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Executive Master’s in Innovative Governance of Large Urban Systems, EPFL

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Most of my interviewees agreed to meet me on short, or zero notice, as I just walked into their places of work and started asking questions. I found everyone genuinely had a strong desire to play a role in making West Africa a better place to live.
Abstract

There is a string of large cities along the West African coast, and in the next century, considering population growth and urbanization rates, they will achieve urban-level densities. This will create, in effect, one of the largest conurbations, or metroplexes on Earth. The metroplex of Economic Community of West African States (ECOWAS) Corridor will need major infrastructure investments, whose cost will be greatly reduced and effectiveness will be increased if the appropriate right-of-ways are established in advance. This thesis looks holistically at the ECOWAS metroplex by reviewing West African land law and custom, economy, society, and taking in to account the technical considerations to create an argument for a unique design of right-of-way land administration. In this conceptual proposal, micro-business becomes the guarantor of the right-of-way tenure before infrastructure is actually built. The results of the study are expected to be useful for related programs and projects of diverse stakeholders from international and regional organizations, public and private sector within the future metroplex.

Research Question:

What are the factors that will likely lead to successful infrastructure investment in West Africa, and what might an infrastructure wayleave look like at a conceptual level once those success factors are applied?

Keywords: Urban Agglomeration, Wayleave Law, African Development, Transportation Planning

A Note on Canadian Spelling

Canadian English spelling differs slightly from American spelling, and is closer to British spelling. Many American words than end with "or", end with "our" in Canada (for example, "color", "neighbour". As well, Canadian English has been influenced by the French language more so than in the USA, such that some words, "centre" for example, (instead of "center") follow the French spelling. There are no differences in pronunciation, minus the minor differences in accent.

This thesis is written in Canadian English.
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1 Introduction

I am at the midpoint of my career, and have spent about 20 years working primarily in rural regional planning. My current (2019) project is the largest rural regional plan on Earth, covering 2 million square kilometres of land and sea. It is a good project with which to close a career path.

I applied to the IGLUS program because it offered an opportunity of a bridge to a career shift, into urban regional planning from rural regional planning. My reasoning, which will prove right or wrong only with time, was that urban regional planning would allow me to utilize most or all existing skills and experience, while increasing my competitiveness in projects in or near urban areas. The international nature of the IGLUS Program would also increase the optics of my skillset being functional outside North America.

In addition, I have had an interest in expanding into transportation planning for quite some time. The failure of most jurisdictions to properly allocate infrastructure right-of-ways (called wayleaves in Africa) in advance of development is a constant personal and professional annoyance to me. The irritation stems from a combination of the huge cost of purchasing land for wayleaves after development has already occurred (which I help pay for with my taxes); the extremely complex and inefficient transportation networks that usually result as land administrators have had to struggle to weave the new wayleaves through many different existing land uses (resulting in air pollution and traffic jams); and then the results are almost always inelegant or outright ugly. Combining all these factors, it seemed to make sense to apply my planning skills to the allocation of wayleaves for major inter-urban infrastructure projects, well before the infrastructure is actually needed.

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1 No matter that most of my work has been with North American First Nations, who are effectively in a developing socioeconomic context: I need something, an evaluation or a diploma, showing my skillsets are transferable outside North America. Indeed, North American cities are difficult to gain entry to, in this era of the Culture Wars of the West: suburban municipalities are beholden, almost religiously, to car-centric development; while central municipalities have become an exclusivist club of leftwing progressive ideological thinkers (for example, the City of Toronto has set up methods for evaluating impacts of planning programs on gender equality and intersectionality…while at the same not dealing with the fact that the municipal tax base is far too low to adequately maintain basic infrastructure). In other words, to successfully realize my desired career shift, North America has ceased to be an option for me. I am not a supporter of car-centric planning and development…as it has too many direct costs (such as infrastructure and vehicular maintenance) and indirect costs (such as reduced average levels of fitness and reduced possibilities for social interaction). I am also not a supporter of progressivist ideologies, as often I find no solid basis to their philosophical presuppositions; plus I find their methods of indoctrination, ostracism, career disenfranchisement, and quasi-judicial enforcement to be uncomfortably totalitarian in nature, reminiscent almost of the Italian Brown Shirts. But I digress.
So in determining a thesis topic, my criteria became:

1. Involves creation or significant expansion of two or more proximal large metropolises, such that they could grow into one multi-cored metropolitan complex ("metroplex"). Also, that the term “urban region” has more validity as in there will be space between the constituent cities such that both intercity and intracity infrastructural decisions enter the issues of consideration.

2. Outside of Anglo-America.

3. Outside of command-and-control societies (China), and/or where major planning decisions would be effectively controlled at the whim of a small elite (UAE, Turkey).

4. Enough functionality of government that there is some reasonable chance of planning decisions being able to be made and possibly implemented.

These factors placed strong constraints on where my thesis could be focused. The finalists included coastal West Africa, Mumbai-Pune-Surat-Ahmedabad, Delhi-Jaipur-Agra, coastal Kerala, Johannesburg-Pretoria, Dhaka-Kolkata, etc. As it turned out, family friends from Ghana invited us to stay with them in Accra at the same time that I had the time slot to do my research, so the first option was picked. This was my preferred option anyway, as all the preliminary research I had undertaken had showed that coastal West Africa has a very real chance of becoming the world’s largest metroplex by population, matched only possibly by the Pearl River Delta.

