be used to incorporate non-financial impacts through assigning monetary values to these impacts, such as the value of health, human lives, and the environment). While there are a number of methods to do this, this is highly contested and the values that are attached to these impacts can vary dramatically.

One example of a CBA model is the Land Release Assessment Model developed by Eighty20 for Urban Landmark. This is an excel-based financial model which undertakes a CBA for integrated housing developments from the perspectives of the state, developer and resident households. The model has only been applied in two case studies in the Western Cape (Botha & Meltzer, 2010) and two in Gauteng (PDG, 2011). It is purely concerned with financial costs and benefits and excludes some financial costs (such as transport costs to households) and any social amenity costs or benefits. In this sense it is aspatial.

A similar example of financial and economic CBA on a larger scale is that undertaken for the Cornubia Development for Tongaat Hulett in eThekwini, which assesses benefits to the developer, municipality and the economy in general.

Another example of a CBA is the assessment of Social Rental Housing versus RDP housing undertaken by Rhizome Management Services and Rebel Advisory Group (2009). The study distinguished between a financial, economic and distributional analysis within the CBA:

> *"The financial analysis considers the costs of the project taking into account and correcting for (as far as possible) pricing and other distortions. The economic analysis considers primary and secondary effects that result from the projects and aims to quantify these as far as possible. Finally the distributional analysis seeks to assess where the incidence of cost falls, that is the primary beneficiaries of the project and the carriers of the cost burden"* (Rhizome Management Services and Rebel Advisory Group, 2009)

In this way the results are layered: the more 'objective' financial costs are then supplemented by the more subjective economic benefits determined primarily through household surveys, and then concluded by differentiation of these costs based on their incidence. Factors considered in the economic CBA included crime, school dropout rate, employment rates, transport savings. The distributional analysis considered costs to three groupings: National/Provincial government, municipalities, and residents.

In another example of a CBA, the study by Venter et al (2004) follows a similar methodology to that of Biermann and Van Ryneveld (2007), but focuses on quantifying costs *and* benefits. Benefits are assessed in terms of the ability of residents of each location to access social networks and physical and natural resources needed for the attainment of sustainable livelihoods. The fact that the study took 18 months to complete indicates the complexity of the task. Importantly, the data on household costs, travel patterns, and residents' perceptions of livelihoods benefits were collected from household surveys conducted as part of the study. Three coarse development outcomes were used to project future city growth scenarios to determine whether sites would be considered 'well-located' in future and found that "future patterns may very well change the relative suitability of some localities in comparison to others." (Venter, et al., 2004:571)

The study aimed to cover the following objectives: (Venter, et al., 2004:565)

- "Consider all cost components, including land, social/community services, bulk infrastructure, and economic and environmental (including energy) costs,
- Consider both capital and maintenance costs, and
- Consider costs to all parties concerned, including households, local governments or service providers, and other spheres of government".

Transport costs include infrastructure cost, user costs (including the opportunity cost of time spent travelling), and indirect costs (accruing to individuals and society in the form of accident cost) for work, education and shopping trips.

Benefits were largely assessed through household surveys – administered to up to 200 households per settlement. Benefit scores were amalgams of quantitative and qualitative data and could therefore not be combined with cost to get net cost/benefit ratios, but could only show the relative costs and benefits between different locations.

> Biermann & Van Ryneveld (2007:230 citing Venter, et al., 2004) note that:
>
> *"The introduction of a cost-benefit approach, with the inclusion of benefits in the form of sustainable livelihood capitals indices and instituting, albeit fairly qualitatively, the distinguishing between capital and recurrent cost and to whom the cost accrue, has more recently been incorporated to address the specific question of the impact of peripheral housing localities on energy efficiency and sustainable livelihoods, through mainly sample surveys of existing households"*

CBA is more of a methodology than a tool, and is usually undertaken in Excel spreadsheets. There are elements of CBA that would prove useful to incorporate into a fiscal impact study, such as the reduction of lifecycle costs to NPVs, but the inclusion of benefits and the conversion of these into monetary values require detailed household surveys and advanced economic valuation techniques.

4.5 Municipal Services Finance Model (MSFM)

The Municipal Services Financial Model (MSFM) was developed for National Treasury and the Department of Cooperative Governance under the auspices of the DBSA as part of the Municipal Infrastructure Investment Framework (MIIF). The MSFM is an MS Excel based spreadsheet tool that projects the infrastructure requirements and associated revenue and expenditure over a 10 year timeframe, using a calibrated baseline situation. It was developed in 2004 to model the ‘big five’ engineering services (water, sanitation, electricity, roads and solid waste), but has expanded over the last 10 years to cover all municipal functions. The MSFM is in the public domain and has been applied to 40 individual district and local municipalities, including detailed applications in Nelson Mandela Bay (in 2010), eThekwini (in 2009-2012), Cape Town (in 2012-2013), Johannesburg (in 2012) and Buffalo City (in 2008). The MSFM only considers costs to the municipality and to the national and provincial government in the form of grant funding to the municipality. It also considers household bills for municipal services.

The MSFM is not a spatial model, although it has been applied to determine the potential additional municipal financial impact of alternative spatial growth patterns (in Kokstad in KZN and in seven Western Cape Municipalities – see PDG and City Think Space, 2013) through varying the applicable unit costs. For the purposes of this project the MSFM is not directly applicable because of its complexity, its lack of spatial considerations and its time horizon being too short. However, the unit costs and elements of the methodologies employed for cost projections and subsidy allocation may be useful for incorporation into a fiscal impact tool.

4.6 City Efficiency Costing Model

The City Efficiency Costing Model (CECM) is an Excel-based spreadsheet model developed for the FFC to determine the fiscal impacts of inefficient land use (PDG, Stephen Berrisford and ACC, 2011). It calculates the capital and recurrent costs of a given city, with a given spatial form, over a period of 10 years. In addition to calculating these costs, the model allocates these costs to four financial ‘actors’ within the city: households, businesses, the City and the State, through an analysis of subsidy and tariff structures. An additional ‘actor’ is defined as the environment and the costs to the environment in terms of carbon emissions from transport, resource use (water and electricity) and waste generation. The costs that are quantified are limited to those that are directly related to space: land, housing, infrastructure (engineering infrastructure for municipal services) and transport.

To avoid data constraints and to widen the applicability of the model, the CECM was tested on a ‘hypothetical city’, with characteristics similar to the three largest South African Cities. The hypothetical city was split up into 37 indicative zones with homogenous housing typology and a mix of residential and commercial land use. 11 vacant zones around the city were also defined. The zones were allocated attributes in terms of housing, land, transport, density, resource use and demographics, which was based on real data from the three metros. Unit costs were applied to calculate the recurrent costs of operating the city in the base year (2010) and cross checked against city budgets and state subsidy flows. The growth of the city was then modelled over 10 years using a number of growth parameters including household growth, economic growth and housing delivery rates.

The benefit of the CECM was that it prompted thinking about a methodology to cost the fiscal impacts in space. Through the process, lessons were learned about what data is readily available in metros and what additional data may need to be collected or estimated. The CECM is a conceptual tool to model fiscal impacts at a city scale. It is therefore too coarse and high-level to assess individual development applications. Many of the concepts that were developed in the CECM were incorporated into the eThekwini Spatial Analysis of Investment model, described earlier in this report.

4.7 CSIR Space Planner

The CSIR Space Planner was developed to accompany the Guidelines for the Provision of Social Facilities in South African Settlements (Green & Agrue, 2012). It is an online tool that can be used to determine the space required in the design of public facilities, taking into account density, road space, etc. The tool has a range of pre-defined service standards, or these can be customized. The one weakness of the tool is that it only generates the need for a new facility if the entire population threshold is exceeded by the settlement being designed. It does not indicate the demand on other facilities outside the settlement if thresholds are not exceeded. It also does not factor in any spatial considerations around distance to facilities. While the service standards are of interest to this study, the tool is not directly usable.

4.8 UrbanSim

UrbanSim is open-source software developed in the United States in the 1980s, and is described as the most widely-used urban modelling software in the USA. It uses a combination of Land-Use Transport modelling and Agent-Based Modelling to simulate urban growth on a micro scale. Wray et al (2013:15, citing Waddell, 2002) describes UrbanSim as "a family of models which applies a series of approaches and techniques such as aggregate non-spatial modelling for the economic and demographic transition models and agent-based discrete choice simulations for the household location choice component". Some of these inputs, such as travel times, are derived from external models (e.g. EMME transport models).

UrbanSim has been adapted for use in the South African context by the CSIR since 2007. The model was piloted in Ekurhuleni, eThekwini and Nelson Mandela Bay to illustrate its functionality and benefits. It is currently being used in Nelson Mandela Bay and about to be used in Tshwane, as described above. There is also potential for the model to be used for the whole of Gauteng (Louis Waldeck, pers. comm. 30th July, 2014).

The primary benefit of UrbanSim is to provide a spatial manifestation/prediction, up to 30 years into the future of the spatial and socio-economic distributions within the city as a result of policy and legislative constraints (e.g. Zoning schemes, protected areas, development incentives), coupled with discreet choice made by households and businesses. The disadvantage of the model is its complexity. It requires specialist skill for its application and is data intensive, with the result that it takes a long time to set up and run the model in a metro.

UrbanSim is generally applied at the city scale or higher, and its outputs provide useful information with which to assess the impacts of spatial growth from a household perspective (e.g. travel modes, trip time and cost, and access to employment opportunities). To determine impacts of the spatial growth pattern from the municipal or national government perspective, the outputs of UrbanSim would need to be combined with other types of calculations (e.g. infrastructure costing or financial planning), as is currently being undertaken in Nelson Mandela Bay.

During a meeting held with the CSIR on 30th July, it was determined that the complexity of the model and its associated time and cost, prohibit its use for this project. It was also decided that the fiscal impact tool should not be dependent on outputs from the UrbanSim, given that this model will not be available in all metros in the short term. However, the existing UrbanSim model outputs in Nelson Mandela Bay may prove very useful insights into the types of data that may be available, as well as assist with the development of a costing methodology.

4.9 Development Viability Appraisal

Although the Terms of Reference for the study did not require an international literature review, it is worth noting that similar planning tools have been institutionalised as an integral part of the development planning process in the UK (Crosby, et al., 2013). Development Viability Appraisal (DVA) is a generic term for financial assessments that can take place across a range of different scales. Crosby et al. describe how these models are used in the UK planning process to assess affordable housing targets and the 'planning obligation' contribution to local government, which is a portion of the financial surpluses generated by planning permissions – equivalent to value capture that has been debated in the South African context (see, for example, African Development Economic Consultants, 2012).

Crosby et al highlight the risk of DVA being only a snapshot of a dynamic market in which the assessment values change over time. The models described are similar to the Urban LandMark Land Release Model in that they aim to assess levels of profit to developers through using discounted cash flows to incorporate the timing of all costs and revenues. Crosby et al describe two different methods for calculating residual value: a simple residual method and a more complex process of discounted cash flows. What is described is similar to proprietary models used by private developers in South Africa to determine rate of return, or to determine surplus available to purchase land using an embedded 'hurdle' rate of return.

As the assessment of developer profit is not of direct interest in the fiscal impact study, the DVA tools are not considered immediately relevant. It could be argued that the useful elements of these models are already incorporated, and adapted for use in a South African context, into the Urban LandMark Land Release Assessment tool.

5 Evaluation of existing models and tools

Insights from the review of existing tools

The brief survey undertaken for this project has found that none of the metros currently have a tool to assess the long term operating and capital costs of development to multiple actors. While there are a number of tools being used, these tend to address only one dimension of cost (e.g. capital, not operating, or municipal and not provincial). The tools tend to be focused on planning and budgeting. This may be through the costing of a theoretical desired end state to inform planning, or through short term modelling to determine MTEF budgets. Cost is calculated as an anticipated output of planning, but does not factor in the assessment of development applications. Where development applications are assessed, and this tends to only happen with the larger developments, metros are using existing tools in combination to assess impact, or relying on external consultants and expert opinion from officials in line departments. Smaller development applications have a limited incremental impact on overall city costs and the cumulative impact goes unnoticed.

While many metros quantify the capital cost implication of developments on municipal infrastructure in the form of development charge calculations or traffic impact assessments, none of them appear to calculate the long-term operating cost implications, and this appears to be a major gap.

