Kente

Turning the tide of slum development

Peter Sanders, Jill Slinger, Els van Daalen

Continuous Modelling Project
Spm2931
2009/2010

COLOPHONE
Auteurs: Peter Sanders, Jill Slinger, Els van Daalen
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Section A: Organisation of the Continuous Modelling Project

A.1 Introduction

The continuous modelling project falls in the third quarter from 1 February until 29 March 2010. The first six weeks are devoted only to the case study. In the seventh week attention is also given to the development of a proposal for an individually selected new System Dynamics study.

A.2 Supervision

Students work together in groups of two on the project. Each group receives 30 minutes of supervision per week with their supervisor at an allocated time on Thursday morning. Students are requested to bring hard copies of the deliverables for each week (listed in Table A.1) to their supervisory session, so that these can be discussed and an accurate record of progress can be kept. Each student is expected to spend ten hours per week on the continuous modelling project.

This course is run in parallel with a skills training Reflection on Modelling (spm 2999c Reflectie op Modellen). Students are required to attend a lecture on 16 February 2010 and write a reflective essay for this course. The deadline for the essay is 19 April 2010.
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A.3 Products and grading

The final products include a model and modelling report of at most 25 pages per group and an individual proposal for a new System Dynamics study of at most 4 pages. The final documents, stapled together, must be placed in the receptacles located outside room b3.230 on, or before, 12:00 on Monday 29 March 2010. A digital version of the model (including. validation runs and runs with policy options implemented) must be included with the final report and mailed to the supervisor of the group.

The modelling report has a dual purpose. It is intended that the students take the role of the consultancy bureau contracted by the fictitious client (Kente City Council). The report should then be a report for a client. This means it should be analytically sound, but also client-friendly in the sense that it is readable, methodological choices and technical terms are explained, it is complete and the client can identify with the problem description and the conclusions and recommendations. The joint schedule for developing the model and producing the modelling report is presented in Table A.1.

The final model, the joint modelling report and the individual proposals for a new System Dynamics study will be graded. The process that the students follow in developing their model and their weekly progress form a component of the final mark. The final mark for an individual student of the project component of the spm2931 course is made up as follows:

- **Joint model 25%**
- **Joint modelling report 65%**
- **Proposal for new SD study 5%**
- **Modelling process 5%**

The final model, modelling report and individual study all have to be submitted for a grade to be issued for spm2931**.**
The reflective essay has to be submitted to obtain a grade for spm2999c.

A.4 Structure of the modelling report

The final modelling report of no more than 25 pages must include the following:

- Problem description;
- Modelling question(s) (incl. scope of the study);
- Methodology (particularly the choice of modelling technique)
- Conceptualisation;
- Specification;
- Verification and validation (including sensitivity analysis);
- Explanation of model behaviour;
- Policy measures (outcomes of tests);
- Conclusions and recommendations

The complete model equations and the outcomes of relevant tests and experiments must be included in the appendices.

A.5 New System Dynamics study

Besides the modelling report based on the case study, students are also expected to develop a proposal for a new System Dynamics study. This document (max 4 pages) must comprise:

1. a list of four possible topics;
2. a motivation of the suitability or lack of suitability of System Dynamics as a modelling method for resolving the problem;
3. the choice of topic for the new SD study;
4. the modelling question(s);
5. detailed project plan for the new System Dynamics study with a paragraph per step in the project plan including, for instance, where data can be obtained.

The four possible topics should include at least one topic unsuitable for SD and at least two topics suitable for SD, so that a clear and motivated choice of topic can be presented.

A.6 Time Schedule and Deliverables

A time schedule for conducting the continuous modelling project is specified in Table A.1. The deliverables have to be completed before the dates indicated so that the entire report and final model can be completed on time.

Table A.1: Time schedule for the continuous modelling project

Date	Deliverables
Week 1 2/02 4/02	 Introductory lecture Problem description and modelling questions First causal diagrams (sub-models) for discussion
Week 2 11/02	Introductory chapter Causal diagrams Table with data from the case study description
Week 3 16/02 18/02	 Reflection on Modelling Lecture (spm2999c) Powersim-diagrams Description of conceptual model and chapter introductions
Week 22 - 26/02	*Spring Break*
Week 4 4/03	Model specification in Powersim Planning verification and validation Planning sensitivity analysis
Week 5 11/03	Verification and validation completed Explanation of model behaviour Sensitivity analysis completed Description of different policy measures
Week 6 18/03 22/03	Analysis of policy options Preliminary conclusions and recommendations ***Hand in draft report***
Week 7 25/03 29/03	Complete analysis of policy options Final conclusions and recommendations List of possible topics for new SD study for discussion ***Monday 29/03 before 12:00 noon*** (i) Final report, (ii) Final model, model tests and policy runs and (iii) Proposal for new SD study
19/04	Reflection Essay (spm2999c)

A.7 Some useful references

[1] Why we iterate: scientific modeling in theory and practice, Jack B. Homer,Syst. Dyn. Rev. 12, 1–19, 1996.

[2] Maps and models in system dynamics: a response to Coyle, Jack Homer, Rogelio Oliva, Syst. Dyn. Rev. 17, 347–355, 2001.

[3] Qualitative and quantitative modelling in system dynamics: some research questions, Coyle RG. Syst. Dyn. Rev. 16, 225–244, 2000.

[4] All models are wrong: reflections on becoming a systems scientist, John D. Sterman , Syst. Dyn. Rev. 18, 501–531, 2002.

[5] Collecting and analyzing qualitative data for system dynamics: methods and models, Luis Felipe Luna-Reyes, Deborah Lines Andersen , Syst. Dyn. Rev. 19, 271–296, 2003.

[6] Integrating critical thinking and systems thinking: from premises to causal loops, Robert Y. Cavana, Edwin D. Mares, Syst. Dyn. Rev. 20, 223–235, 2004.