The Economic Community of West Africa States (ECOWAS) has proposed a two-phase high-priority corridor from Abuja to Dakar, which would parallel the coast. The first phase would run from Lagos to Abidjan, the second phase would tie in from there and eventually continue to Dakar. At Lagos, the ECOWAS corridor will tie into the Nigerian network, effectively extending it to Abuja.

The ECOWAS corridor represents a local recognition that a West African metroplex is forming. This thesis has been designed from the beginning to tie into and support ECOWAS initiatives, which to date tend to be country-specific².

And so I landed in Accra in early December 2017. Well, actually Lomé for a couple of hours, because a plane had lost a wheel on the Accra airport runway and we needed to wait while things were put back in order. A sign of the month to come.

Previous literature reviews had not prepared me in any way for what to expect on the ground. Uber worked and was reliable, and cheap. Almost everything else was a logistical challenge, and WAWA ("West Africa Wins Again") and TIA ("This Is

² The Abidjan-Lagos Transport and Transit Facilitation Project is related to the Abidjan-Lagos Corridor Organization², which is based in Abidjan but appears to be focusing on efforts in Cote d’Ivoire to complete the portion of the corridor from Abidjan to the Ghanaian border.
Africa”) became part of the daily lingo. However, within the daily challenges, I was able to experience real day-to-day life in Accra, things I would never have encountered otherwise. It is these interactions that provided real insights to cultural interactions that have definite West Africa-specific planning implications.

For example: one night, at the outskirts of Accra, on our way to our weekend retreat hotel in the hills, the car overheated. We were on a dark road, with my pregnant wife and two children in the back seat. My first instinct was to leave the car, get an Uber to the hotel, drop off the family, and return to deal with the car. But Uber, I found out, does not serve the outskirts of Accra. Through a combination of sheer luck and the kindness of strangers, we parked the car for the night at a local police station (both the police and the prisoners in the locked cell in the back were very friendly). Local fellows at the nearby pub helped us flag down a taxi, who drove us up the hill to our accommodation, and the hotel owner negotiated down the fee the taxi driver wanted to charge us, which was initially over 10 times the standard rate. The planning implications: in Accra, and probably much of West Africa, when you are in a visible place, no matter how vulnerable you are or how much you stand out, you are safe.

Alternatively, I saw the electrified razor wire on top of high fences around most single-family homes, guard dogs patrolling my host’s home, guards at doors, guards at fences. But apartment buildings, like where we were staying: no guards, no crime. I surmised this was partly due to lack of soundproofing: any scream, 100 neighbours would know. This reinforced my other observations that Crime Prevention Through Environmental Design is of key importance to African planning.

Then there was the squatting. It seemed every square meter of seemingly unoccupied land had a resident squatter. The empty lot, a quarter hectare, next to my host’s home, contained 9 tiny residences, swept clean every day by the 40-50 residents. The gap between the walls of the University of Ghana and the surrounding road was filled with homes and ramshackle shops. In some cases, the shops are pushing over into the edge of the road such that traffic is affected. In all papers I had read on land law in Ghana, none had prepared me for the true extent of the squatting problem.

Finally, I never stopped observing the lack of local production. Everyone seemed to be selling something, but with the exception of some local produce, most things were imported. I never saw a factory or a farm. Through simple observation, it became clear that security of land tenure was essential to any transportation project, while economic development must be a central objective to any project.
1.1 Moving from A Quantitative Study to a Qualitative Study

I spent much time before coming to Ghana trying to learn about economic multipliers. My thinking was there must be formulae which utilize demographic, geographic, and economic information to provide forecasts on utilization of proposed new infrastructure, and economic impacts of such infrastructure. My thinking was that by finding the correct formulae, and the correct data, I would be able to create a defensible set of proposed infrastructure investments, with a clear line of next steps for project and program advancement.

This seemed like a reasonable approach. After all, ‘Transportation Planning’ as a vocation usually is associated with a degree in civil engineering, not planning (just look at the degree requirements for “transport planner”). So if I wanted to work more in transportation planning, I should do the things a civil engineer would do.

While in Africa, through my interviews, it became clear however, that the data such models require to operate is not currently available. Even macro data on population, such as the number of people in a given district of Ghana, is hopeless to collect due to the afore-mentioned squatting issue. Also the vast majority of transactions are in cash, in the local currency, and are frequently not recorded, making detailed economic projections very difficult. Based on the extreme traffic congestion in Africa, it was clear that any appropriate infrastructure investments would be heavily used; while alternatively, due to the issues of crime, inappropriately design infrastructure would be unused (the public busses I saw never had more than a single passenger, even on the most heavily used roads).

The lack of data was the first impetus to revise my envisioned hard-quantitative thesis to a more qualitative one. The second came after I attended a training program on High Speed Rail systems, given in Paris (April 2018) by the Union Internationale des Chemins de Fer (UIC). In this program, we were provided the basics of the economic multipliers and traffic forecast models used. I was already aware of the Gravity Model, but there were others as well. But I learned two things of import. Firstly, while the general transport forecasting and economic multiplier models were general knowledge, their specific exponents, which actually create the useful outcomes, are created with great expense and difficulty by consulting firms. Secondly, once these models are completed, they are then closely guarded by these companies as trade secrets. It is vastly outside the purview of a master’s thesis to recreate these equations. Thirdly, the equations are very place-specific. A model perfected for the South of France may have some usefulness in northern France, but certainly none in England. So I learned that all I would be able to access was a basic equation, without any real usefulness in West Africa; and I would not have the proper data to put into the equation.
The third impetus to revise my envisioned hard-quantitative thesis to a more qualitative one came after I read research provided by my supervisor. This material is reviewed in detail later on. In effect, the same consulting companies that have these completed equations on the economic multipliers of infrastructure investments and the traffic demand forecasting thereof, are consistently and fraudulently using those equations. It is standard practice that forecasts deliberately exaggerate the usefulness of proposed investments while under-representing the costs of the infrastructure. So consistently is this done, that the exaggeration factors may be statistically summarized!