Of the tools assessed, the one that addresses the requirements of the Terms of Reference most completely is probably the Spatial Analysis of Investment developed in eThekwini. The Spatial Analysis of Investment model was developed for a specific purpose to compare generic 'situations' in the City, but would need to be modified to assess a single, specific development application. This tool's conceptual origins can be traced to the Planning Support System, the Social Rental Housing CBA and the City Efficiency Costing Model. However, its two greatest flaws are that it ignores the benefits that are included in the former two models, and also ignores the warnings about the simplistic treatment of transport patterns made by Venter et al. (2004).

These are elements that could be strengthened if this model were to be used as the basis for a fiscal impact of development tool. In addition, the reduction of the future operating costs and revenues to a Net Present Value, in the way that the Urban LandMark Land Release Assessment tools does this, would also be useful. Other tools that have been reviewed here would be useful, either in providing essential inputs to the proposed tool (e.g. transport models, GIS-overlays and UrbanSim), or through providing methodological insights (CBA, MSFM, CECM and UrbanSim).

6 Determination of need for a fiscal impact tool in a case study metro

Discussion around metro needs and expectations

A workshop was held with the eThekwini municipality, as the selected case study metro, on 3 September 2014, attended by the research team and officials from the departments of Engineering, Spatial Planning, Transport and Economic Development.

The main need identified at the workshop was a means of assessing what was termed the 'outlier' decisions – large scale applications that are not foreseen in the general planning of the municipalities. This could be because of their large scale, large demand on resources or location outside of existing zoning schemes. These types of projects include large-scale private developments, city housing projects and the national Strategic Infrastructure Projects (SIPs). Fiscal impact, environmental and other policy related evidence is needed for the municipality to support or reject these applications in the face of much political pressure to have them approved.

One attendee felt that the tool should provide a motivation for development that supports the nodes and corridors that are identified in existing planning and development policy, i.e. illustrate the benefits to locating in these areas. While this should be an outcome of the tool, it is believed that one should not assume the outcome of a fiscal impact study. Therefore while it is assumed that the benefits of locating in a planned node or corridor would outweigh the costs, this should not be presupposed.

The Spatial Planning department representatives stated that a tool is not required to assess all development applications, as the planning has already been done, and at the point of application, an assessment would be too late.

In this regard, a tool that enabled an assessment of fiscal impact in advance would be useful to inform strategic planning. While this suggestion was discussed, it was pointed out that this would require a metro-wide evaluation of all sites in the metro, similar to what has been done in the Cost Surfaces and Housing Prioritization Models. This type of tool could then inform re-zoning that would minimize costs to the municipality. The inclusion of operating costs to these types of models would be highly beneficial to the city. It was concluded that this was outside the scope of the current project, but there may be opportunities to extend the tool for strategic planning purposes in future. This is discussed later in the report.

The Economic Development representative stressed the need to include not only the costs associated with developments, but the benefits as well. In particular, job creation and broader economic benefits should be quantified. There are also other social benefits (social integration, security, etc.) but these are less easy to quantify.

There was little support for a comparative tool, i.e. one that could compare the costs of the same type of development, but in two alternative locations. This was not believed to be of use because developers typically have only a single site available and are not able to amend the location of the application based on the outcome of the tool. However, this would apply to municipal housing projects, and would be the basis of any tool that generated a metro-wide fiscal impact assessment.

If a comparative tool is not developed and fiscal impact is assessed for a single development, then there is a need for a benchmark against which the result will be judged. It was accepted that the cost benchmarks could be built up over time as a number of developments are assessed in order to develop a data base for relative cost comparisons. Various options for case studies were discussed, but it was agreed that Cornubia was the logical choice for the piloting of the model, given that good data is available and a cost/benefit analysis has recently been undertaken. It was also noted that the costs emerging from an assessment of Cornubia may reflect 'higher than average' cost because of the level of specification for the project.

Another option that was raised was a tool that could be provided to developers to determine the cost impact of their development prior to making an application. It was argued that this would eliminate a number of fruitless applications if developers know that the city would reject them anyway. An analogy was made with an online bond calculator that allowed home buyers to assess the affordability of mortgage repayments. This type of tool would be useful for the calculation of payments due by developers (e.g. developer charges), but could provide too much information with which developers could lobby the city. Given the mandate of the research team to produce a tool that is useful to metros, this suggestion will not be taken forward.

Conclusion to the discussion

A number of conclusions can be drawn around the needs that a tool must address, arising out of the engagement with the metro. The tool should:

- accommodate large, mixed use developments, both private and city-driven;
- assess individual applications and need not be comparative;
- include benefits as far as possible;
- include an assessment of operating costs; and
- be able to be integrated into existing city models to inform strategic planning.

The purpose of the tool is to: inform better decision-making around development approvals; to illustrate the trade-offs around spatial location; and to identify incidence of cost over the long-term to inform negotiating cost-sharing.

7 Considerations in the development of a fiscal impact tool

7.1 Design principles

The following principles, which informing the development of the tool, have been derived from the Terms of Reference. The tool must:

- Be applicable to all metros;
- Use non-proprietary software;
- Have limited user inputs;
- Be relatively simple to operate;
- Be transparent in its assumptions and calculations;
- Produce replicable outputs;
- Maximise on the format and availability of existing data in metros; and
- Consider the timing of investments and revenue generation

7.2 Scoping the tool

As a result of the discussion with the eThekwini municipality and further debates held within the project team, the Fiscal Impact Tool was scoped and designed. The outcomes of these discussions are presented below under the eight major issues that needed to be resolved before the tool was developed.

7.2.1 Types of development

Given that the tool is primarily aimed at large-scale development, it needs to accommodate mixed use development. Cornubia is a good example of this type of development. The land uses need to be adequately broken down to isolate those that have different cost drivers, while at the same time keeping the number of land uses manageable. The model provides for 19 different land uses in a development.

Residential categories have been grouped into three income groups: low, medium and high income. The actual incomes of these households are not defined in the model, but rather calculated based on property value. The only difference between the three income groups is that they provide the user the option to specify different service costs, density ranges, consumption patterns and subsidy regimes for each income bracket. Given the large variability in the different types of residential development, and the need to be as inclusive as possible, the housing typology, density, value and service level characteristics of each of the residential categories have been left as ‘free-format’ inputs, i.e. these are defined by the user. Note that the model defaults make the assumption that low income households are heavily subsidised, but this can be overwritten if necessary.

While the model allows for only three medium and high income land use types, it provides for four different low income residential land use categories, given that the focus of the metros for their own projects is often on alternative forms of low cost housing.

For industrial land uses, four categories have been defined to isolate differences in cost structure:

- Small industrial sub-unit;
- Medium industrial unit; and
- Large industrial park.

Commercial land uses have been divided into three generic categories:

- Small retail unit;
- Large retail unit; and
- Office.

The final land use category is agricultural and other enterprises and comprises four general categories:

- Smallholding;
- Agribusiness; and
- Mining.

It is noted that because the focus of this tool is on *impact*, the tool is required to calculate the difference between the resources and services required for the new development versus what existed on the same site prior to the development. In many cases these will be greenfield sites, but not always, in which case the operating costs of the existing land use need to be considered. This is catered for in the model by subtracting the current demand from all future demand to calculate future impact on demand and operating costs.

7.2.2 Services and functions to be included

Municipal **engineering services** are impacted on by spatial location in different ways, depending on the type of infrastructure: internal, bulk or connector.

- Internal infrastructure cost is dependent on service level and density, and is thus a function of service characteristics and housing typology.
- Bulk infrastructure costs are assumed to be spatially neutral, in that this infrastructure usually comprises centrally located facilities (water treatment works, wastewater treatment works, landfills, etc.) that serve large areas and a large number of developments (although bulk infrastructure costs may vary from one catchment or region to the next). However, bulk infrastructure cost is dependent on the demand on the infrastructure system, and is thus a function of land use, service level and income level.
- Connector infrastructure, which is defined as the infrastructure required to connect internal infrastructure networks to bulk infrastructure networks, is entirely a function of the spatial location of the development in relation to existing bulk infrastructure.

The following municipal engineering services (bulk, connector and internal) need to be included in the tool:

- Water;
- Sanitation;
- Electricity;
- Solid waste[2]; and
- Roads.

Stormwater was initially included as an additional service, but because of difficulties in modelling stormwater requirements in any generic and simplified manner, it has been included in the roads costs.

The number and type of municipal **public services** (community halls, libraries, sports and recreation, public safety, clinics, etc.) and provincial **social services** (schools and health facilities) provided is influenced by population thresholds and accessibility considerations, and is therefore a function of density. Public services have been excluded from previous exercises to quantify the fiscal impact of spatial location. This is because the demand for the service is the same for the same land use, irrespective of location, and is highly dependent on what existing facilities are available in the vicinity. However, the argument for including public services in this assessment tool is that they have a strong impact on the use of existing facilities, either utilising unused capacity in existing facilities, or requiring new facilities as population thresholds are exceeded. Public and social services facilities are also impacted on by density, with denser settlements making the provision of these services more efficient. Municipal public services are modelled as a combined 'package' of the individual services, but the mix of the services in the package can be amended in the model defaults

The following provincial social services have been included:

- Education (a combined grouping including primary schools, secondary schools, vocational education and training); and
- Health (a combined grouping including primary, secondary and tertiary facilities)

Transport services included in the model are divided into the following categories:

- Private (cars and private commercial vehicles);
- Conventional buses;
- Municipal Bus Rapid Transit (BRT);
- Passenger rail;
- Minibus taxis; and
- Non-motorised transit (NMT)

It is noted that transport choices (modal split and destination) vary over time. Average travel speed can also change with congestion or new infrastructure. These are not things that a relatively simple model such as this one can hope to predict. Therefore, modal splits and trip characteristics (average length and speed of trips) are treated as a data input that the user must estimate prior to using the fiscal impact tool. This information can be sourced from existing transport models, or from more sophisticated urban spatial growth models like UrbanSim.

The cost of land and top structure is included as an overall **property** cost for each land use.

The following functions have been **excluded** from the model as not having a sufficiently direct relationship to one development to justify the extensive calculations required to attribute costs:

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[2] Note that solid waste differs from the other services in that it does not have networked infrastructure. It therefore does not have connector infrastructure.

- Municipal, provincial and national governance structures and overheads;
- National administrative functions (home affairs, social development, labour, etc.);
- Freight transport;
- Inter-city passenger transport; and
- Capital costs of electricity generation and transmission[3]

7.2.3 Apportionment of costs

The principle that is adopted in the model is that the total capital and on-going costs of providing and operating services should be calculated in the first instance before these costs are apportioned to the various parties that are responsible for the payment thereof. The following financial 'actors' are defined in the model for the purposes of apportionment of the costs:

- Households;
- Businesses;
- Municipality;
- State (National and provincial); and
- State-owned entities (a combined grouping of water boards, Eskom and Prasa).

Costs are apportioned to each of the actors according to the fiscal policies in existence at the time: rates policies, tariff policies, fare levels, subsidies, grants, etc. It is acknowledged that these will change over time, but as this variation cannot be adequately predicted, the model is based on these policies remaining constant over time.

The 'businesses' included in the model are those businesses that will purchase the developed sites. The model does not include external private sector entities involved in the construction of the development and the provision of services as a financial 'actor'. The economic benefits of the construction and operation of the development are, however included (see below). This means that some costs (e.g. construction costs) are paid to a party outside of the model (e.g. private contractors). This means that there is some fiscal 'leakage' in the model.

7.2.4 Inclusion of benefits

The ToR defined that the tool would be required to calculate fiscal impact, i.e. monetary costs. However, the ToR also requires some consideration of impact on the environment (discussed in the next section). During the engagement with eThekwini Metro the issue of benefits was also raised. The model remains primarily a fiscal impact tool, with monetary quantification of impact first, and the consideration of other benefits undertaken as a secondary step thereafter. Travel time is quantified in time and in economic value. Economic benefits of employment creation and increase in economic activity is also included as a secondary output

The economic value of time is calculated by assuming an hourly wage rate of residents and multiplying this by time spent travelling over the 20 year period. This calculation is the value of the time for all residents, not the difference between the pre- and post-development situation. Therefore this result can only be used to compare the development with an alternative development. A calculation of the value of the difference in travel time would be meaningless because it is not known where the residents resided prior to moving to the development, and therefore what economic impact the development has had as a result of altered travel patterns. This type of calculation would have to be done in a city-wide exercise using a complex model such as EMME or UrbanSim.