[7] The validation of commercial system dynamics models, Geoff Coyle, David Exelby,Syst. Dyn. Rev. 16, 27–41, 2000.

Section B: Case Description

Kente

Turning the tide of slum development

B.1 Introduction to the Kente Case

This case description focuses on the urban problems of large cities in the developed and developing world. A number of press articles and reports on the urban poor and slum development in large cities across the world are included for your information. The following articles are provided as illustrations of the scale and prevalence of the problem:

1. Report reveals global slums crisis (press article, B.2)
2. Urban explosion: the facts (press article, B.3)
3. Urban decay not limited to the west (B.4).

A (non-existent) city, named Kente, forms the subject of the case study. You are requested to represent the Centre for Process Management and Simulation of the Delft University of Technology in conducting a modelling study for the Kente City Council. To ensure that the modelling project can be completed on time, fictitious information and interviews from the study "Urban solutions for Kente" conducted by the international consultancy *Urban Solutions* are included. These fictitious data are based on information from real cities. You are advised to focus on the information relating to the motivation for the study (section B.5) and the information and interviews (sections B.6 to B.12) in conceptualising, specifying, verifying and validating your model.

B.2 Report reveals global slums crisis

Source: BBC World
Friday, 16 June 2006, 11:47 GMT 12:47 UK

Slum-dwellers who make up a third of the world's urban population often live no better - if not worse - than rural people, a United Nations report says.

Anna Tibaijuka, head of the UN Habitat agency, urged governments and donors to take more seriously the problems of at least a billion people. Worst hit is Sub-Saharan Africa where 72% of urban inhabitants live in slums rising to nearly 100% in some states. If no action is taken, the world's slum population could rise to 1.4bn by 2020. More than one billion people live in slums now. Habitat - the UN's human settlements programme - is hosting an Urban Forum in Vancouver next week on how to stem the crisis. Its report is billed as a ground-breaking survey of urban growth, making a clear distinction between slum and non-slum development for the first time in UN history.

According to Dr Tibaijuka, speaking to reporters in London, slum-dwellers suffer a double disadvantage: they both live in misery and their plight often goes unreported given the traditional focus on the rural poor in the developing world. "The average aid worker is not aware of the extent of the problem - this report is the proof," UN Habitat's executive director added. Some states, the report notes, have already taken significant action to improve conditions, notably in Latin America where about 31% of urban people are classified as living in slums (figures for 2005) - down from 35% in 1990.
Such progress is welcomed as part of the UN's Millennium Development Goal of achieving a significant improvement in the lives of at least 100 million slum-dwellers by 2020. Among the report's findings:

- Expectations of better access to education are unmet for most slum-dwellers; a 2003 study found that one in five children in the Nairobi slum of Kibera had no access to primary schools
- Poor sanitation, described as a "silent tsunami", means illness and death are rife; in one part of Harare, 1,300 people share one communal toilet with just six squatting holes
- In Cape Town's slums, children under the age of five are five times more likely to die than those living in the city's high-income districts
- Young adults living in slums are more likely to have a child, be married or head a household than their counterparts living in non-slum areas

"Rural poverty has long been the world's most common face of destitution but urban poverty can be just as intense, dehumanising and life-threatening," UN Secretary-General Kofi Annan says in an introduction to the report.

Upgrade and prevent

A slum is defined by UN Habitat as a place of residence lacking one or more of five things: durable housing, sufficient living area, access to improved water, access to sanitation and secure tenure.

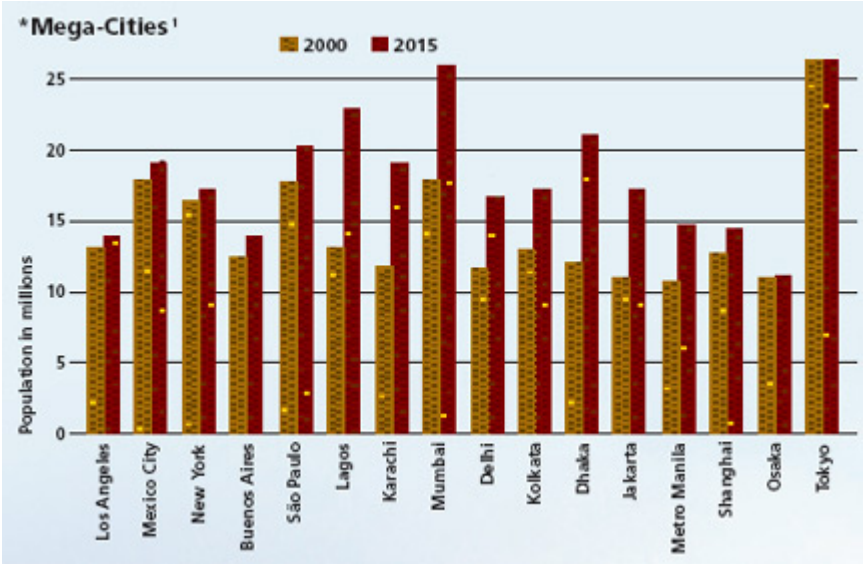
"*People move to the cities not because they will be better off but because they expect to be better off*"
Anna Tibaijuka
executive director of UN Habitat

Slums have existed in what is now the developed world since the Industrial Revolution and 6% of its current urban population also fall under Habitat's definition. However, the growth in slums is unprecedented, Habitat finds, and the nature of the problem has also changed. Of the urban population of South Asia, 57% live in slums though this is down on the 1990 figure of nearly 64%. Dr Tibaijuka told journalists that urbanisation in itself was not the problem as it drove both national output and rural development. "History has shown that urbanisation cannot be reversed," she continued. "People move to the cities not because they will be better off but because they expect to be better off." The only effective way to upgrade slums and prevent new ones emerging, she said, was to persuade governments to improve infrastructure. While help from international donors was required, she also argued that governments could take relatively cost-free action such as reforming property laws.