So all hope of a quantitative thesis was abandoned. By preparing a qualitative thesis which highlights West African success factors, while using these factors to begin designing a made-in-Africa solution, my intention is to help guide future work and help prevent inappropriate development. This became the problem statement:

**What are the factors that will likely lead to successful infrastructure investment in West Africa, and what might an infrastructure wayleave look like at a conceptual level once those success factors are applied?**

Through the paper, I collect these key success factors, whether by literature review, interview, or deduction, and highlight them as follows:

**What are the factors that will likely lead to successful infrastructure investment in Africa?**

#1.
#2.
Etc.

These key factors then become the analysis framework for designing an infrastructure wayleave.

Although I anticipate that future applications to any jobs whose titles contain both “transportation” and “planning” will receive lukewarm attention, due to my continued lack of quantitative background, at least now I will be able to explain why it is limited, and how my services are essential regardless.

### 1.2 Interviewee Selection and Process

The purpose of the face-to-face interviews for the case study in Ghana was to collect on-the-ground information, tacit knowledge that cannot be found in books or at the Internet, and the best information would be gathered through face-to-face contacts.

All interviews were conducted with an open, unstructured, quasi-journalistic approach. The Researcher wanted to get past formal answers and understand
what was happening on the ground, so it could be possible to see Ghana from the same planner's perspective as the Ghanaian planners.

Interviewees were selected on the basis of their position with the government agencies or ministries considered appropriate to the topic of this thesis (see Section 3.1) In many if not most cases, the author simply walked into the office of the appropriate person. Everyone met was extraordinarily helpful. Some of the more senior fellows required an appointment, but in most cases the appointment was the day of, and again, they were very helpful.

In the case study, Ghanaians were found to be very well-spoken in general, to such a high degree that it was as if they had been trained in one of the rhetoric schools of old. They have been also plain-speaking, stating exactly what they view the problems are: a welcome relief from the ever-cautious, ever-censored communications of Canadians (the author is Canadian). Because of these open conversations, the author left feeling with some confidence that he had a deep enough understanding of the culture and the situation that the author could get past summarizing problems issues, bypass politically correct pat solution statements (ergo, “build better transparency in government”, “coordinate better and reduce silo-ization”, etc), and start developing innovative but pragmatic concepts that might just work.

In effect, it’s a surprise to end up applying the professional approach that has been applied in other contexts. This approach, which has become my default, is to strive to develop a deep intuitive understanding of the worldview of the people being planned for, and write the policies accordingly.
2 West Africa Context

This Chapter reviews the context of West Africa as it relates to the ECOWAS Corridor. A case is built for the need for a corridor that combines space for different types of linear infrastructure, with space for primary, secondary, and possibly tertiary economic activities. The key aspect of this case is a combination of population growth rates and urbanization rates that together create a compelling argument that over 100 million people can be reasonably expected to settle in the Abuja to Abidjan (ECOWAS) corridor in the next century. Retention of space for high-capacity linear infrastructure will have considerable positive social and economic effects over the long term.

Africa is the world’s second-largest continent, with about 30 million square kilometres. It has a total population of about 1 billion people. All parts of Africa are known to have an abundance of natural resources. The continent is extremely diverse, and the author has noted that it is usually thought of as having five main regions: north, east, west, southern, and central. Interpretations of the boundaries of these 5 regions vary.

North Africa is dominated by the Sahara, the world’s largest desert, and is a mainly Islamic region with strong Arabic cultural influence throughout. The main population centre is along the Nile River in Egypt. Residents tend to be Caucasoid, with Negroid as a minority.

The remaining regions of Africa are populated mainly by Negroid ('Black') peoples, and are collectively called Sub-Saharan Africa. These four regions share some cultural similarities, although well over 3,000 languages are spoken.

East Africa is best known for the Rift Valley, which includes considerable topographic variation. It stretches from Ethiopia southwards, and includes most of the east coast of the continent. Central Africa is the land of tropical rainforests, and is dominated by the Congo River. It faces westwards to the Atlantic. Southern Africa shares many similarities with East Africa, but with a temperate rather than tropical climate. It faces the Atlantic, Southern, and Indian Oceans and is known for abundant offshore sea life.

West Africa includes the southern half of the western ‘bulge’ of Africa. It has a tropical climate, modest topography, and very high populations. It faces mainly southwards to the Gulf of Guinea (part of the Atlantic), although a portion also faces westwards to the Atlantic.

While there are certainly differences between the different West African states, nothing singles out Ghana as being particularly unique (except perhaps in having the highest quality of governance and best social stability in the region). This is the justification for making the assumption that information gathered in Ghana has moderate to high applicability to the remainder of West Africa, and thus field work in Ghana is appropriate to the entire ECOWAS Corridor.
2.1 Geographic Context

West Africa is not overly mountainous, and has a tropical climate along the coast and a drier climate northward and inland. Figure 1 shows the topographic map of West Africa.

Figure 1: West Africa

The Niger River plays an important role, as it flows northeast from Sierra Leone, providing water to otherwise arid areas in the southern Sahara, before flowing to the sea in eastern Nigeria. Figure 2 shows the bio-geo-climatic zones of West Africa and the course of the Niger River.