[3] Although these costs are indirectly included in the bulk electricity tariff, which is included in the operating costs in the model.

Employment creation is measured by using current cost of employment figures for each economic sector / industry as provided by the South African Reserve Bank; and dividing the relevant sector cost per person year of employment into the capital or operating expenditures required for each type of infrastructure or facility. The result is a measurement of the additional person years of employment that could be expected as a result of the development over 20 years.

The increase in economic activity is measured by the growth of Gross Value Added as a result of the construction of the development (property and infrastructure) as well as the operation of services for the 20 year period. The calculations cannot determine whether developments are new or have simply re-located from elsewhere in the municipality. The approach that has been taken is similar to that taken by KPMG for the cost/benefit study of Cornubia, except that it does not rely on the functioning of a Social Accounting Matrix save to use the multipliers generated by them.

7.2.5 Environmental costs and benefits

The following environmental costs and benefits are quantified in the model:

- Water use;
- Electricity use;
- Carbon emissions from passenger transport;

The possibility of including embodied energy in construction and the impact on biodiversity and agriculture where explored. The calculation of embodied energy was found to be too complex for a model of this nature, and eThekwini were not able to provide any data to support the inclusion of the biodiversity and agricultural impacts for this version of the model.

The environmental costs and benefits are not quantified in monetary terms as this process includes complex economic calculations (such as Contingent Valuation) that are not consistent with the methodology employed in this model, and are not feasible within the scope of this project.

It is envisaged that the fiscal impact assessment tool may provide one set of data into a decision-making process around a development proposal. For example, a multi-criteria decision process could be followed, with the fiscal impact assessment providing data for one criterion, and the secondary evaluation of benefits forming the basis for other criteria. Further criteria not considered in the fiscal impact tool may be considered in the decision, as illustrated in Figure 1 below.

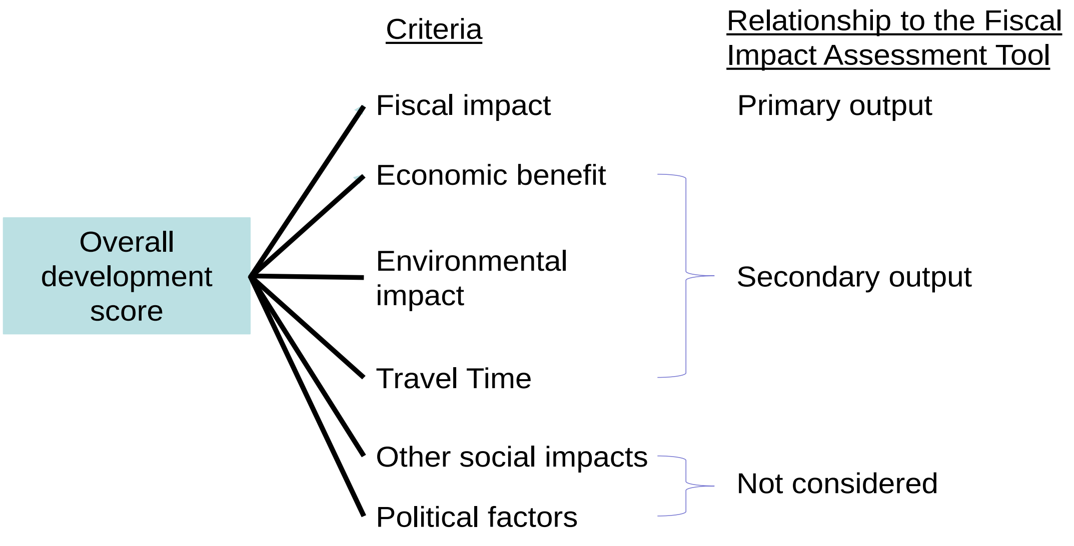

Figure 1: Possible integration of the fiscal impact assessment outputs into a multi-criteria decision making process

7.2.6 Impact of location

The location of a development is assumed to impact on fiscal and non-financial costs in five ways:

Travel distance – The distance of trips to and from the development is determined by its location relative to other land uses. This travel distance in turn impacts on travel time and carbon emissions. Travel distances will change over time as a city develops and land uses changes. As this model is not GIS-based and does not model the entire municipality, it is not possible to calculate trip distances automatically, as is done in more sophisticated transport or urban dynamic models. Travel distance is incorporated in the models as a critical user input. The user is required to enter average trip distance (trips originating in the development) for the base year and year 20. This information should be obtained from the municipal transport model, if possible

Availability of transport modes – The ability for residents or visitors to access the development by particular modes will depend on its location relative to transport networks, particularly railway stations, BRT routes and bus routes. This is also likely to change over time as transport infrastructure is provided. The availability of transport modes is incorporated in the model through the modal split. Users are required to enter the current modal split for the development area (theoretical split is the area is not currently occupied), and the anticipated modal split in year 20. The model then assumes a linear transition in this split from the base year to year 20.

Existing infrastructure capacity - Any change in land use is likely to change the demand in services. An increase in demand requires additional infrastructure to supply the demand. This infrastructure may exist already, having been built with excess capacity to support growth, or may still have to be built. The principle that is applied in the tool is that the infrastructure that is required to cater for the added demand should be costed, irrespective of what infrastructure exists to serve this demand. The reason for adopting this principle is that if the capacity exists, then this was an investment that has been made historically, but the costs of which still need to be recovered or at least accounted for. If it does not exist at present, then new infrastructure will need to be built, possibly with capacity in excess of current demand to cater for further growth. The main benefit, therefore, of having existing infrastructure capacity, is that the sunk investment can be utilized, and no additional capital finance is needed presently. This is therefore considered a *benefit* of development in a particular location, and not a *cost*, and is included as a secondary consideration in the model in the same way as the other benefits described above. The cost outputs from the model are therefore presented in two ways. The primary output is a Net Present Value (NPV) of total cost (not taking into account existing capacity). The secondary output is the required immediate capital expenditure that is needed in the first year to provide for the initial development needs. This latter figure can then be used to compare areas that have existing infrastructure against those that do not.

Distance to existing infrastructure networks – The development may be able to connect directly into existing bulk infrastructure networks, or may require additional infrastructure to do so. This additional infrastructure is termed ‘connector’ infrastructure. The user is required to calculate (or estimate) and input the distance to existing water, sewer, electricity and primary road networks. This calculation is already being done in eThekwini through the Housing Prioritisation model. For solid waste, the important consideration is whether the development is located within the threshold distance for direct transport to landfill. If not, then a transfer station will be required, which affects the cost structure of the service.

Cost characteristics of infrastructure – The development will link to infrastructure networks that may have high or low cost characteristics. For example, the wastewater may flow to a high-cost, small-scale wastewater treatment works or a high-volume low-cost regional treatment works. This is accommodated in the model through the ability to over-write the default capital and operating costs with values that are specific to the development.

Thresholds for public and social services – Public and social services are planned according to population and distance thresholds. If a development falls outside of the distance threshold for a particular service, then it may require a new facility to be constructed. In addition, if there is unused existing capacity at a facility within the threshold of the development, then the impact of the development is reduced. This impact of location has not been accommodated in this version of the model due to the complexity of the calculations required.

7.2.7 Impact of density

The density of residential development is a direct input by the user, based on the development application. In addition, a range of over-writeable default values are given for defining low density and high density ranges for each income group. The model then incorporates density considerations in the model by calculating where on the density range the development sits and using an appropriate factor. Density is assumed to impact on the cost of a development in the following ways:

Cost of land and top structure – Land costs are reduced due to the reduction in area in dense settlement forms. However, some dense forms of housing top structure are more expensive per unit than less dens forms. These two considerations are not calculated by the model, but are instead inputted directly by the user as an estimate of the total finished unit property value by land use category.

Cost of internal infrastructure – Dense settlement forms require less internal infrastructure (water, sewer and electricity reticulation and internal access roads) per capita. The impact therefore relates to the capital cost to construct the infrastructure, but also the operating cost, which is a function of the extent of the infrastructure. Density is accounted for in the capital costs of internal access roads, which are calculated on the basis of the assumed road frontage of a rectangular erf. The capital costs of water, sewer and electricity reticulation are not yet included in the model. However, these cost variations are not believed to be significant. The operating costs for water, sanitation and solid waste are calculated according to cost ranges for high and low density settlements and the specific density of each land use and income category. The operating costs for electricity are assumed not to vary significantly with density and the operating costs for roads account for density in that they are calculated by road length.

Cost of public services – Dense settlement forms increase the viability of municipal public services, as service thresholds are reached more easily and single facilities can serve greater populations. The model considers these efficiencies through a reduction in the operating costs of municipal public services for dense settlements. This is done very simply through a density-related cost reduction factor, currently estimated at 1.5.

Demand for services – Demand for services is assumed to vary according to density. The most significant variations are expected for water and sanitation, because larger properties have gardens and swimming pools. As property size in medium and high income areas is roughly related to income levels, the demand for electricity and trip generation are assumed to be higher in low density areas. Solid waste generation rates have not been varied according to density.

Viability of public transport – Denser settlement forms make public transport more viable and more attractive. However, as individual developments are unlikely to make public transport viable on their own, this has not been included in the model, as a city-wide transport analysis is required.

8 Model overview

8.1 Model structure

The Fiscal Impact Tool (FIT) is a spreadsheet based model developed in Microsoft Excel 2010. It uses multiple sheets and advanced excel functions but no macros. Users do not require any knowledge of MS Excel above basic familiarity with the software in order to use the model.

The model is broken up into the following five sections:

- Preliminaries: a title page and instructions on how to use the tool

- Inputs – containing essential information about the site and the development. Notes are provided on all input tables to guide users and ensure consistency in application.
- Outputs – main results of the model presented in graphical format, with tables on two separate sheets: summary outputs and detailed outputs.
- Defaults - covering unit demand, unit capital cost, unit operating cost, environmental factors and cost apportionment (financial responsibility and subsidy arrangements).
- Engines - take the inputs, assumptions and unit costs and project these forward in time to generate the outputs.

The structure of the model sections is shown in the figure below.

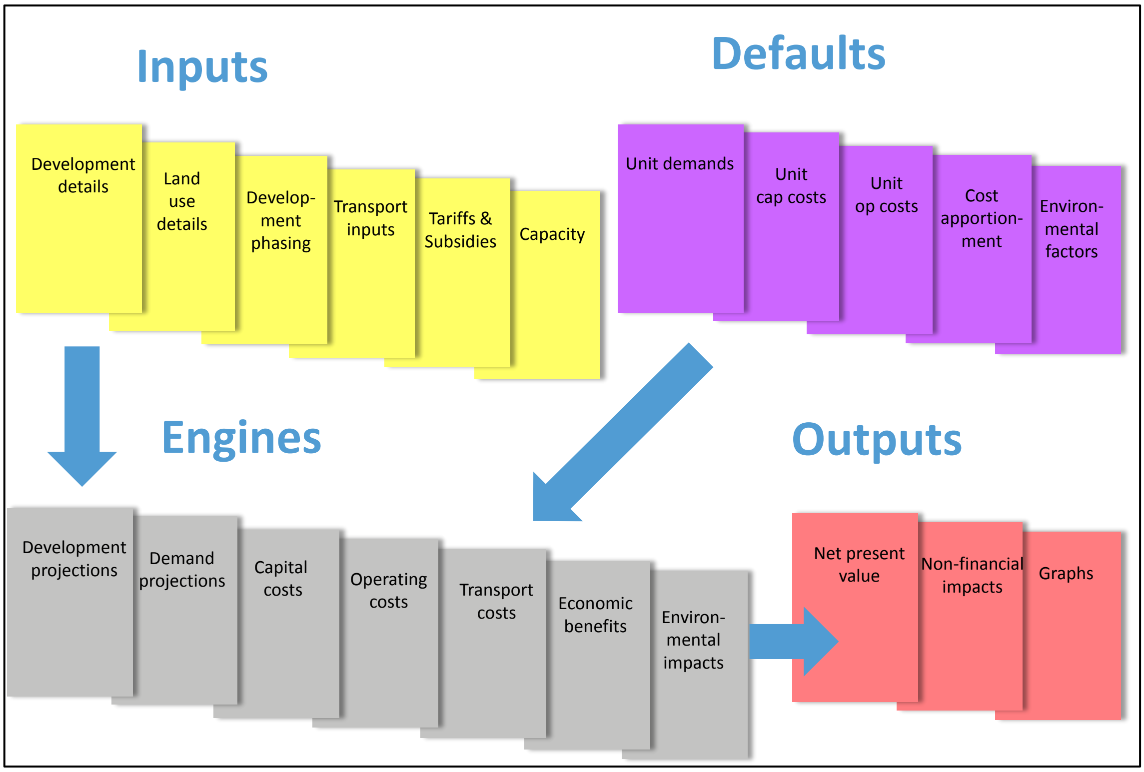

Figure 2: Structure of the fiscal impact tool

The model is structured to ensure ease of use, with increasing levels of complexity depending on how intensively the user is prepared to engage with it. At a most basic level, the user need only engage with two sheets:

In this **'basic'** mode, all the background calculations are undertaken with default assumptions in the calculation sheets.