B.3 Urban Explosion: the facts

Source: New Internationalist January 2006, Issue 386

For the first time in human history most of us live in cities: many in desperate conditions. The **NI** takes the measure of urban growth and poverty.
The UN Millennium Development Goals aim to improve the living conditions of 100 million slum-dwellers by 2020. But the number of slum-dwellers is estimated to grow by nearly 500 million between now and then.



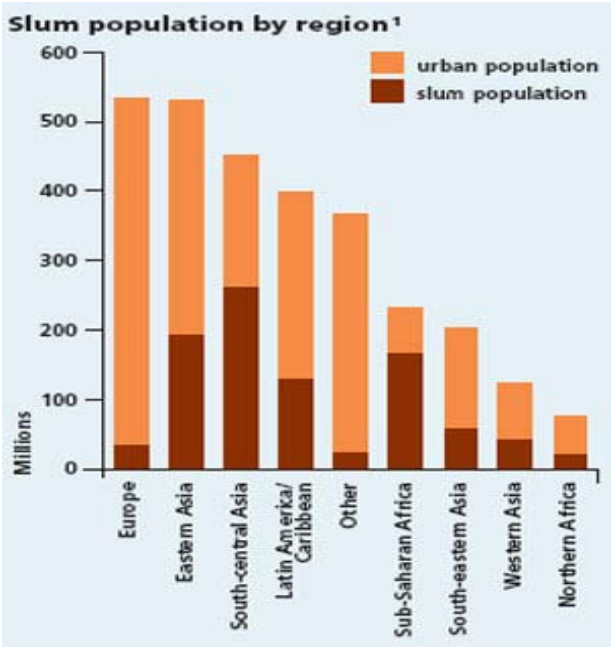
Mega-city growth

Of the billion people designated very poor, over 750 million live in urban areas.

- Over the next 3 decades, urban growth will bring a further 2 billion people into cities in the Global South, doubling their size to about 4 billion people. These cities are already growing at a rate of about 70 million people per year. Overall almost 180,000 people move into cities every day. In Mumbai alone, an estimated 300 new people a day arrive from the countryside.[2]
- Of the 23 cities expected to reach a population of more than 10 million by 2015, 19 of them will be in the Global South.[3]
- While official Chinese sources put the population of Beijing and some other Chinese cities in the top 16 (above), independent sources outside the country don't.

Cities and slums connect

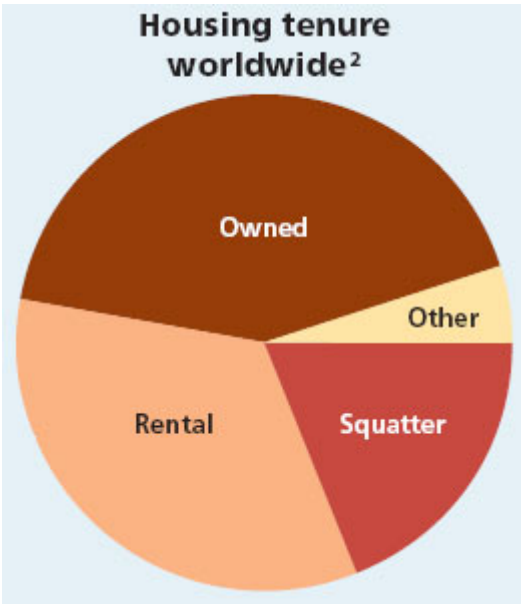
While not all squatters live in slums and not all slum dwellers are squatters, the categories substantially overlap. Slum population by region[1]



- In 2005, an estimated total of 1 billion people were living in slums worldwide – about a third of the world's total urban population.[4] By 2030 this figure is predicted to grow by another billion. Amongst the population of the Top 16 cities (left), a staggering proportion live in slums: between 40% and 50% in Jakarta (Indonesia), and a third in mega-metropolises like Dhaka (Bangladesh), Kolkata (Calcutta, India) and São Paulo (Brazil).[5]
- Asia has 60% of the world's slum-dwellers, Africa 20% and Latin America 14%.[4]

Security of tenure

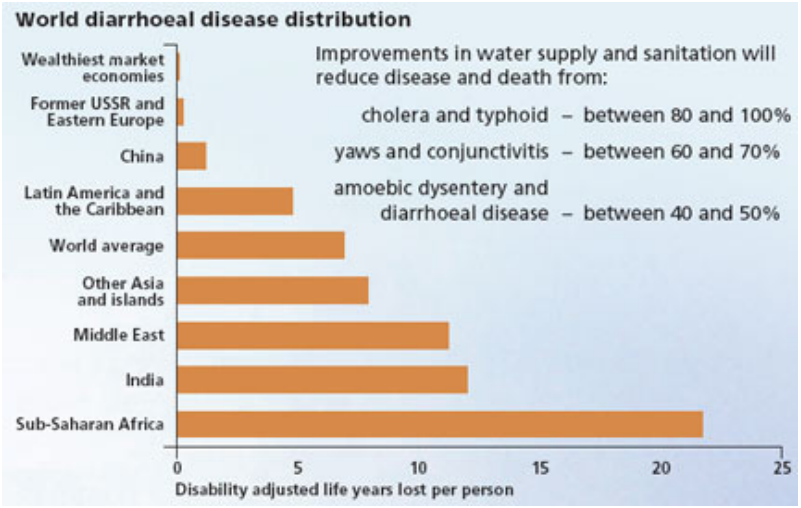
One of the biggest issues for the urban poor is their right to stay where they are.
Each year millions of people are evicted from their homes:



- In July 2000 nearly a million people were pushed out of Rainbow Town in Port Harcourt (Nigeria).[6]
- In early 2004 around 150,000 were evicted in Delhi (India) and 77,000 in Kolkata (India).[6]
- In Beijing an estimated 300,000 people have lost their homes in preparation for the 2008 Olympic Games.[6]
- In 2003-4 in Jakarta (Indonesia) over 100,000 people were either evicted or threatened with eviction.[6]
- Slum clearance and relocation costs 10 times as much as slum upgrading as a method of dealing with urban poverty.[4]

Squatters

Squatting is often the most reasonable and inexpensive way for poor people to move to the city.