Figure 2: Climate Zones of West Africa and the Niger River

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1. Geographic Areas of West Africa
2. Figure 1: West Africa
3. Figure 2: Climate Zones of West Africa and the Niger River
2.2 Historical Context

West African states tended to be geographically larger in the savannas of the Sahel, and smaller on the coast. The rangelands of the Sahel encouraged open farming and made it easier to travel; while the cities on the Niger River were somewhat like ports, in that desert caravans to the Mediterranean would come to these cities. The largest Empires West Africa saw were here, at different times: Ghana, Songhai, and Mali (see Figure 3).

Figure 3: Approximate Locations of the West African Sahel Empires

The farmlands and forests of the southern and coastal areas contributed to high population densities and inhibited travel. While states here were also quite powerful, they were geographically small.

European contact began in the 1400s, as the Portuguese began establishing a series of trading forts down the African coast, usually at the windiest locations they could find, as a protection against mosquitoes. Disease prevented the Europeans from penetrating much beyond these headlands. The Europeans formed alliances with some of the coastal tribes, and by 1530 began to tap into the existing trade in slaves that already existed (prisoners of inter-tribal wars normally became slaves). The Islamic states of North Africa had been raiding for slaves in southern Europe and trading for slaves in sub-Saharan Africa for hundreds of years. However, the Europeans turned the slave trade into a mass-production operation with no respect for the humanity of the slaves. The levels of cruelty experienced are amongst the worst examples of human nature. Many millions of people, many or most in the prime of life, were forcibly extracted from the population up until the mid-1850s, and sent to the New World. This had severe socioeconomic repercussions, the effects of which continue to this day.
The European conquests came in the late 1800s and early 1900s. The stories of conquering the different tribes vary: sometimes non-violently through treaties or protectorates, sometimes through subterfuge and betrayals, sometimes through manipulation of treaties with different tribes, sometimes through military conquest, or some mix. Although Europeans ruled directly for only two generations, their languages became the *lingua franca*, the main form of intertribal communication. The alternating nature of British and French colonies along the coast continues: a trip from Dakar to Lagos along the coast today would involve leaving French-speaking areas 4 separate times.

The European annexations paid inadequate attention to existing ethnolinguistic lines. Analysis by Michalopoulos and Papaioannou (2014) presents that partitioned ethnic groups suffer almost twice the rate of impact by violent conflict as the non-partitioned groups. The next map (Figure 4) shows as maroon the areas of tribes that have been divided by a state boundary.
Fortunately, ethnic violence is less common in West Africa than in other parts of Sub-Saharan Africa. Independence came usually in the 1950s and 1960s, and each country generally weathered a period of tyranny, political uncertainty, interventions by one or more outside power (sometimes violently, sometimes not), and some attempts at forming a functioning republic. In the case of Ghana and Nigeria, and possibly other countries, warfare and tyranny in the 1960s destroyed much of the fledgling industrial development, setting the stage for decades of little or no economic development.
2.3 Ethnocultural Context

West African cultural diversity cannot be over-stated. Hundreds of separate tribes and traditional languages exist. The following map (Figure 5) provides some sense of this. The white areas on the map represent areas covered by languages with fewer than 1 million speakers.

Figure 5: Languages in West Africa With More than 1 Million Speakers

Religiously, the last century has seen very large increases in both the Muslim populations, mainly through the birthrate, and the Christian populations, mainly through conversion from the traditional spiritual/animistic religions. There is not a long history of widespread religious-based violence in West Africa as there is in the Middle East, with the exception of some radical Islamism. Figure 6 describes the changes in the religious landscape of West Africa over the last century.
Figure 6: Religion in West Africa, 1900-2010

Each dot represents 10,000 persons.

Blue: Christians, Green: Muslims, Red: Ethnic Religions
2.4 Population Projections and Distribution

West Africa has the fastest growing population of any region in the world, as well as one of the most youthful populations. The United Nations in 2015 projected that West Africa as a whole would have more than 1 billion residents by 2060.

Figure 7 presents the current population density map.

Figure 7: Map of West Africa Population Density (ECOWAS Corridor in White)

A majority of West Africans still live in rural areas, yet the urban population has increased from only 8.3 percent in 1950 to almost 44 percent in 2015. The changes in lifestyle and consumption patterns associated with a progressive urbanization of the population affect land use and land cover patterns beyond the obvious increase of built-up area (Rindfuss and others, 2004).

Figure 8 (from Rindfuss 2004) below shows the pattern of rural settlements in West Africa, with Ghana highlighted in blue.
Figure 8: Pattern of West African Rural Settlements

Hoornweg & Pope, in a paper commissioned in 2014 by the Global Cities Institute, used a number of statistical methods and assumptions to create a series of growth scenarios for the world’s major metropolitan areas. The 2018 West Africa Growth Ring Master Plan (WAGRIC) by the Ghanaian National Development Planning Commission (NDPC) and the Japan International Cooperation Agency (JICA), used other statistical models to create population projections for Ghana and neighbouring countries to the year 2018. The compiled results for West Africa are summarized in Figure 9 and Table 1 below.

Figure 9: Cities >4 Million Today, and in 2100 (NDPC-JICA)
By no later than 2075, there is a very high probability that overall population densities will reach urban levels (generally, >1,500-2,000/km²) in a continuous strip from Ogbomosho in southwest Nigeria to Accra, in south central Ghana. Other adjacent metropolises will create a metroplex from Abuja to Abidjan. Table 1 describes the results of the Hoornweg & Pope paper, and the NDPC-JICA Plan projections.