At the **intermediate** level, the user can engage with the default data inputted into the model and over-ride these to generate more metro-and site-specific results. The default values should be over-written in all cases where better information is available. If users wish to restore the model defaults, these can be copied and pasted from the tables below the input cells provided on all sheets that contain defaults.

At the **advanced** level, the user can engage with the calculation sheets. It is proposed that these sheets should be locked so that users can view but not modify their contents. This would ensure consistency in application. Alternatively, if they are not locked, then metros can customize the tool to suit their needs.

It is expected that metros will engage at an intermediate level, at least initially, to ensure that the costs adequately reflect their municipal context. Non-municipal users may wish to engage with the model at the basic level only.

8.2 Model functions

A schematic representation of the model functions, illustrating the primary and secondary focus of the model, is shown below.

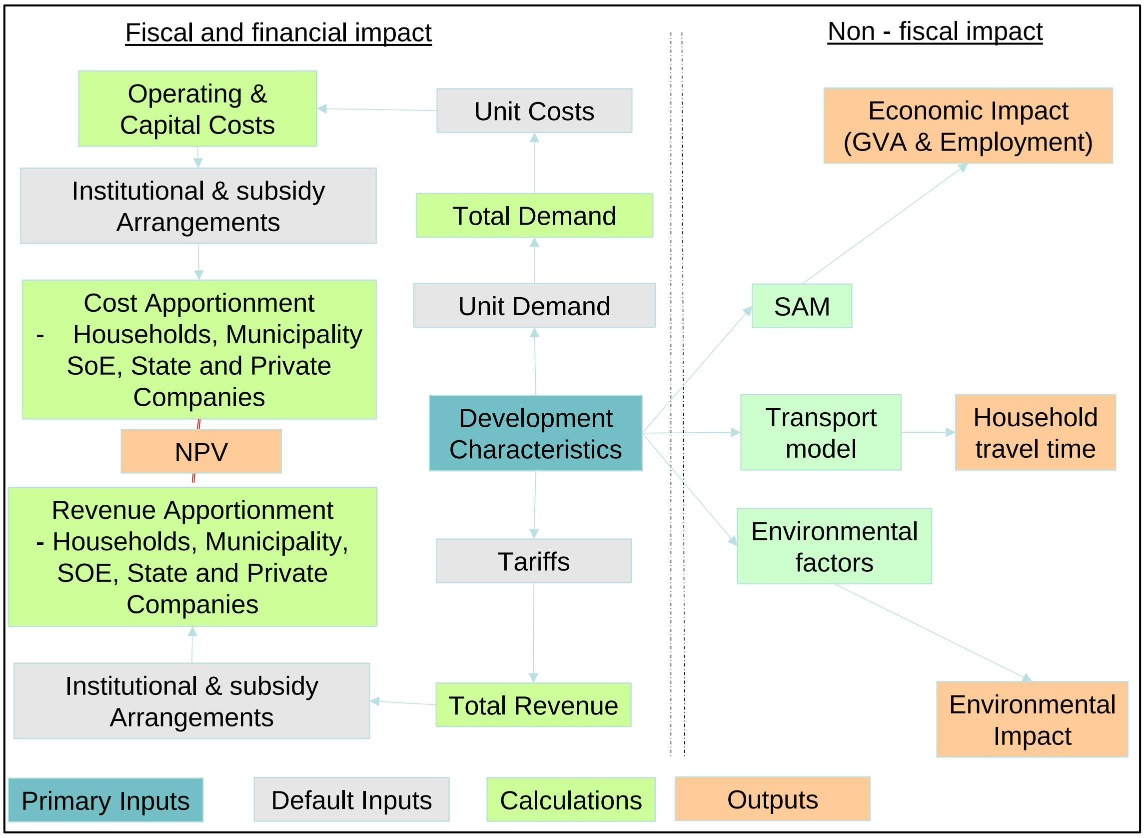

Figure 3: Schematic representation of the fiscal impact tool

The primary output of the model is the Net Present Value of the capital and operating cost impact of the development over 20 years by actor (household, business, municipality, state, SoE), which can be broken down by land use or by sector. Other outputs of the model include:

- NPV per m2 of land use
- Gross Value Added as a result of the development construction and operation
- Employment created as a result of the development
- Water and electricity demand and solid waste generation
- Carbon emissions from transport
- Increase/decrease in household travel time
- Economic value of travel time
- Household expenditure on transport

The focus of this model is on the methodology employed and not on the accuracy of the results. The unit demands and unit costs included in the model are estimates in many cases and can be improved over time, but it is important that the structure and format of the costs and the resulting calculation methodology is first correctly determined, and to which improved costing information can be included over time.

8.3 Costing principles

8.3.1 Overarching costing principles

The model is intended to calculate the overall impact of a development over a 20 year period. For the financial calculations this requires the calculation of both capital and operating costs and benefits over time. In order to account for the time value of money, these costs need to be calculated in the year in which they occur (annual cash flow) and then discounted to the base year as a Net Present Value (NPV). The model currently assumes a discount rate of 3% for this purpose. However, it is recognised that some of the actors may incur costs or receive benefits if the development does not take place. The model therefore subtracts the costs and benefits of the 'do nothing' scenario from those of the development to produce a net cost/benefit cash flow. This is shown conceptually in Figure 4: Conceptual illustration of the net cost/benefit principle, with costs shown in blue below the line in blue and benefits (revenue) shown above the line in green, and the two subtracted to produce the net cash flow. This net cost/benefit cash flow is then discounted to produce a NPV.

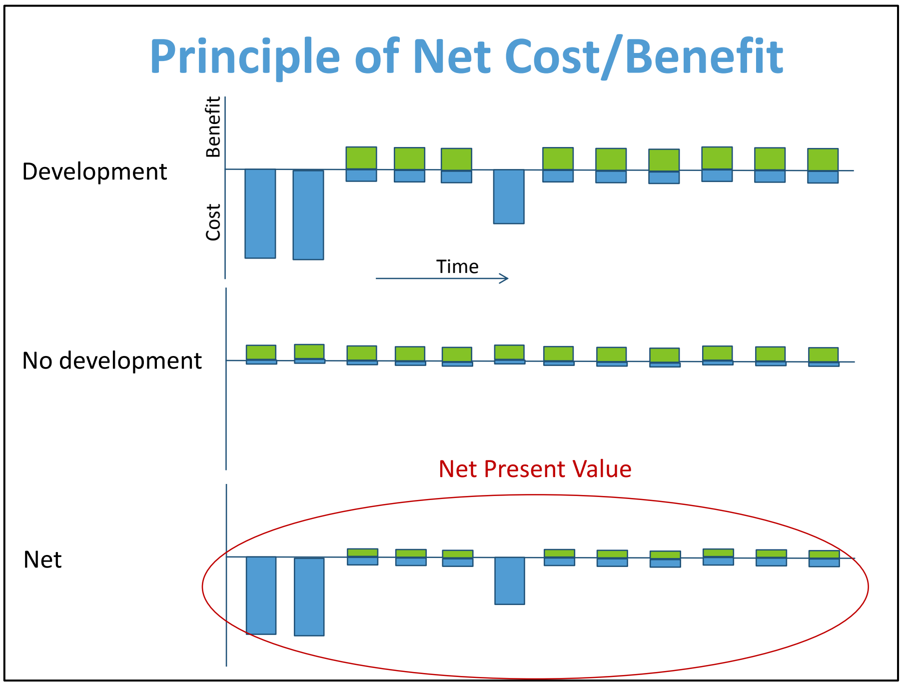

Figure 4: Conceptual illustration of the net cost/benefit principle

Another important principle is that costs and benefits can only be calculated from the perspective of one of the actors, and not for the development as a whole. This is because some of the payments are made from one party in the model to another and the net result of a development-wide cost/benefit (in theory) would be zero. For example, households and businesses pay municipal service charges to the municipality. One can therefore not say "the development costs R*x* million over 20 years", but rather "the development costs *the municipality* R*y* million over 20 years". The exception is the calculation of economic and employment benefits, which are calculated as benefits to the municipal economy as a whole and are therefore not attributed to a specific actor. This is a further reason why it is not possible to undertake a true cost/benefit, as the costs are calculated by actor and the benefits are calculated for the general economy. It is not possible to sum the costs because (as described above), some costs incurred by some actors are benefits received by others.

The costing principles used for each of the eight 'sectors' contained in the model are discussed briefly below.

8.3.2 Water

The water service is broken down into internal, connector and bulk infrastructure. Internal infrastructure is costed based on the level of service. Connector infrastructure costs are only included if the user indicates that the development is not adjacent to existing bulk infrastructure networks, in which case the entered length of the connector infrastructure is multiplied by the relevant unit costs. Bulk infrastructure is based on the peak demand from the development. Water demand is based on level of service, income category and density for residential areas and Gross Leasable Area (GLA) for non-residential areas.

The user is also required to enter the percentage of bulk water that is provided by a water board. This is used to apportion costs appropriately between the municipality and the water board. Percentage profit on water sales is assumed to be split equally between the municipality and the water board, where applicable.

8.3.3 Sanitation

The costing of sanitation is exactly the same as for water, except that sanitation demand is based on an assumed percentage return flow of water used on the site, which in turn is dependent on income level and whether the water supply is provided in-house or not.

8.3.4 Waste

Solid waste includes internal (collection), and bulk (transfer stations, recycling and disposal) infrastructure. Solid waste collection cost is staff and transport costs around the development, priced by service level. Disposal cost includes transport to landfill and considers whether a transfer station is involved, depending on the distance from the development to the nearest landfill, and the solid waste transport threshold of the municipality. If a transfer station is used, the model uses the collection vehicle transfer rate from the development to the transfer station, and the cheaper rate of a larger vehicle for mass transfer from the transfer station to the landfill. An assumed depreciation period of 3 years is used for landfill cells. This is required because landfill space is used up and therefore the capital required needs to relate to a time frame.

Users are required to enter the percentage of waste that is recycled, in order to remove this waste volume from the waste stream. The model assumes that that any reclamation of recyclables happens at the transfer station (if applicable) or at the landfill if no transfer stations are used. The rate of recycling is assumed to be constant over the 20 year period.

Users are also required to enter the percentage of non-residential waste that is collected by the municipality in order to accurately apportion non-residential solid waste costs between the municipality and private waste providers. The costs and revenues of private waste provision are excluded from the model.

8.3.5 Electricity

Electricity costs include internal (Low Voltage) and connector (Medium Voltage) infrastructure. Capital costs for bulk electricity (Generation and transmission) are excluded, but the operating costs for bulk electricity are included through the bulk tariff, which forms a portion of the retail tariff. Internal infrastructure is calculated by level of service, while connector infrastructure cost is calculated by the length of connector infrastructure required to connect to the existing network, by a unit cost.

The user is required to state whether the areas is served directly by Eskom or not. If so, then the electricity capital costs are ascribed to the State Owned Entity and not to the municipality. The model assumes that the entire development is served by either the municipality or Eskom and cannot accommodate a mixture of electricity service providers. Bulk electricity operating costs are not included in the model, as it is assumed that the bulk tariff paid to Eskom by municipalities is equal to the bulk operating costs and a zero sum is achieved.