- In Latin America less than 30% of dwellings are built by the formal housing sector.
- In Caracas (Venezuela) over the past 50 years the state has constructed 1 million homes, the private sector about 2 million and the inhabitants of barrios have constructed 3 million themselves.[7]

- In 20 years the city of Mumbai has grown by 100%, but the number of squatters has increased by more than 1,100%.[8]
- In the Philippines, a study of squatters in the capital, Manila, found that although only 10 per cent of them are as well off as their poorest established neighbours, they were still 10 times better off than they had been in their villages.[9]
- An estimated 70% of households in sub-Saharan Africa cannot afford mortgage loans.[4]

Life on the edge

Poor people build in undesirable areas – but at a price.

- Earthquakes have destroyed over 100 million homes in the 20th century – mostly in urban shantytowns and poor villages.[10]
- The residents of the Nairobi shantytown of Kibera (Kenya) pay 10 times more for water than residents of wealthy neighbourhoods connected to the metered municipal water system. In times of shortage this goes up to 30 or 40 times the official price.[3]
- There are 20,000 pavement-dwelling families in India's biggest city, Mumbai. Just breathing Mumbai's polluted air is equivalent to smoking two-and-a-half packs of cigarettes a day.[8]
- Despite their difficult existence, it is estimated that only 1% of the residents of Brazil's favelas are involved in the drug trade.[3]

Disease and services[11]

The quality of life in shantytowns can be significantly improved through the provision of basic services.

- There is 1 toilet for every 500 people in the slums of Nairobi (Kenya). Worldwide an estimated 100 million people have to use the ‘wrap-and-throw’ technique of getting rid of their faeces.

1. *Global Urban Observatory*, UN Habitat, Nairobi, 2003.
2. *The Challenge of Slums*, UN Habitat, Nairobi, 2003.
3. Robert Neuwirth, *Shadow Cities*, Routledge, New York, 2005.
4. Financing Urban Shelter, UN Habitat, 12 November 2005, Nairobi.
5. Water and Poverty, Asian Development Bank, Water and Poverty Report, May 2002.
6. ‘Forced Evictions Worldwide’, *Environment and Urbanization*, April 2005.
7. Sabine Britner and Helmut Weber, *Caracas, Hecho en Venezuela*, Revolver, Frankfurt, 2005, .
8. ‘Towards a pro-poor framework for slum upgrading’, *Environment and Urbanization*, April 2005.
9. Peter Wilsher and Rosemary Righter, *The Exploding Cities*, Quadrangle Books, New York, 1975.
10. Mike Davis, ‘Ecology against Capitalism’, *Socialist Review*, July 2005.
11. Water and Sanitation Report, UN Habitat, Nairobi, 2003

B.4 Urban decay not limited to the West

Urban decay is not limited to the Western or developed world. The Michenzani apartment blocks in Zanzibar's town centre, built with East German development cooperation in the 1970s and once a symbol of progress, have now turned into a blighted area.

B.5 Motivation for the study

The problems in large cities take various forms, but are often visible in the decline of inner city areas and industries. Old and abandoned industrial areas and unkempt high street shops are symptoms of urban decay. The increase in the percentage of impoverished people in a city and slum development in city centres and elsewhere constitute a pervasive and worldwide problem.

Representatives from Kente recently attended a conference on urban development. Intense debate on urban decay and slum development in both developed and developing countries took place. In reaction to the issues raised, the City Council of Kente decided to consult an international planning bureau *Urban Solutions*. The council wanted to establish to what extent the symptoms of urban decay are present in Kente and how they can best act in this matter in the future.

Urban Solutions is a planning consultancy specialising in identifying and analysing problems of urban decay the world over. In the study they conducted for the Kente City Council, information was collected from the various section heads of the Municipality of Kente by means of interviews. They then performed an assessment of the extent of urban decay problems in Kente. Summaries of these interviews are included in the appendix together with information from the Kente Statistics Bureau.

The main conclusions and recommendations of the study were presented to the Kente City Council by *Urban Solutions* on 16 December 2009. A brief summary is included below.

Summary of the conclusions and recommendations
Urban Solutions was requested to assess the severity of the urban problems of Kente. Based on the findings of this study regarding the problems faced by Kente compared with other large cities, *Urban Solutions* advised the Kente City Council on further actions.

Urban solutions concluded that the symptoms of large city urban decay and central slum development are indeed present in Kente. The available information regarding these symptoms in other large cities is fairly extensive, but knowledge of the structural causes of these urban problems is limited. Using the information collected via interviews with the heads of department of the Kente Municipality, *Urban solutions* concluded that it is essential to develop an understanding of how the situation arose in Kente. Such an understanding will make it possible to develop policy measures that can effectively influence the current situation for the better.

Urban solutions recommends that the Kente City Council looks beyond the symptoms of urban decay to the underlying causes. To do this it will be necessary to investigate the development of the city of Kente over many decades. *Urban solutions*, therefore, recommends that the Kente City Council uses a simulation modelling approach to represent the real world situation and to test different policy options. The City Council should consider hiring a specialised consultancy such as the Centre for Process Management and Simulation of Delft University of Technology to conduct this modelling investigation based on the information collated by *Urban Solutions*.