**Table 1: Population Projections for ECOWAS Corridor Cities**

<table>
<thead>
<tr>
<th>CITY</th>
<th>2018 Pop. (m)</th>
<th>2040 Pop. (m)</th>
<th>2050 Pop. (m) Hoornweg &amp; Pope</th>
<th>2100 Pop. (m) Hoornweg &amp; Pope</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>JICA-NDPC High</td>
<td>JICA-NDPC Low</td>
<td>Hoornweg &amp; Pope High</td>
</tr>
<tr>
<td>Abidjan</td>
<td>5</td>
<td>10</td>
<td>12</td>
<td>11</td>
</tr>
<tr>
<td>Accra</td>
<td>4</td>
<td>9</td>
<td>6</td>
<td>13</td>
</tr>
<tr>
<td>Kumasi</td>
<td>2</td>
<td>7.8</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Lome</td>
<td>1</td>
<td>5</td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Cotonou/Porto Novo</td>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lagos</td>
<td>18-21</td>
<td>38</td>
<td>32</td>
<td>100</td>
</tr>
<tr>
<td>Ibadan</td>
<td>3</td>
<td>10</td>
<td>9</td>
<td>27</td>
</tr>
<tr>
<td>Ogbomosho</td>
<td>1</td>
<td></td>
<td></td>
<td>10</td>
</tr>
<tr>
<td>Sekondi-Takoradi</td>
<td>0.5</td>
<td>3.1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>TOTAL</td>
<td>35+</td>
<td>65+</td>
<td>198+</td>
<td>130+</td>
</tr>
</tbody>
</table>

The emergence of this urban agglomeration is recognized in high-level Ghana documents. Figure 10 below is in the Ghana 2015-2035 National Spatial Development Framework, created by the NDPC and the Town and Country Planning Department, shows, with the taupe-coloured rings that surround the red dots, the tremendous growth anticipated in many of the largest cities.
The WAGRIC document states:

“West Africa Coastal Mega-Region (Mega Coastal Economic Corridor): Abidjan-Lagos Corridor is to be developed into an integrated coastal economic corridor (its population estimated to be 65 million in 2040) connecting coastal economies and cities between Abidjan and Lagos along the approximately 1,000km long motorway. Urban facilities, urban expansion areas, industrial areas and conservation areas should be strategically located along the two axes of existing roads and new motorways. In the super long term (beyond 2040), this area would become a coastal mega-region equipped with a high-speed railway, as well as a motorway. “

NDPC-JICA 2018, Page 4

It also appears another metroplex is likely to parallel the Niger River, from the delta cities (such as Port Harcourt, Owerri, Onitsha, Enug), through Abuja to the large cities of central Hausaland (such as Kaduna, Zaria, Kano), and perhaps into Niger.

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#1. The corridor must be capable of handling enormous traffic loads, as the metroplex may end up having a population over 100 million.
2.5 Economic Development

Bocoum (2003) wrote about the historic ties of trade that bound what is now the Lagos to Accra corridor, and the need for a regional approach to urban development in what he argues is not an emerging megalopolis, but a re-emerging urban system. The paper argued strongly for what is now the ECOWAS corridor (although ECOWAS extended the corridor from Accra to Abidjan).

Economic development in West Africa is a study in contrasts, with some economic systems still in the Stone Age and others as advanced as anywhere in the world. It is therefore necessary to discuss these by sector, most of the information for which was observed by the author, and is corroborated in the NDPC-JICA WAGRIC Plan (mainly Chapter 3).

2.5.1 Primary Industries

2.5.1.1 Agriculture

West African diets are based heavily on palm oil, cereals, fish, and chicken. While fish from the sea are caught off African shores, in a typical grocery store in Ghana or Nigeria, almost all the packaged food is imported, much of it at Western prices. Dairy in particular is entirely imported. In Ghana, it is well-known that only about 20% of the chicken is produced locally; due to European agricultural subsidies Spain produces far more chicken than it needs, and the surplus is shipped to Africa, where it is dumped on the market at prices so low that local producers cannot compete.

Locally-produced cereals, fruits, and vegetables are extremely cheap by comparison. For example, a pineapple will cost about US$0.50, while a liter of milk, usually imported from Belgium, typically runs about US$3.50.

Mechanized industrial-scale agriculture is rare. Farms tend to be small and the effort needed to work the land tends to be undertaken manually. Export crops, especially palm oil and cocoa, are tree-based, requiring that most of their care and harvest be undertaken by hand.

Luan et al (2013) researched the decline of food self-sufficiency in Africa, presented in the map (Figure 11) below viii. Blue represents full self-sufficiency, dark green 80%-100% self-sufficiency, light green 60%-80% self-sufficiency, yellow 40%-60% self-sufficiency, and red less than 40% self-sufficiency.

In the case of Ghana, there are opportunities too numerous to describe. Multiple grains can be grown, such as sorghum, yet bread is made from imported wheat. Cocoa beans are exported whole. Goats are a major protein source, along with chicken, but both are imported. Every type of tropical fruit and vegetable grows in abundance, soils are black with organics, and rain is plentiful. As stated by Professor Akosa, a former Commissioner of the NDPC: “There is no good reason that West Africa cannot feed itself!”
2.5.1.2 Forestry Products

Though much of West Africa is naturally tropical forest, there is effectively almost no domestic wood production. Deforestation of forests in order to collect fuel wood is a major issue in Nigeria especially, and is contributing to desertification. Some small-scale furniture production facilities were noted in Ghana and Nigeria, but these tended to be on squatted land, using the roadside as a de facto storefront.