8.3.6 Roads

Roads comprise internal access roads, connector roads and the higher order municipal road network. The following simple formula is used for estimating internal access road length:

$$Access\ road\ length = \frac{1}{2} \times \sqrt{(\frac{Area}{3})}$$

This assumes that an erf is rectangular and three times as deep as it is wide, and that there are properties on both sides of the road. This is a rough approximation only and does not account for multiple storeys, so is likely to over-estimate the access roads required by high density units. Connector roads are costed according to the specified distance to the primary road network. These connector roads are assumed to be Class 3 or Class 4 roads that would be required to provide access to the development. If these new roads would serve a number of users, then the distance should be divided by the total number of users that the connector infrastructure would serve. The capital cost of higher order roads is costed per additional peak hour trip as a result of development, because the higher order road network is designed to cater for the peak traffic. Bulk operating costs are calculated by additional trips per year that are added to the municipal network by the development. The unit of 'R/additional trips per year' is not a conventional unit of measure, but is the only way to allocate the cost of additional operating cost as a result of the development (which does not necessarily increase road length). All default road costs have been adjusted upwards to include stormwater, and this should be borne in mind by the user when over-writing the defaults.

8.3.7 Transport

Transport capital costs are calculated per additional passenger trip per mode added as a result of the development. The capital cost of private vehicles (cars) and taxis are excluded from the model. Transport operating costs are calculated per passenger kilometre based on assumed vehicle occupancies. These units are then multiplied by the passenger trips, as calculated through combining the modal split, trip generation rates for the various land uses, and average trip lengths. At present the modal split is assumed to be the same for all land uses.

Non-motorised transport (NMT) is considered a public transport trip (for modal split and trip length) because this is how it is captured in travel surveys. NMT has capital and operating costs associated with the construction and maintenance of pedestrian walkways and cycle lanes.

8.3.8 Public and Social Facilities

Municipal public services and provincial social services are costed on a per capita basis. At present the model defaults assume that a full package of public services is provided to all residents of the development, but this can be over-written by the user. Health and education costs have been derived as a simple division of the 2014 provincial budgets and population figures. No provision has been made for private schools or health facilities.

8.3.9 Property

Property value for each land use category is entered directly into the model whether as the average unit value for residential land uses or the average value per m2 (net) for non-residential land. This value is the estimated market value of the completed serviced land and top structure at current prices. The cost of land and buildings that is used in the model calculations is the property value less the value of the internal and bulk infrastructure serving the property. At present this adjustment to the property value only considers the engineering services (water, sanitation, electricity, solid waste and roads), but could arguably include transport infrastructure, social facilities and public services as well, which all add value to the property. At present these latter services have been excluded from this calculation as there is uncertainty about the degree to which these services add direct value or not. The calculations of tariffs and property rates for non-residential land uses require an estimation of the average size of non-residential units, which is also a user input of one of the initial pages.

9 Basic information required and responsibilities of the user

The model is expected to be used mainly by municipal officials dealing with development applications or potential development applications. It is therefore assumed that a certain amount of detail is known about the development. If not, the user is required to estimate these values. As a minimum, the following information is required in order to populate the essential user inputs in the model and run it in the 'basic' mode:

- Development location details (area, distance from existing infrastructure networks, and service provision arrangements in the area);
- Land use details (extent and characteristics of existing and future land uses, including housing typology, property values and service levels);
- Development phasing (when construction of the different land uses is expected to take place);
- Transport inputs (modal split, average trip length, average speed by mode and subsidy arrangements);
- Tariffs and subsidies (prevailing tariffs, fares and subsidies in the municipality); and
- Existing bulk capacity[4] (for the infrastructure networks serving the development area).

Users are also strongly urged to interrogate and improve the default data contained in the model.

10 Limitations of the model

The terms of reference required a fiscal impact tool that could calculate the fiscal and non-financial impact of development through considering the cost impact of multiple services and functions to a range of actors. This has proved not to be a simple exercise, and the review of existing models has shown that this has not been attempted before in South Africa. Throughout the model development process, the developers have faced the modeler's dilemma: whether to prioritise simplicity and user-friendliness, or whether to prioritise complexity and accuracy. The approach that has been taken is to adopt a compromise position. The tool is by necessity complex to satisfy the Terms of Reference, but this complexity has been hidden, to some extent, by requiring that the user only interact with the absolute minimum number of sheets and inputs. To achieve this compromise, and given the budget and time constraints to this project, a number of simplifying assumptions have had to be made, which produce model limitations. Many of these assumptions and limitations have been mentioned above, and others are listed in Annexure B. Important limitations of the model are:

- The model is restricted to 19 land uses. Any land uses not accommodated in the model would have to be included under another category with the most similar demand for services. Institutional land uses (government buildings, schools, churches, etc.) are not explicitly included, but could be categorised under the commercial land use.
- All operating costs are assumed to stay constant in real terms and the same costs are assumed to be applicable to the same land uses across the entire development. However, transport operating costs are treated differently. While the operating cost and the average fare per passenger kilometre is assumed to remain constant, the overall cost per household per month will vary over time because of changes to transport modes and distances. This requires that transport gets treated differently to other services in the model.
- Asset renewal is not factored into the capital expenditure requirements. While this may not be necessary in the 20 year period (as it is assumed that the entire infrastructure

[4] This is an optional input and is only required if an estimate of the initial capital investment is required.

will be new), depreciation provisions would still impact on the operating account of the various actors. These have not been included in the model not included

- The inclusion of non-financial impacts (particularly environmental impacts) has been minimal. This has proven to be very complex to include in a model of this nature, and very specific data, expertise and interpretation is required to factor in these impacts.
- Default values have been entered into the model in order to make the model run in its demonstration form, to complete the objectives of this project. Default data has been derived from the MSFM and other existing sources of unit costs available to the consulting team (including data supplied by the eThekwini municipality) to be as applicable as possible to all SA metros. The blending of data and the filling in of the many gaps with estimates has meant that this data is very difficult to reference properly, and no attempt has been made to do so. These defaults are not considered defensible and will need to be verified or independently derived in future work. A very clear caveat to the model has been provided that states that **all defaults should be over-written by users where possible**. For the demonstration model, information specific to eThekwini and Cornubia has been used to over-write any default values.

11 Cornubia results

11.1 Purpose of the case study

The Cornubia development to the north of Durban was selected as a case study to test the model as this is a good example of a large integrated development, and it was believed that a good amount of data around development details and costs was available.

The purpose of using a case study was to:

- Assess the format in which development data was available
- Refine the structure of the model to accommodate the features of the development
- Check the internal workings of the model
- Assess the reasonableness of the model outputs against other studies that have been done on Cornubia

The purpose was not to try and replicate any of the previous studies, as very different methodologies have been employed. However, these studies do serve as a reality check for the Fiscal Impact Tool results.

At the conclusion of the modelling it became evident that there are a vast number of results that can be presented in a number of ways, depending on the primary interest of the user. The primary interest has yet to be defined, so the output summary tables have selected a small number of results that are believed to be the most informative. These are provided in Annexure C. The main graphs from the Fiscal Impact Tool are presented below, with a brief discussion around the significance of the results.

11.2 Fiscal impact

The results show that the fiscal impact of the development is greatest on the households and businesses that locate at Cornubia. This is due to the dominance of the initial property price in the overall costs. The split of the NPV of Costs (below) shows that the contribution of the Municipality and the State is roughly equal at R783 million and R 707 million respectively. The costs incurred by State-Owned Entities is far lower at only R28 million.

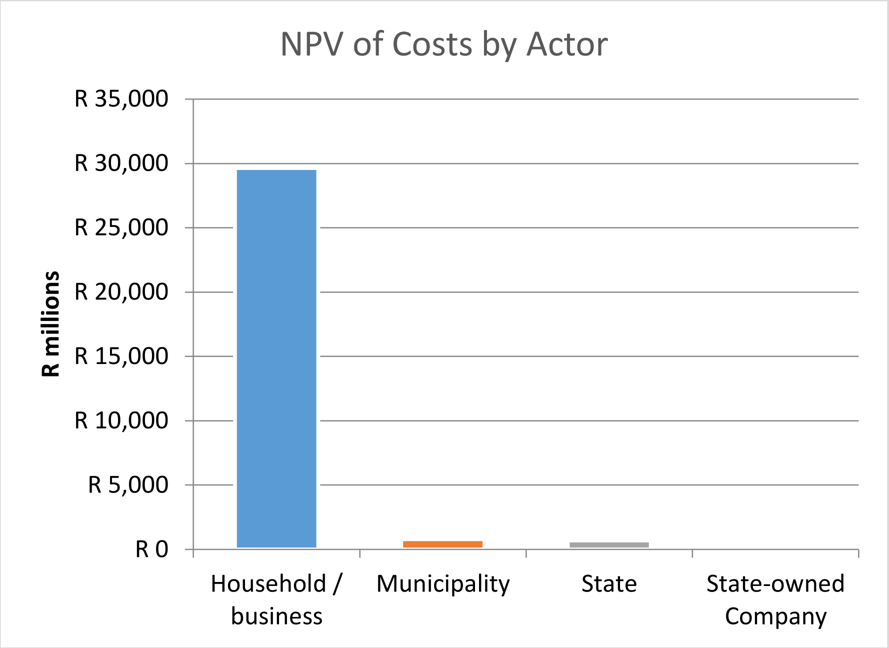

Figure 5: NPV of Costs by Actor

The dominance of the property value is clearly shown in the graph below, and makes up 77% of the total NPV of costs. This is followed by Transport, Public Facilities and Electricity as the next largest contributors to the total.

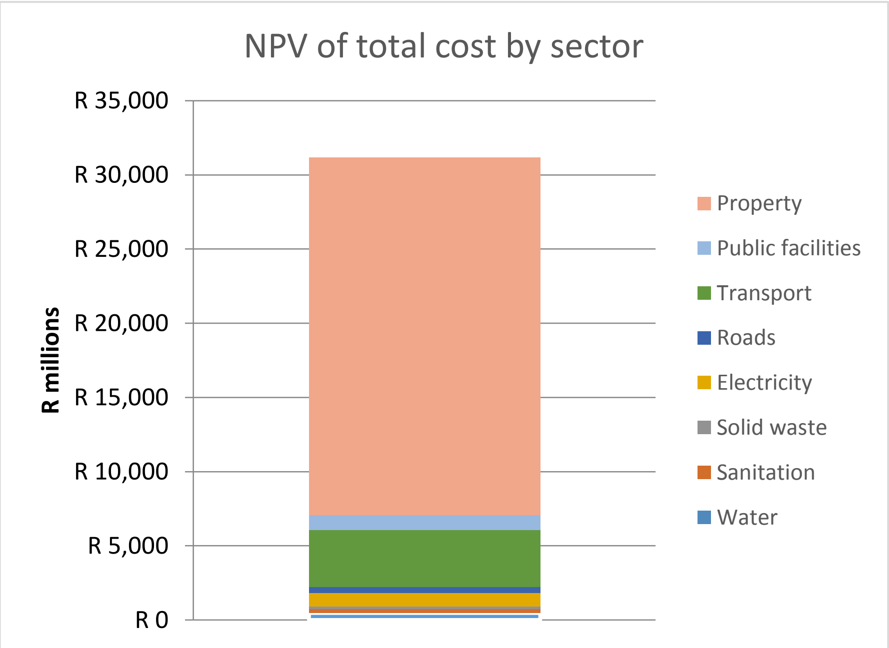

Figure 6: NPV of total costs by sector

The split of the NPV of costs between capital and operating costs (Figure 7) shows that this is almost exactly equal over the 20 year periods.