The Kente City Council voted unanimously to adopt the recommendations of *Urban Solutions* and to contract the modelling specialists recommended by them to conduct a modelling study into the structural causes of the urban decay and slum formation problems of Kente and to test possible policy options. The City Council considers that this study should assist in convincing the residents of Kente that their councillors are aware of the problems in the inner city areas and in contrast to the situation in other large cities are dealing seriously and professionally with this sensitive matter. Mr Klanti, the councillor in charge of urban development, was allocated the responsibility of managing the contract with the Centre for Process Management and Simulation of the Delft University of Technology. The

City Council asked Mr Klanti to report back on the findings and recommendations of the study within a period of three months. The next council meeting is scheduled for 31 March 2010 and the City Council will then debate policy options and decide on a plan of action.

B.6 Summary of the interview with Senge Platezi, mayor of Kente, conducted by Tristan Koopman (director *Urban Solutions*) on 2 December 2009 in Kente

Mr Platezi, you graduated in social geography at the University of Kente. What can you tell me about the development of the city of Kente since independence in 1960?

Senge Platezi: "During my study, I became very interested in urban development from an historical perspective. In fact, before I was elected mayor of Kente, I worked at the Department of Urban Development and Management. But, to answer your question, following the Second World War and the independence that followed in 1960, Kente experienced a period of strong growth in the housing and industrial sectors. This growth has stagnated over the last two decades and this has caused the inner city to gain an image as an old industrial city – a "has been". The long term residents also seem to have lost confidence in their ability to regenerate the inner city. Recently, there has been an influx of new residents. The ongoing drought in the country and rumours of jobs in the city has caused many rural families to move to the city. They have settled in squatter camps on the outskirts of the city and there is slum development in the centre.

Kente has great potential for development in comparison with other similar cities. It has a renowned university, extensive natural areas and a well regarded entertainment industry. However, Kente has the lowest employment rate in the surrounding region and on average a low expendable income. In addition the percentage of households with a low income level is increasing in Kente whereas the national average is considerably lower. These figures have been almost constant over the last twenty years.

What do you as mayor consider a reasonable approach to the problems of urban decay and slum development?

SP: An approach that takes the interaction between the various elements in an urban system into consideration. I'm thinking of elements such as houses, industries and income groups. If it were possible to understand and model the relationships between these elements, we would be able to increase our understanding of the city's development. This would make it possible to develop more effective policy.

You mention the relationships between different elements of an urban system. Can you explain this and how do you think these relationships can best be identified?

It is important to create a balance between the number of households and the number of jobs in a city. On the one hand, if more houses are built in a city, but no additional employment opportunities are created, this can lead to impoverishment of areas of the city and a reduction in the value of houses in these areas. On the other hand, if insufficient housing is provided and families from the country continue to pour in in the hope of employment, squatter camps flourish. The different departments have a great deal of knowledge about the causal relationships within and between various elements of the urban system. In my opinion, a deeper understanding of these causal relationships will help in the generation and testing of realistic policy options for the city. A promising point of departure is provided by the interviews with the departmental heads in the Kente Municipality. So, I must refer you to the interviews with my staff and recommend that you gather data about how the problems have developed over time.

B.7 Summary of the interview with Mr. Opi, Departmental Head: Urban Development and Management, conducted by Piet Bell (*Urban Solutions*) on 4 December 2009, Kente.

Mr. Opi first explained the problem of urban development and decay. Urban development is the growth process of urban areas, where an urban area is usually defined as an interacting system of industry, houses and people in a particular location. Under favourable conditions, this interaction ensures that an urban area grows in size. However, during the growth process more and more of the available land is used. When the rate of growth of the city starts to decline owing to restricted land availability and less desirable development opportunities, the population composition and the economic activities also change. Unless, active and persistent renewal of existing areas occurs, the limited land availability means that over time the area is characterised by aging houses and older industrial buildings.

In the interview Mr Opi mentioned that Kente is surrounded by a nature area that is protected from development by the IUCN and an international treaty. This means that the area available to Kente is limited to +/- 2.750 hectare, 93% of which is already built-up with houses and industry. The average area occupied by a house is 0.075 hectare while an industry occupies 0.2 hectare on average.

Mr. Opi finds it particularly important to view the development of the city of Kente over the long term. He maintains that it takes at least a decade before trends in cities are visible or measurable. With this in mind, it would be advisable to analyse the development of Kente from 1960 onwards.

B.8 Summary of the interview with Mrs. E. Spring, Divisional Head: Citizenry and General Administration, conducted by Piet Bell (*Urban Solutions*) on 7 December 2009, Kente

Extracts of the interview with Mrs. Spring (ES) are presented below.

Mrs. Spring, what are the primary determinants of population growth?

ES: Immigration to and emigration from Kente normally amount to 10% en 7% of the population per year. Births account for a 3% increase per year while the population is reduced by 1.5% per year owing to deaths.

Is migration constant over the years, or not?

ES: The migration rate is dependent on the attractiveness of the city in relation to its environment and nearby cities. The attraction that the city holds for people can be viewed as the product of the situation with regard to the availability of housing and the job availability. If there are many employment opportunities in relation to the number of Kente residents then the city is attractive to immigrants because of job opportunities. If housing is available this also increases the attractiveness of the city to immigrants.

How does the Department of Citizenry and General Administration categorize the residents of Kente?

ES: We distinguish three groups based on income levels, namely low income, middle income and high income groups. Each one of these groups is influenced by immigration, emigration, births and deaths. More surprisingly, investigations by our department have shown that the migration between the groups is negligible.

B.9 Summary of the interview with Mr Flat, Divisional Head: Housing conducted by Piet Bell (*Urban Solutions*) on 7 December 2009, Kente

The Department of Housing distinguishes three types of house each of which is associated with an income group, namely low income houses, middle income houses and high income houses. These three types of houses are related to each other in that the high income houses age and become middle income houses. Similarly, the middle income houses age and become low income houses. This process of the aging of houses means that the houses are successively occupied by households with progressively less expendable income. The declining physical state of the houses and the increased need and costs of maintenance means that the houses become less attractive and decline in value.