2.5.1.3 Mineral Production and Oil & Gas

As with most of Sub-Saharan Africa, West Africa is a treasure trove of resources. Though natural resource extraction for export provides funds for the import of essential goods, it also contributes to a cycle of dependency, as easy cash so generated tends to be used to pay for imports rather than improving domestic production.

It is also associated with corruption, particularly as regards the Nigerian oil industry.

2.5.2 Secondary Industries

Interviewees indicated that the dictatorships that spread through Africa following independence caused de-industrialization. This occurred through combinations of outright seizure, excessive red tape, loss of workers through political turmoil or police action, cost of grafts or bribes, etc. Perhaps more importantly, those with entrepreneurial talent typically made an exit during this period. Widespread entrepreneurship has not returned since.

In Ghana and Nigeria, the only production facilities noted were for concrete, which is the primary building material. The author noted enormous latent demand for
almost all domestic products. What was needed to realize these manufacturing opportunities were clear land tenure, supply chain reliability, adequate water and dependable electrical supply. Under-employment is endemic and wages are very low, so finding labour is typically easy, if management can prepare a culturally-appropriate workplace and workers can make their way to and from their homes and the workplace.

Processing of food crops before export is frequently cited as a major potential source of economic growth. Lack of reliable electrical supply for factories is a common limiting factor, as is access to related production chains. The need for more entrepreneurship, more economies of scale, and access to capital is a repeated theme. The NDPC suggested in 2014 that smallholder farms producing the same crop should cluster near nucleus farms, whereby the nucleus farm would provide needed logistics for all the smaller farms.

### 2.5.3 Tertiary Industries

#### 2.5.3.1 Retail & Household Services

West Africans know retail. Every part of every street side is filled with shop-keepers and salesmen selling just about everything. Somehow, this includes perishable imported foods, like grapes, somehow kept cold and neatly packaged in plastic until they are sold to car passengers who are stopped in traffic or at lights. While big box and mall-style shopping exists, for the everyday, street side sales are the standard. Similarly, basic services, like grooming, are available at a myriad of locations, some with roofs some without. Most Africans with steady employment hire household help, generally for about US$100 per month, to perform everyday tasks.

One talk at TED.com, by Niti Bhan entitled “The Hidden Opportunities of the Informal Economy” looked at the economic impact of an African street side clothing retailer. The owner of this facility used a tree as her store, both for shade and for hanging her merchandise. Ms. Bhan inquired of the retailer, and learned that she paid taxes daily to the local municipality, helped clean and maintain her portion of the street side, and purchased about US $1200 monthly in clothing, which she procured from a number of wholesalers. The difference between what Westerners would think of as the ‘formal’ versus the ‘informal’ economy is not the same as it is in Africa, and the on-the-ground success of projects must take this into account.

Gantner, in 2009, added insights on the need to build in the form of the African marketing system into the structure of the wayleaves and infrastructure:

> Architectural research indicates that land use considerations must appropriately consider the role of markets in the streetscape, the form of African markets, and the tendency for transit and transportation hubs to surround markets.” - p.44
The author found that all interviewees agreed with the above sentiments. It became clear that infrastructure in West Africa must be thought of holistically, and wayleaves must be programmed with temporary and permanent land uses that are consistent with economic needs.

### What are the factors that will likely lead to successful infrastructure investment in West Africa?

#2. In West Africa successful projects incorporate small-scale retail. These will improve security, by putting eyes on the street; and also allow for upward-mobility by creating ample entry-level business opportunities for unskilled workers on an emerging trade corridor.

#### 2.5.3.2 Professional Services

In Accra, affordable medical care is available through innumerable clinics and hospitals of every size, caliber, and service level imaginable. Other professional services are similarly very accessible and inexpensive. Ghanaians tend to be very well-educated and the author found that professional services of any kind were typically more easily accessed in Ghana than in Canada, and generally provided a more customer-friendly level of service (including nutritionists, dentists, doctors, nurses, pharmacists, lawyers, and maintenance workers).

#### 2.5.3.3 Governmental Employment

In Ghana and Nigeria, governments have relatively small bureaucracies and are not regarded by the public as a common form of employment. The government staff met by the author in Nigeria and Ghana were all extremely eager to help their people any way they could, but often felt dis-empowered from doing so. The most commonly cited reason for the sense of dis-empowerment was lack of coordination or passive resistance from other government departments.

#### 2.5.4 Transportation and Logistics Services

It was the author’s observation, and a frequent statement in the NDPC-JICA WAGRIC Plan, that transportation is effectively the Achilles Heel in West Africa. Infrastructure tends to get built but not be maintained. Everything takes a long time. Traffic rules are obeyed as is convenient but are rarely enforced, and when they are enforced, the reputation is that bribes to police are cheaper and faster than paying fines. Schedules are typically guidelines. Corruption and bribery amongst Accra airport staff in particular was obvious and universal. Rights-of-way (also called wayleaves), if not immediately built upon, are used by squatters, which sometimes interferes with traffic flow and makes it very difficult to expand transportation infrastructure. There is little or no coordination between projects. For example, in suburban Accra, a pedestrian overpass was seen that was built to truck-load engineering standards, but had no stairs on either side, and terminated 10 meters in front of an office building.
A key observation is; the inability to get people or things from one place to another in any kind of predictable time or cost framework is what holds up the primary and secondary industries of West Africa. In the WAGRIC Plan, transportation played a fundamental role in all aspects of future development.