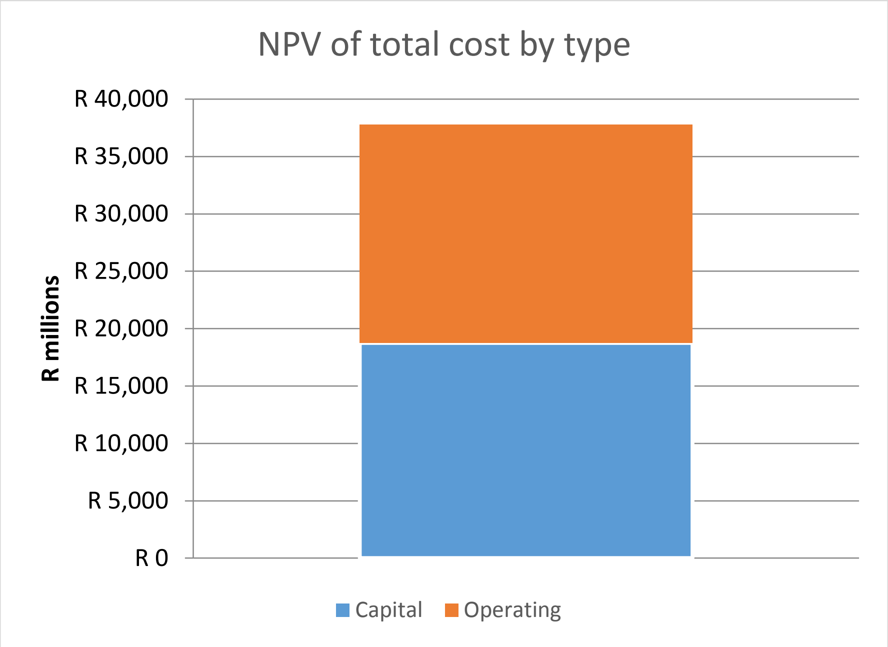

Figure 7: NPV of total costs by type

The percentage of costs that are made up by each of the eight sectors differs between the operating and capital costs (Figure 8). Property dominates both types of investment, but is relatively smaller on the operating side. Transport operating costs are considerably greater that the initial capital costs. This is also the case for electricity and public services. It is only water and sanitation, both of which have required significant connector infrastructure and bulk infrastructure upgrades, where the initial capital investment is greater than the NPV of the operating costs over 20 years.

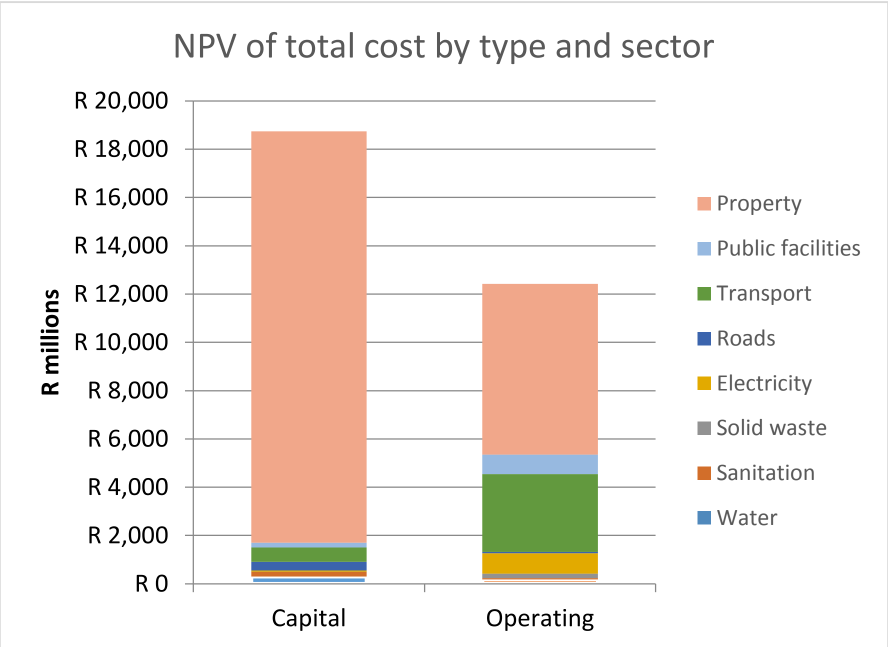

Figure 8: NPV of total cost by type and sector

Figure 9 illustrates the unit cost of servicing each of the land uses, both in terms of initial capital costs and long term operating costs. The graph illustrates the higher costs of servicing the non-residential land uses, with only minor variations in the unit costs of servicing the residential land uses. The blank spaces in the figure represent land uses that are not included in Cornubia.

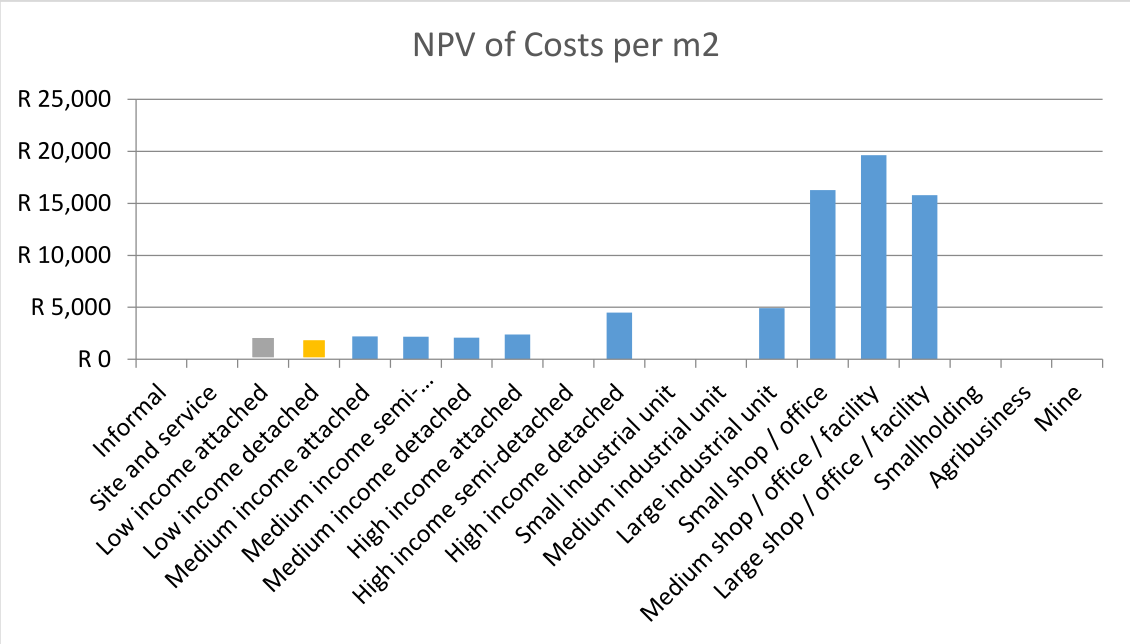

Figure 9: NPV of costs per m^2

11.3 Economic benefits

The economic benefits included in the model comprise GVA and employment. The model calculates the total NPV of the GVA of Cornubia over 20 years to be R36 billion. The distribution of this economic benefit by land use (i.e. the land uses that contribute to this impact) is shown in Figure 10.

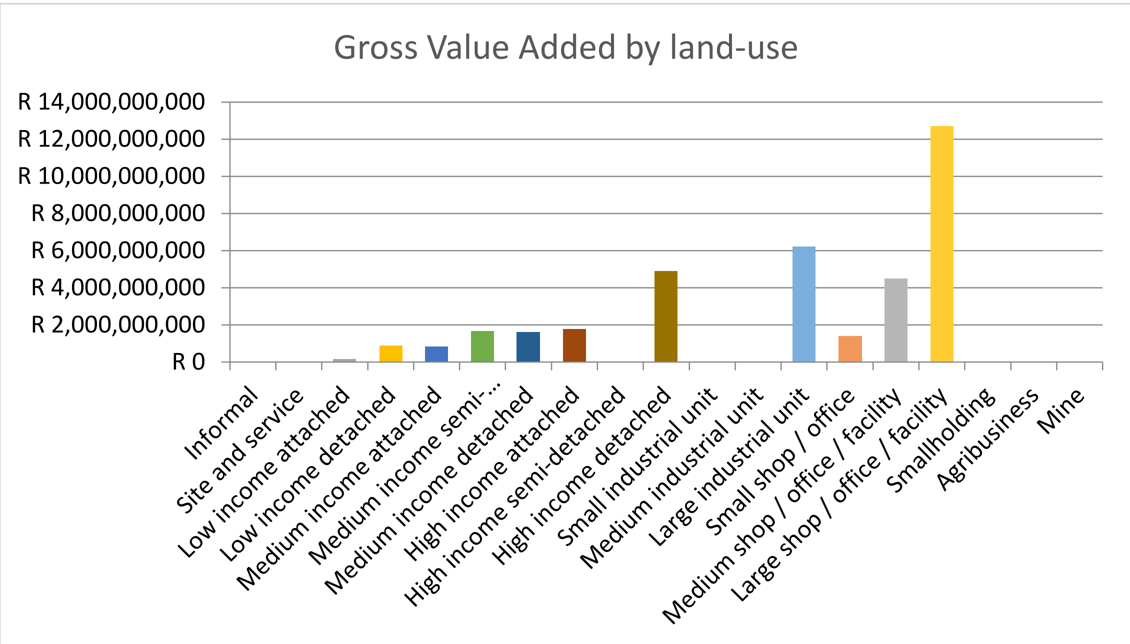

Figure 10: Gross Values Added by land use

The total employment for the construction and operation of Cornubia is calculated to be 285,523 person years.

11.4 Non-financial impacts

The non-financial impacts include the impacts on the environment and the social impacts of travel time. Figure 11 shows that an estimated 525 million tons of additional CO_2 will be produced over 20 years from transport emissions as a result of the Cornubia development. An additional 3 813 Ml of water and an additional 145 GWh of electricity will be required in year 20.

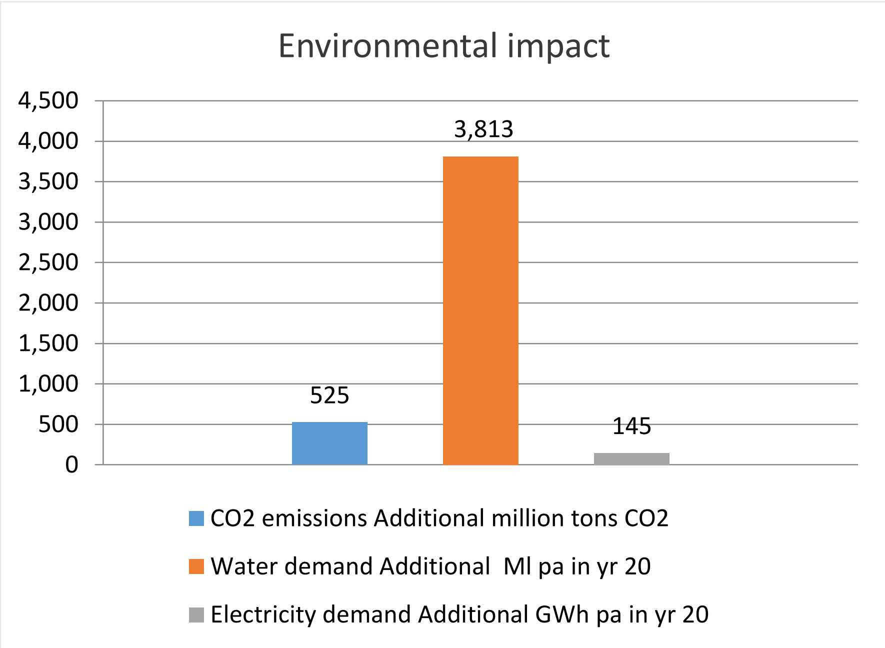

Figure 11: Environmental impact

The transport assumptions included in the model were relatively modest and indicated a moderate shift from private to public transport, favouring rail and BRT over taxis, and a minor reduction in average trip length as the northern suburbs of Durban develop and densify. These assumptions result in a reduction in travel time of between 8 and 17 minutes per day per household (average of 9 minutes) between year 1 and year 20. The economic cost of all travel time originating in Cornubia over 20 years is calculated to be R31 billion. The relatively high calculated household incomes for Cornubia mean that travelling costs as a percentage of monthly household incomes are fairly low at 9% for one low-income land use to 0.5% of the highest income land use.