The construction of high and middle income housing is influenced by two factors, namely the demand for housing and the availability of land. According to Mr Flat, the demand for housing is usually estimated by considering the ratio of the number of households to the number of houses. When this ratio is much higher than 1, its profitable for the construction industry to build more houses they would normally do and housing construction increases. Similarly, when there are more houses available than are needed, less houses than usual are built.

The availability of land also influences housing construction non-linearly. When the land is practically empty, an increase in the number of houses and industrial buildings acts to stimulate further construction. The location becomes more attractive owing to the improvement in transport infrastructures and the growing market for the industrial concerns. When the available land is practically full, the construction of housing and industries is constrained by the fact that the land that remains is fragmented or unfavourably located.

The average construction percentages for high and middle income houses are 5% and 4% per year, respectively. The average lifetime of the high, middle and low income houses are 33, 25 en 25 years, respectively. In 1960 Kente had 4 400 high income houses, 6 400 middle income houses and 3 200 low income houses.

B.10 Summary of the interview with Mr. Worker, Departmental Head Business and Employment Opportunities conducted by Piet Bell (*Urban Solutions*) on 9 December 2009 in Kente

Kente can be characterized as an old industrial town. If old industry could generate as many jobs as new industry this would not be a problem. However, many research studies have demonstrated that old industrial concerns generate less employment opportunities per concern than do new industries. A new industry creates approximately 6 high income jobs, 12 middle income jobs and 9 low income jobs, on average. For an established industry these figures are respectively 4, 8 and 6 jobs per concern, while an old industry generates respectively 3.5, 5 and 5 jobs per concern.

The life cycle of an industry is comparable with the lifecycle of a house. The availability of employees and the availability of land together influence the establishment of new businesses. If the number of potential employees increases, by immigration for instance, the need to pay competitive salaries decreases and the cost of running a concern decreases. This stimulates the establishment of new industrial concerns.

The ready availability of suitable land for industrial activity means that the construction percentage remains at its usual level. As more industries concentrate together, the location becomes even more attractive and the construction percentage increases above its normal level. When the available land is practically full, on the other hand, further construction is discouraged and the construction rate declines to zero. Clearly, the effect of the availability of land on industrial construction is non-linear.

A third mechanism influencing the normal construction level (9% per year) is that a new industrial concern tends to spins off more related industries than does an established industry. Indeed numerous studies indicate that an old industry does not generate any additional concerns. This means that the rate of construction or establishment of new industry depends on the composite sum of the new

industries and the established industries, taking into account that the established industries are only 60% as effective in this generation process.

In the first two years after independence, Kente had 600 new, 300 established and 100 old industries. The average lifetime of the new, established and old industries is 15, 20, 25 years, respectively.

B.11 Information supplied by the Kente Statistics Bureau to *Urban Solutions* on 10 December 2009.

The development of the population of Kente over time is depicted in Figure 1. Kente had 50 000 residents in 1960. The middle income group represented 50% of this total. The higher and lower income groups each represented 25% of the population in 1960. The potential working population was about 17 500 people in 1960.

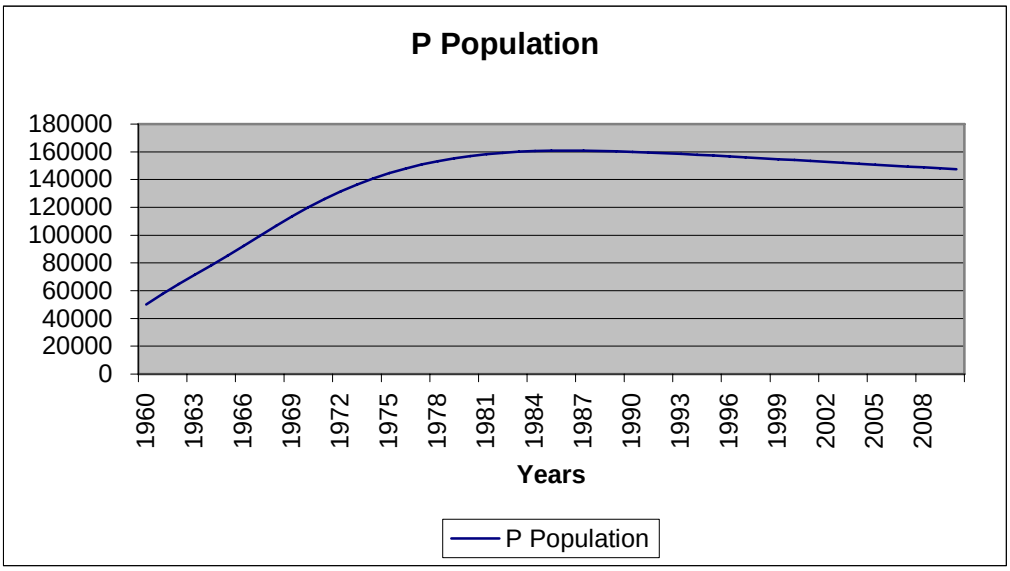


Figure 1: The population growth of Kente (Source: Kente SB)

The percentage of the population with a low income grew slowly over the last decades as depicted in Figure 2. The growing percentage of low income earners has earned Kente a bad reputation. Besides this reputation, an increasing low standard of income is a sign that the percentage of highly educated people present in Kente is not increasing and this has consequences for industrial development, which can stagnate.