It is impossible to select appropriate multipliers when considering socioeconomic impacts of proposed infrastructure projects in West Africa. First and foremost, there is lack of appropriate statistically-defensible data that is required by such multiplier equations.

However, also this is because infrastructure maintenance and use regulations may or may not be appropriately applied, and in many cases the infrastructure is one piece of the puzzle. For example, the medium-term plan issued in 2014 by the Ghana National Development Planning Commission lists the primary factors limiting agricultural production in Ghana. These include:

- Lack of reliable water,
- Low access to funding for capital improvements,
- High post-harvest losses (related to transportation but more to storage facilities) and,
- Lack of economies of scale in agriculture.

There is also the issue of construction vs. operations and maintenance. The Ghanaian government has attempted to address this problem by separating planning and construction functions, and O&M functions, for roads, railways, and airports (see Figure 12). These restructurings occurred too recently to indicate whether they have been successful.

A successful infrastructure wayleave program must consider all the success factors and the needs of each economic sector.

### 2.5.5 Quaternary Industries

Telecommunications in West Africa are affordable, high quality, and readily available. The author found international calls and internet services were generally one-tenth the cost of similar services in Canada. In contrast, web development is generally very poor, with most government staff choosing to use their *hotmail* or *gmail* accounts for professional use rather than relying on government servers.

The development of an advanced quaternary economy in high tech was not a common topic in Ghana; instead, there was a great deal of informal discussion, and articles in local journals, on the need to improve financial services.
2.6 Transport and Utility Needs of Different Sectors

Table 2 summarizes the needs of the economic sectors in West Africa to genuinely prosper. Any transportation corridor needs to have the potential to support all the success factors throughout its entire length.

Table 2: Key Needs of Ghana Economic Sectors

<table>
<thead>
<tr>
<th>Success Factors</th>
<th>Agriculture</th>
<th>Forestry</th>
<th>Mining</th>
<th>Manufacturing</th>
<th>Retail</th>
<th>Professional and Financial Services</th>
<th>Transportation Services</th>
<th>Quaternary</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clear Land Tenure</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Supply Chain Reliability (Transportation)</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Adequate Water</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependable Electrical Supply</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Access to Unskilled Labour</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Access to Trade-Skilled Labour</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Access to Professionals</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Access to Financial Services</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
<tr>
<td>Access to Fuel</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Safety Through Nearby Microbusiness</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#3. To maximize the economic multiplier effect of an interurban infrastructural wayleave, there must be allowance given in the design for provision of utilities along the route, as well as local feeder roads.
Land Law and Administration in West Africa

The success and failure of development in large part begins and ends with security of land tenure. Land tenure in West Africa, however, is complex. Tribal land tenures, land claims from previous generations, a history of excessive government expropriation followed by land remaining fallow, judicial recognition of squatter’s rights, and poor tenure systems all contribute to a system that creates a need for land to be rigorously guarded as de facto seizures of poorly-guarded lands are the norm.

As stated by Mitchell et al (2015, p. 193):

“If land governance is poor, people are at risk of disaster, eviction and land grabbing...

“...implementing Western style systems...tend to require high accuracy field surveys and with a key focus on land titling, rather than the various kind of social tenures that are predominantly found in local communities. The systems are too costly, take too long time to establish, and are too demanding ... [to provide] secure tenure...

Of the various subthemes of this thesis that were researched, land law was by far the most common topic of academic literature. The findings were very consistent. Below is a sampling of selected extracts from a number of papers, arranged chronologically. This section could be much longer. For the sale of brevity, only enough writings are included to provide the reader a good understanding of the situation, its evolution, and current issues. Almost all documents reviewed related to Nigeria or Ghana. None were found that focused on any other West African country, although most indicated that land law systems demonstrated similar patterns across region.

In 1955, Davis wrote that traditional African land law systems worked well for the locale and the culture.

“Prior to ... the nineteenth century, a high degree of statecraft developed [among] ... the Akan tribes of the Gold Coast...When the system functioned well, it had both democratic and autocratic elements. Each of the seventy major tribes had strict chains of command with village chiefs, district chiefs, and a paramount chief at the top of the pyramid. ...The strength of this ancient system lay not only in its rules of lineage, but in its religious reverence ... These tribunals have been compared with and found similar to the early Anglo-Saxon institutions that formed the foundation of the English judicial system.

Davis, 1955, p. 119
In 1965, Bentsi-Enchill wrote that the issue arising was that no systemic, logical, and fair system had been or was being implemented to guide West African states away from the traditional system and towards a modern system.

“African systems of land tenure in general as compared with systems of tenure prevailing elsewhere present no special or extraordinary problems; their principal defects arise mainly from the fact that they have been mostly left to make their own informal adaptation...to changing circumstances; and that perhaps their greatest single need is the speedy institution ... of general title registration based, as Torrens was concerned to base his famous reforms, on methods that are "reliable, simple, cheap, speedy and suited to the needs of the community."

Bentsi-Enchill, 1965, p. 121

In 1971, Woodman described the different types of land tenure that had arisen in Ghana, where both traditional and modern land tenure systems were functioning.

“...there are three possibilities of the fee simple existing in Ghana, although two of them involve controversial points:

1. If government acquires land under ... compulsory acquisition (expropriation), all previous titles are normally extinguished. There seems no reason why the government should not subsequently grant a fee simple in such land. ...