11.5 Testing of results against other benchmarks

Certain data provided by the eThekwini metro could be used directly to calibrate the model and achieve direct costs inputs. For example, the costs for the Western and Northern Aqueduct and the Ohlange bulk gravity sewer were added as connector infrastructure costs. However, the cost estimates provided in Annexure L of the Cornubia Business Plan were the result of independent engineering projections and could only be used to check the Fiscal Impact Tool results (as opposed to the inputs). It is noted that the engineering calculations only consider capital costs and not operating costs. It is assumed that these are calculated at current prices and not discounted, so they have been compared with equivalent figures in the Fiscal Impact Tool. Unfortunately, despite the very clearly different structure of the two costing exercises, the comparison in the table below shows poor correlation. The Fiscal impact tool consistently underestimates the capital cost of most of the services. The reasons for this are not known, and further engagement with the eThekwini Municipality is necessary to understand the basis for the Business Plan Costing and why the Fiscal Impact Tool is producing different results. The comparison is shown in Table 1, with brief commentary providing possible reasons for the variations.

Table 1: Comparison between the Cornubia Business Plan and the Fiscal Impact Tool

R million	*Cornubia Business Plan (CBP)*	*Fiscal Impact Tool (FIT)*	*Comment*
Water	731	429	FIT water demand estimate is 18 Ml/d versus the CBP estimate of 40 Ml/day. Possible variation in peak factors.
Sanitation	1,060	271	FIT water demand estimate is 15 Ml/d versus the CBP estimate of 28 Ml/day. Possible variation in peak factors.
Solid Waste	not included	10	CBP did not consider the off-site impacts of solid waste transfer and disposal.
Electricity	345	78	FIT unit capital costs require checking as the costing methodology is new.
Roads and transport	1,990	1,356	Although the two cost estimates are similar, the CBP is dominated by road infrastructure, while the FIT is dominated by public transport infrastructure. The generic modal split that was provided is most likely not accurate for this area. Trip generation rates also need to be checked.
Social facilities	765	281	Possible variation in unit costs. FIT uses Provincial budget information and a bespoke public services unit cost model. Cost assumptions for CBP unknown.
Property	not included	24,196	
Open space/wetland improvement and maintenance	234	not included	This capital and operating cost item is not currently a feature of the FIT.
Internal infrastructure	2,946	included above	The internal infrastructure is not broken down by service in the CBP, but if a distribution of these costs were undertaken, the cost variations would be even greater.
TOTAL (excl. property)	8,071	2,425	

It would have been possible to simply increase the unit demand and unit costs in the Fiscal Impact Tool to achieve the same capital cost estimates as in the Cornubia business plan. However, this is not a preferred solution as it could mask any potential errors in either of the tow costing exercises. For this reason, a closer assessment of the differences is believed to be necessary.

The economic impact results can be compared with the cost/benefit analysis of Cornubia undertaken by KPMG in 2014[5].

	KPMG	***FIT***	***Comment***
GVA (R million)	R 21,725	R 36,026	The KPMG study was undertaken over only 15 years versus the FIT period of 20 years
Employment (person years)	290,846	285,523	Very close correlation, although the unit for the KPMG results may be jobs, as opposed to person years.

Both the GVA and employment results show good correlation. The NPV of costs and benefits to the municipality also show a fair correlation. KPMG calculates an NPV of –R1 103 million, while the FIT calculates an NPV of –R1 176 million.

11.6 Discussion

While the variations between the FIT results and those of complementary study are disappointing, they do present the opportunity to better understand the FIT assumptions and mechanics, as well as the basis for the other cost estimates. It is clear that further testing and refinement of the FIT is required in order to produce replicable and reliable results.

Many of the results produced above are only meaningful if compared with other developments, or if scenarios are run within Cornubia (e.g. additional transport investment, different mix of land uses, increase property rates, etc.). This emphasises the need to apply the model more widely.

12 Conclusion

This project set out to assess whether metros were using any tools that are adequate to determine costs to government, households and the environment with a key focus on costs to government, and whether they inform planning and development decisions. The review found that no metros are using such a tool and there is little quantitative costing work that is being undertaken to support planning decisions. Therefore, there appears to be a place for a fiscal impact tool, and this project has set out to develop the conceptual methodology and a model to demonstrate what such a tool would look like, how it would function and what data inputs would be required from municipalities.

Discussions were held with eThekwini Municipality to scope the model and to gather data from the Cornubia development to populate and test the model. While the Cornubia data has been entered and results have been produced, these have not been interrogated by the municipality. The model has therefore only been piloted on a single development and has yet to undergo any rigorous testing. As a demonstration model it serves the purpose of being able to show that the calculation of the long term costs of development to various parties is both possible and useful,

[5] 2nd Draft, September 2014

but that this does require a fair degree of development- and municipality-specific information and user engagement.

While the tool we have developed will be useful to inform strategic planning and to improve decision making that incorporates spatial considerations, the tool does not negate the need for the enforcement of planning regulations or the need for the city to clearly identify areas for growth, especially with regard to publicly funded residential development over a 20 year horizon.

13 Recommendations for further work

13.1 Model testing

The model has not yet been tested by municipal officials, and this probably the first step that needs to be taken to validate the findings of this project and improve the tool. One of the things that will need to be tested is whether officials are able to obtain the required data in their municipality, and whether they are able to accurately (and consistently) estimate inputs where data cannot be obtained. Despite being flexible to the format of the data inputs, this project has shown that data is very difficult to obtain in the format that is useful for such a modelling exercise, even from a well-capacitated and engaged metro.

For the testing of the model it is recommended that the demonstration model be used to familiarise the metro with the tool, and allow officials to identify which departments and individuals would derive the most benefit from its application, so that these individual can be asked to test the model. As the model is likely to still have 'bugs' and not be adaptable to every situation in its current form, it is recommended that City Support Programme staff (or appointed service providers) jointly run the model with municipal staff so that model errors can be quickly identified and fixed before faith in the model is lost.

Ideally the model should be tested with as wide a range of developments as possible. These would include private and city developments, low-cost housing of varying typologies and in varying locations, integrated developments, and variations in service provider arrangements. The more metros test the model, the better.

In addition to the identification of any errors or areas for improvement in the model, the testing process would also help to clarify where metro officials see the main benefit of the model lie, and therefore where effort in its refinement should be focused. The format of the outputs should be debated to present the available figures in the most useful format.

13.2 Refinements to the model

Even without model testing, there are some areas of the model where additional work could be done, but that were not possible within this project time frame. These include:

- Checking the unit demand and unit cost data against existing resources;
- Checking of peak factors for water, sanitation and electricity demand;
- Amendment of the transport calculation to allocate modal split according to income group;
- Amending the public and social services demand calculations to account for distance thresholds; location and capacity of existing facilities;
- Inclusion of 'land take' impacts on biodiversity and agriculture;
- Inclusion of density considerations in the cost of internal water sanitation and electricity infrastructure;
- Refinement of the cost apportionment defaults based on research around current levels of subsidy;

- 'Dashboard' type user interface which presents the main variables and main outputs on the same page (which would depend on the main variables and main outputs being known);
- Inclusion of a graph showing planned infrastructure provision versus infrastructure demand – to be displayed on the Development Phasing sheet; and
- Projections of project cash flows by actor.

13.3 Integration with existing models

The tool that is being proposed has a very specific function: to calculate the fiscal impact and costs to households and the environment of single proposed land developments in metros. However, the tool could be modified in future to interface in a productive way with existing models.

Firstly, the transport inputs could be greatly improved through an interface with UrbanSim. There may be other potential areas where UrbanSim may provide more specific and accurate inputs, but there may also be scope for some of the parameters from this tool (specifically cost data) to provide inputs to the application of UrbanSim in metros.

Secondly, there is scope for this tool to interface with the eThekwini Housing Prioritization Model. The most obvious area of interface is for inputs for this tool (such as distance to bulk networks or accessibility of social facilities) to be derived from the Housing Prioritisation model. However, as a more ambitious project, there is potential for the fiscal impact tool (or aspects of it) to be embedded into the Housing Prioritisation Model to determine capital and operating costs of any development type across the entire metro. As an ideal scenario, a user would be able to input a land use type (or combination thereof) and the Housing Prioritisation Model (which would have to be re-named if it were to be broadened to other land uses) would produce a 'Fiscal Impact Surface' across the metro, indicating the optimal location(s) for that land use. This would begin to address the strategic planning functionality that was expressed as a need in the engagement with eThekwini municipality, but could potentially be applied in other metros as well.

13.4 Further research work

The most obvious area that requires further research is on developing accurate and defensible unit demand and unit costing data for South African metros. This is a substantial piece of research that requires a sound methodology, sufficient resources and a clear view of the format of the units that are to be developed.

The combination of a financial cost model with economic cost/benefit techniques and some environmental impacts proved to be very difficult. The monetary quantification of non-financial impact is a vast area of academic research and further work needs to be done to establish whether any of these existing methods are suitable for this type of tool, and if so, what would be required to incorporate these methods into the model. Alternatively, such research might establish that these methodologies are all complex in their own right and are better off being kept as distinct exercises.

This project has highlighted that any fiscal impact assessment undertaken over the long term is highly sensitive to transport projections, but at the same time these projections are highly uncertain. Other models exist that are able to project travel patterns based on projected (or computer generated) land use changes, but these models are not designed to produce the type of outputs generated in the Fiscal Impact Tool. Combining a transport model with the Fiscal Impact Tool would produce an extremely complex and cumbersome model, if it were possible at all. Further work is therefore required to understand how the outputs of a transport model can better be incorporated into the Fiscal Impact Tool to make the transport inputs more accurate.

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Annexure A – Survey Questionnaire

Introduction

You may be aware that the City Support Programme and the South African Cities Network have commissioned a study into the fiscal impacts of development on spatial form.

In the first phase we are trying to determine what existing tools and models metros are using to assess the long term cost of development through a telephone survey.

Please could you answer a few questions on this topic? It should take 10-15 minutes.

Questions

- Do you have any tools to assess the long-term costs to the municipality associated with development applications or development in general?

[If so]

- Please could you describe these tools?
- How do you factor in
    - Capital costs of infrastructure (bulk, link, internal)?
    - Long term operating costs to the municipality (service costs – over what period)?
    - Revenue generating potential of the development?
    - Costs to external parties (province, national (i.e. subsidies), parastatals)?
- Costs to households living in the development?
- Environmental impacts?

[If not]

- What are criteria, ways and procedures for testing the costs associated with the development application?
- What are the criteria used to decide on long-term growth patterns (e.g. extension of the urban edge)?

Notes

If you have any tools, or a process diagram for development applications, please could you forward to the email address provided in Section 4 of this document.

Annexure B - Detailed sheet commentary

This annexure provides additional commentary and guidance on the essential inputs to the model, to be used as supplementary to the guidance provided on the individual model sheets.

Preliminaries

The preliminary sheets provide a title page and instructions on how to use the model. No user inputs are required. The instructions also explain the colour coding of cells used in the model.

Section 1: Inputs

DEVELOPMENT DETAILS

The development details sheet includes essential inputs required in order for the model to run. There are three types of information on this sheet:

- Information relating to the model run
- Information relating to the overall development
- Connector infrastructure distances
- Service provision arrangements

All of the yellow cells on this sheet need to be filled in by the user. If information is not known it will be estimated. Cells left blank will be read as zero.

LAND USE DETAILS

This sheet has two areas: the left hand side dealing with the type and extent of existing land uses, and the right hand side dealing with engineering service levels. Level of service must be entered for new development. However, for land uses that are being replaced, the existing level of service must be indicated.

The residential land use categories can be called anything that best describes a common housing typology or situation. Figures must be entered for the number of units of each that currently exist, and the number of units that are expected to exist in year 20. The total (net) area of each land use must be provided, as well as an estimate of the completed market value of each unit at current prices.

For non-residential land uses the land use categories are fixed. Information is provided in square metres of Gross Leasable Area per land use, as well as the total net coverage of each land use. The property value figure is entered in R/m^2 (net) and must reflect the total land value including services and top structure.

Infrastructure and open space categories are only added to make up the area total, which is checked against the total site are entered in the development details sheet. These land uses cannot be allocated a service demand.

The model assumes that existing land uses on the site are either retained on the site in their current form (existing = future), or removed immediately in year 1 and replaced by development (existing > future), or expanded upon (existing < future), depending on what is entered in the existing and future columns.