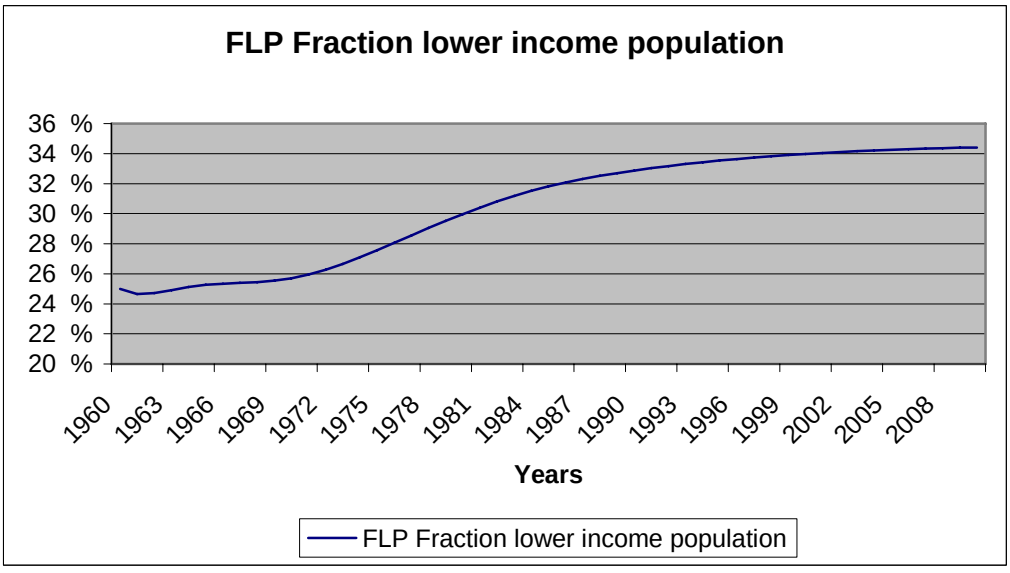


Figure 2: The percentage of the population with a low income level (Source: Kente SB)

The figures from the Kente Statistics Bureau reveal that the average number of people per household also differs per income group. The households with a high income consist of 3 people on average, households with a middle income level consist of 4 people on average, while households with a low income consist of 5 people on average.

The employment opportunities from 1960 onwards are given in Figure 3.

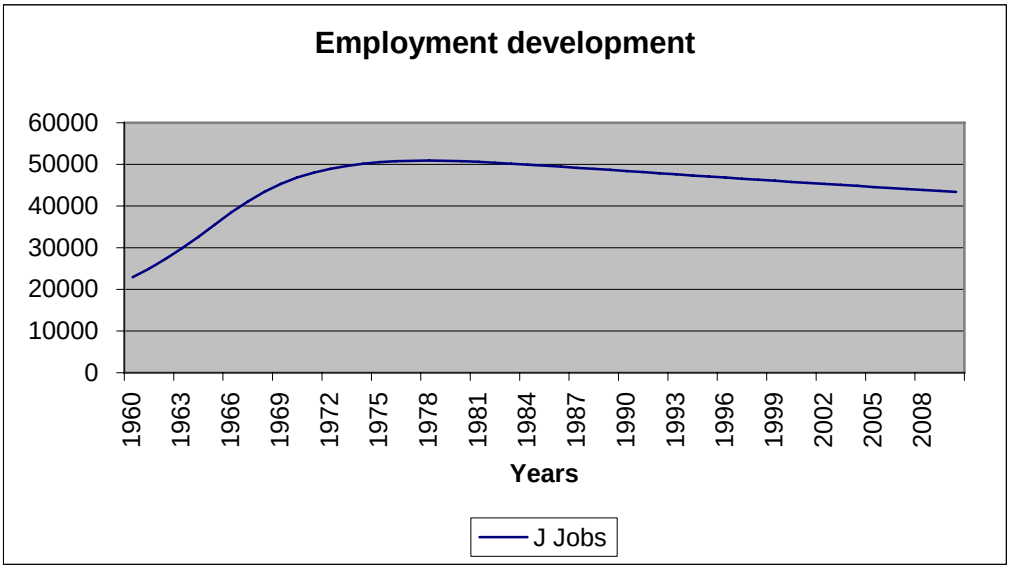


Figure 3: Employment (Source: Kente SB)

B.12 Report of the meeting of departmental heads of Kente Municipality regarding the project "Urban solutions for Kente"

Chair: Mr. Platezi, Mayor
Kente
11 December 2009

Present:
Senge Platezi (mayor)
Ro Opi (: Urban Development and Management)
Eve Spring (Departmental Head: Citizen Affairs and General Administration)
William Flat (Departmental Head: Housing)
Sunday Worker (Departmental Head: Business and Employment Opportunities)
Tristan Koopman (Director *Urban solutions*)

Purpose of the meeting: Generate insight into the development of the various components of the city over time, so that the interactions between these components can better be recognised and understood. This information can assist in the development of the proposed simulation model.

Department: Citizen Affairs and General Administration: Research undertaken by this department indicates that migration to the city depends primarily on the attractiveness of the city in relation to its surroundings. The attractiveness depends in turn on the availability of housing and jobs. The city's attractiveness is high when there are few households compared with the number of available houses, but is low when there are many households competing for few houses. Similarly, the city is highly attractive to immigrants when there are few people competing for many jobs and is least attractive when there are many people competing for few jobs. These effects on the attractiveness of Kente to immigrants are non-linear.

The figure below illustrates the population development of the different income groups.