Service levels are entered by selecting a pre-defined list of service levels from a drop-down menu. Users may amend the names of the service levels in the Unit Cap Cost sheet in Section 3 of the model, but must then also enter the correct unit capital cost, unit operating cost (Unit Op Cost Sheet) and unit demand (Unit Demand sheet) for the revised service level.

The final column on the Land use details sheet requires the user to estimate the number of people per household for residential units and average unit size for non-residential land uses. This is unlikely to be known for the specific development, and will therefore need to be derived from city-level data. This is an essential input for the model to operate correctly.

DEVELOPMENT PHASING

On this sheet the user must specify the anticipated phasing of the development. Residential, non-residential and infrastructure phasing is entered separately. All columns must sum to 100%. If the entire development takes place in year 1, then the first row should be entered as 100% and the remaining cells entered as zero.

The assumption behind the default infrastructure phasing is that infrastructure is (and can) be provided as and when needed. This must be over-written if infrastructure is provided in advance of demand.

TRANSPORT INPUTS

The model is highly sensitive to transport inputs and care should be taken to get as accurate information as possible. It is expected that this information can be obtained from a metro transport model or from metro travel surveys. The table of defaults at the bottom of the sheet indicate the level of State subsidy for each of the transport modes. The user portion is calculated from the fare information and the cost information entered in the 'Tariffs & Subsidies' and 'Unit Op Cost' sheets. The municipality is assumed to be responsible for covering the remainder not covered by the user, the State or an SoE. These white cells are calculated and should not be over-written. The assumption in the model is that the transport subsidy regime is constant over time

TARIFFS & SUBSIDIES

The 'Tariffs & Subsidies' sheet covers operating tariffs for municipal services and transport, and capital charges for municipal services.

Operating tariff structures vary greatly between municipalities. The 'Tariffs & Subsidies' sheet has been structured to capture the most common tariffs structure generically, but is not expected to match a particular municipality's tariff structure exactly. Where tariffs differ, average tariffs need to be calculated prior to entering these into the model (e.g. electricity). Block tariffs have been provided for in the case of water and sanitation, and the tariff blocks can be adjusted by the user. For simplicity, transport fares are entered in a very general unit of Rand per passenger kilometre per mode. Where this figure varies by trip distance, an average fare should be calculated for the average trip distance.

The column for internal capital charges reflects whether the municipality or the developer is responsible for internal infrastructure costs. The column for bulk and connector costs reflects how much of the actual bulk and connector costs are recovered through Development Charges.

At the bottom of the page are two inputs relating to housing. The first is a simple input of the current individual housing subsidy quantum. This amount is not specified by housing programme, but is an average figure that is applied to all low cost housing interventions to reflect State investment. The assumption in the model is that State investment is capped at the subsidy amount multiplied by the number of units constructed and the municipality is responsible for the remainder.

The second housing input is a table that uses a simple loan amortisation calculation to estimate household income based on property value. This correlation was proven in empirical work undertaken in the City Johannesburg, and relies on the assumption that the value of a household's property is approximately equal to the loan repayments they could afford using 25% of their household income on a 2o year loan. The correlation breaks down at the low and high ends of the income spectrum, but is considered adequate for the purposes of this model. To ensure consistency in model application, it is recommended that users do not overwrite the default values in this table.

CAPACITY

In order to estimate how much available capacity can be used by a development, it is necessary for the user to enter the available capacity in the networks that supply the development. This information will need to be provided by the relevant engineering department and may be difficult to source. The sheet covers water, sanitation, solid waste and electricity only. Road capacity and public facility is too complex to handle in this model and has therefore been excluded.

The 'Capacity' sheet is optional and can be left blank if the current capacity is not known. Its purpose is to indicate when the current capacity will be used up and what the immediate capital need is. To use this sheet, the user must estimate the current bulk capacity available in the network that serves the development area (in the units specified). The calculations then reflect when the available capacity will be used up and what the immediate capital need for bulk and connector infrastructure to satisfy the projected demand in Year 1. The final columns estimates the capital need for bulk and connector infrastructure to satisfy the projected demand in Year 20.

Note that these outputs are displayed on this sheet only and are not taken through to the outputs section.

Section 2: Outputs

The first output sheet contains graphs that are drawn from the other two output sheets. The 'Output summary table' sheet presents a selection of the main model outputs by land use. These are:

Net Present Value of Costs over 20 years by actor – The sum of operating and capital costs, less the capital and operating revenue, discounted at the assumed discount rate over 2 years and provides an indication of which actor is most heavily impacted financially by the development. Note that negative values reflect net profit from the development and positive numbers reflect net cost.

Net Present Value of Costs per m^2 – This is the previous output divided by the net coverage of each land use and provides an indication of the most expensive land uses.

Economic benefits – This is the Net Present Value (i.e. discounted) economic benefit of the investment in property and infrastructure, as well as the economic benefit of operating the development over 20 years. It is therefore heavily influenced by the amount and type of capital investment. It does not represent the economic benefit of the non-residential land uses doing business over the period.

Employment – Represents the employment potential, measured in person years, of the initial construction activity, as well as the operating of services in the development over 20 years.

Environmental impact – Three type of impact are calculated: carbon emissions, electricity demand and water demand. Carbon emissions are calculated as a result of transport as additional tons of CO_2, i.e. the difference between the developed and non-developed state. The calculation does not account for the fact that trips may have been displaced from elsewhere in the metro. The electricity and water demand figures are presented as GWh per annum and ML per annum in year 20 respectively. It could be argued that MVA and Ml/d may be more relevant units from an engineering units, but as this output indicates impact on natural resources, the units have been calculate for a full year.

Transport – A range of transport-related outputs are presented. The first is an indication of the increase or decrease in average travel time by residents living in the development between year 1 and year 20. This result is more meaningful than total increase in travel time for the whole development, because this is skewed by the difference in the number of people living in the development in year 1 and year 20. The second output is the economic cost of travel time, which is calculated by multiplying the total travel time over the 20 year period by the estimated hourly wage of residents in each land use category. This result is the cumulative cost of all travel to and from the development and does not subtract any project travel from the 'no-development' case. The third transport output is the household cost of transport, measured in R/hh/month in year 20, which is then divided by the assumed household income to present the % household expenditure on transport in the final output column. This is an assessment of the financial burden of transport on households living in the development, which can be used to assess the impact of location or transport infrastructure availability.

Section 4: Engines

DEMAND

The first section of the engines covers the demand projections. This includes the unit demand for each service, the projections of numbers of units developed per year, and the demand for each of the services. Because transport has input parameters that vary over time (e.g. average trip distance, modal split and average speed), there is a need to project transport demand annually, and thus transport sheets have a different structure in the model.

UNIT COSTS

Capital cost is first calculated as a unit cost per land use, then a unit cost per actor.

As for capital costs, operating cost is first calculated as a unit cost per land use and then a unit cost per actor. Note that transport operating costs are excluded from the operating unit costs because these are not assumed to be constant over time, as the other costs are.

COST SCHEDULES

The unit costs are multiplied by the development projections (when the development actually takes place) to generate schedules of capital and operating costs per year (again, excluding transport operating costs). These cost schedules are generated per actor and by sector.

Transport operating costs are calculated in a similar manner, but use trip distances as well as the development projections to calculate operating cost schedules by actor and by mode.

NON-FINANCIAL IMPACTS

The non-financial impacts calculated in the next section of the engines comprise travel time, and the economic costs thereof, and carbon emissions and an economic cost thereof.

NET PRESENT VALUE

The Net Present Value (NPV) calculations were undertaken in real terms using a real discount rate of 3% applied to the sum of the capital and net operating costs over 20 years. This calculation is done by actor, by sector and by investment type (capital or operating).

GROSS VALUE ADDED

GVA is calculated based on the capital and operating investment in each of the sectors using the multipliers from the references listed above. This GVA is reduced to a NPV figure using the same discount rate as above.

EMPLOYMENT

Employment figures are calculated using average cost of employment figures for capital and operating investment in each sector, obtained from the eThekwini Social Accounting Matrix (SAM) prepared by KPMG in 2006 and updated using Burrows & Botha (2013).

ANNEXURE C – OUTPUT SUMMARY TABLES

	Net Present Value of Costs over 20 years - by actor				Net Present Value of Costs per m²				
	Household / business	Municipality	State	State-owned Company	Total	Household / business	Municipality	State	State-owned Company
	R	R	R	R	R/m²	R/m²	R/m²	R/m²	R/m²
Informal	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Site and service	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Low income attached	R 32,085,418	R 34,186,486	R 74,160,236	R 1,225,733	R 2,245	R 401	R 427	R 927	R 15
Low income detached	R 185,274,908	R 249,510,699	R 385,970,074	R 7,053,667	R 1,989	R 356	R 480	R 742	R 14
Medium income attached	R 642,038,225	R 33,374,343	R 43,127,113	R 11,263,131	R 2,190	R 1,605	R 83	R 108	R 28
Medium income semi-detached	R 1,262,464,197	R 57,873,435	R 99,991,763	R 22,290,094	R 2,160	R 1,578	R 72	R 125	R 28
Medium income detached	R 1,225,265,152	R 68,278,596	R 85,723,994	R 21,977,098	R 2,073	R 1,532	R 85	R 107	R 27
High income attached	R 1,475,971,300	R 40,985,433	R 1,445,220	R 13,737,440	R 2,350	R 1,968	R 55	R 2	R 18
High income semi-detached	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
High income detached	R 4,321,377,726	R 32,577,835	R 809,323	R 7,666,533	R 4,475	R 4,116	R 31	R 1	R 7
Small industrial unit	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Medium industrial unit	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Large industrial unit	R 4,419,605,660	R 369,662,493	R 20,511,815	R 85,784,039	R 4,717	R 3,274	R 274	R 15	R 64
Small shop / office	R 1,114,563,589	R 61,628,536	R 303,298	R 16,433,590	R 16,338	R 12,384	R 685	R 3	R 183
Medium shop / office / facility	R 3,636,495,713	R 19,686,314	R 647,036	R 33,182,494	R 19,632	R 15,152	R 82	R 3	R 138
Large shop / office / facility	R 10,211,105,925	R 207,987,240	R 1,105,352	R 62,552,171	R 15,751	R 12,453	R 254	R 1	R 76
Smallholding	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Agribusiness	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
Mine	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0	R 0
TOTAL / AVERAGE	**R 28,526,247,812**	**R 1,175,751,411**	**R 713,795,224**	**R 283,165,992**	**R 5,421**	**R 4,134**	**R 170**	**R 103**	**R 41**

[add any other logos here]

Economic benefits		Environmental Impact			Transport			
GVA	Employment	CO_2 emissions	Electricity demand	Water demand	Increase/decrease in ave time over 20 years	Economic Cost of total travelling time	Household cost of transport in yr 20	% household income in yr 20
R	Person years	Additional million tons CO_2	Additional GWh pa in yr 20	Additional Ml pa in yr 20	mins/day	R total	R/hh/month	%
R 0	0	0	0	-	0	R 0	R 0	0%
R 0	0	0	0	-	0	R 0	R 0	0%
R 149,115,458	1,383	3	0	19	-8	R 110,105,971	R 886	9%
R 862,755,540	8,195	14	2	156	-9	R 765,865,701	R 946	7%
R 833,656,743	7,230	16	4	167	-16	R 1,668,809,329	R 1,690	6%
R 1,651,514,191	14,529	27	7	282	-16	R 3,511,670,541	R 1,750	6%
R 1,595,003,596	14,353	24	6	243	-17	R 3,612,976,795	R 1,781	5%
R 1,745,936,936	16,277	20	8	329	-17	R 4,576,504,044	R 1,781	3%
R 0	0	0	0	-	0	R 0	R 0	0.0%
R 4,871,949,772	50,353	11	4	188	-17	R 16,919,993,605	R 1,781	0.5%
R 0	0	0	0	-				
R 0	0	0	0	-				
R 5,828,564,950	38,227	193	28	1,296				
R 1,400,166,135	10,698	32	2	75				
R 4,474,331,265	29,651	69	65	240				
R 12,612,682,476	94,627	117	18	819				
R 0	0	0	0	-				
R 0	0	0	0	-				
R 0	0	0	0	-				
R 36,025,677,062	**285,523**	**525**	**145**	**3,813**	**-9.16**	**R 31,165,925,985**	**R 1,061**	**4%**

[add any other logos here]