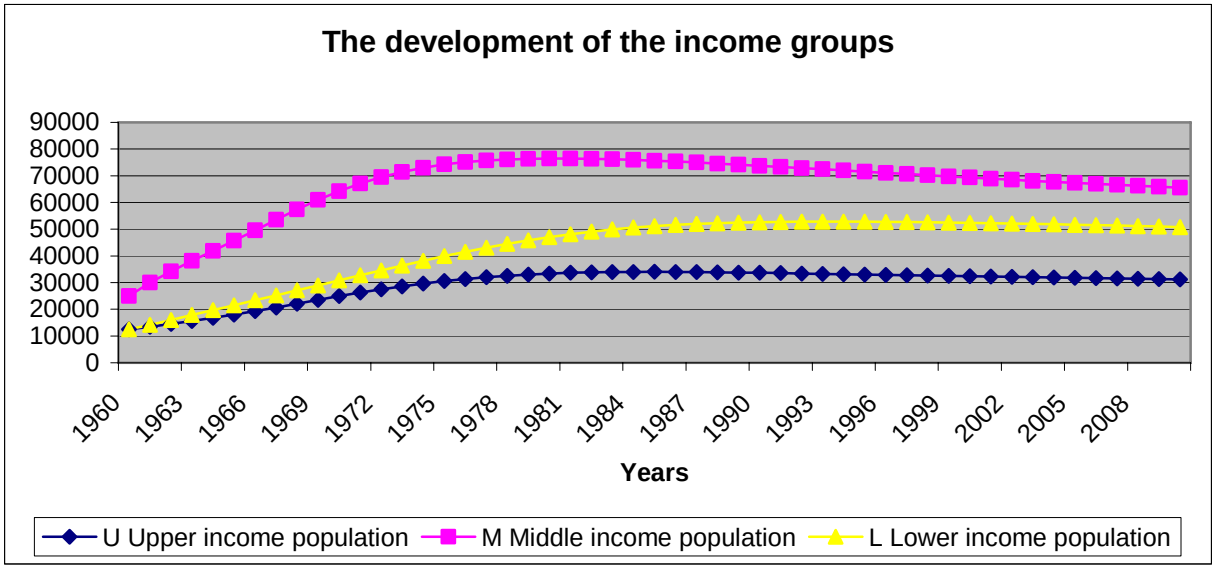


Figure 4: Different income groups over time (Source: Kente SB)

Department of Housing: Studies conducted by this department indicate that almost no low income housing is or has been constructed in Kente. Instead, the houses currently termed low income housing derive from the aging of middle income housing. Figure 5 illustrates how the housing fractions developed over time."

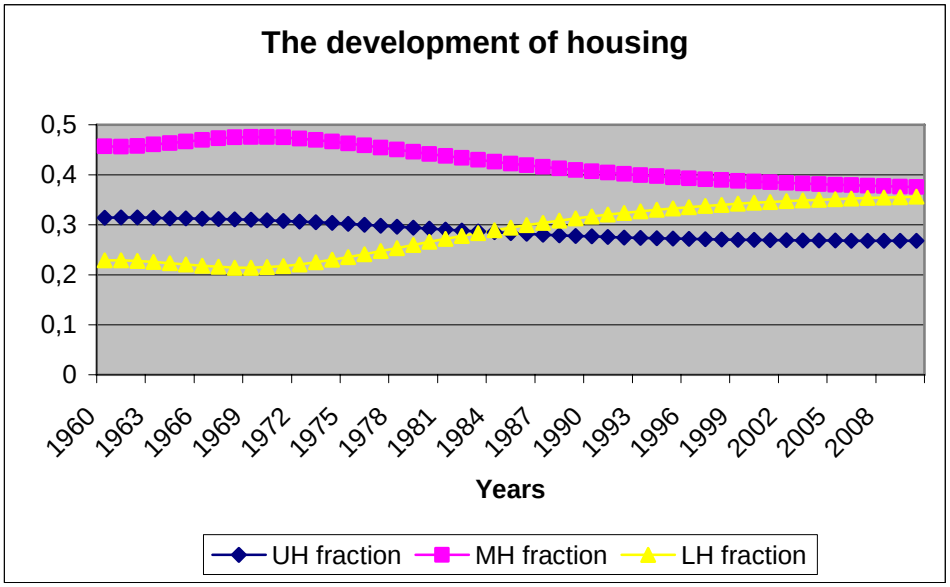


Figure 5: The fraction of lower, middle and upper income housing over time (Source: Kente SB)

Department of Business and Employment Opportunities: The rise in the percentage of old industries is remarkable (see Figure 6). The change in the composition of industry of Kente from predominantly "young" businesses to predominantly old businesses over the period from 1960 to 2010 has resulted in a reduction in the number of job opportunities over the last thirty years. This has contributed to Kente's image as an old and "decaying" city.

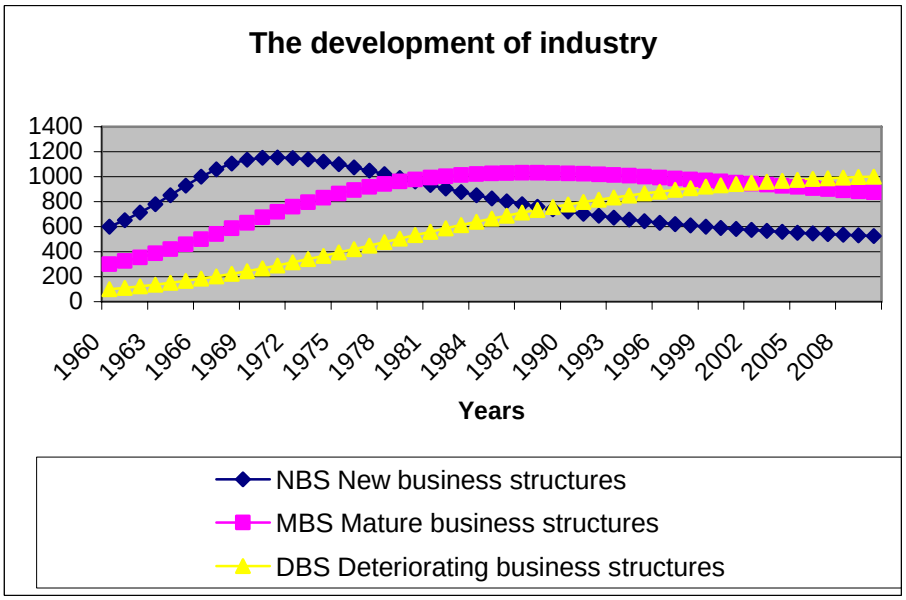


Figure 6: The industrial activity over time (Source: Kente SB)

Summary/conclusion: The proposed simulation model must focus on the interactions between houses, industries and residents. The data in Figures 1 to 6 can probably be used for validating the model.