2. A stool [chief or tribe] holding the allodial (or absolute) title in land which is not subject to any other interest may alienate its title outright. (There is controversy as to whether it may be alienated to an individual, but it is generally agreed that it may at least be alienated to another stool.)

3. A person holding a customary-law usufruct (or determinable estate, or proprietary occupancy) may today alienate his interest freely. ”

Woodman, 1971, p. 150

Kludze released a detailed analysis of the land law of one of Ghana’s tribes in 1973. It is entitled the Ewe Law of Property. Most of the literature after 1973 on land law in Ghana will cite this source document.

In 1997, Appiah-Opuku summarized the many legal issues that had arisen due to the overlap of the traditional and modern land tenure systems.

“Due to the lack of registration of title to land, the courts are filled with disputes between chiefs, regarding the boundaries of their jurisdictions
and their rights over stool land. "Stool" is the name for royal property. These protracted disputes go through a chain of appellate courts to the West African Court of Appeal and even to the Privy Council. The African places great store on the land; he believes that his spiritual ancestors live there, and that it is his sacred obligation to preserve it for them. A chief runs the risk of destoolment if he does not defend stool land."

Appiah-Opoku & Mulamoottil, 1997, p. 165

Karikari, 2006, describes a highly dysfunctional Ghanaian land administrative system that is inefficient, duplicative, and in some cases suffers from a perception of a level of corruption. His observations were consistent with those of the author of this thesis. However, because land administration is not effective in Ghana, paper-based scams cannot be of much effect, which in turn creates little incentive for corruption in the bureaucracy; yet, there is much incentive on the part of landowners to physically protect their land assets from seizure or squatting. In plainer terms, corruption in the land administration system is very low, even though the land administration is very vulnerable, because the only way to effectively steal land is to physically occupy it. The financial returns of stealing land by falsifying paper records are not worth the effort.

In 2009, Larbi showed that the Government of Ghana, which tried to solve the issue of the traditional land tenure system, by expropriating far more land than it could actually use, had unwittingly created a new severe problem: a culture of deliberate squatting and encroachment on unused government lands, which had then become a culture of encroaching on all vacant lands.

“In Ghana, the state has exercised its power of eminent domain under various enactments since colonial times...The result has been the...acquisition of about 20 percent of the lands in the country... The acquisition and management of these lands have given rise to several unresolved issues. These include: the acquisition of lands far in excess of actual requirements; unpaid compensation in respect of some acquisitions; encroachment on acquired lands; [and] lack of intergenerational equity in the utilization of paid compensation...The result has been a loss of public confidence in the state machinery for the management of land. This has led to tension between the state and customary landowners, massive deliberate encroachment on state lands, and challenges to the state's legitimacy to claim control over compulsorily acquired lands.

Larbi, 2009 [emphasis added], page 1

However, in 2010 Obeng-Odoo continued arguing that government should expropriate traditional lands, in order to create clear title. Evidently,
the problem with expropriation had been follow-through: the government had not subdivided and resold lands it had seized from the stools. The end result was effectively a second informal land tenure system, based on occupancy.

“A proficient land market stimulates orderly spatial development and improves quality of life in an environment. This is because activities involved in the disposition and acquisition of land spatially impact the growth and development of towns and cities. Consequently...the acquisition of land from the stool positively enhances spatial development...

“In Ghana; however, ownership and access to land poses several challenges which inhibit planning efficiency: inflexible land tenure systems; weak human resource capacity; weak legislative framework; inadequate funding; and undue political interference in the planning process...

Obeng-Odoom, 2010 [emphasis added], p. 432

The issue of security of land tenure is recognized as being central to success of plan implementation. The Ghana National Development Planning Commission (NDPC) stated in 2014 (Section 6.5, p. 92) that

“the linkage between spatial/land use planning and socio-economic development in the planning and management of cities, towns and communities in the country is weak at all levels. Related to this, is the issue of land ownership which poses major challenge to land use in the country. Problems associated with this include the general indiscipline in the land market, complicated land tenure system; and cumbersome land title registration procedures all of which impede the efficient use of land for development purposes.”

Sam-Awortwi wrote in 2016 that the mixture of traditional, modern, and the new informal occupancy-based land tenure system collectively were creating an unnecessary land shortage in Ghana, making new development more difficult.

“The inefficient land management and administrative measures which for instance give rise to multiple sales of land lead to land disputes and haphazard development (Kasanga and Kotey, 2001). Such inefficiencies likewise encourage encroachment of public spaces as a result of land being limited in physical supply. This serves as one of the reasons for the haphazard spatial development currently prevailing in Ghanaian cities ... planned layouts professionally designed are unacceptably violated by developers; affecting the structure and aesthetics of towns in terms of
the distribution of land uses. In other to ensure a well-functioning urban land market, land management and administration issues have to be attended to.”

Sam-Awortwi et al, 2016, p. 86

To summarize, there are now effectively three separate systems of land tenure in West Africa, operating simultaneously:

1. A legitimate traditional system based on tribal practices.
2. A legitimate modern system based on surveys and land administration.
3. An illegitimate system of might-over-right, squatting-occupation-leads-to-legal-recognition. This system occurred because governments, in the early independence period, expropriated tribal lands in order to bring them into the modern system, but then did not survey or resell the lands, leaving huge areas fallow and in legal limbo.

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#4. Land tenure within and beside the wayleave must be secure. Government needs to ensure that lands are secured, and all alternative claims are legally, categorically, and forever extinguished through compensation, contract, and legislation, before selling or leasing those lands to investors.
3 Case Study Ghana

3.1 Legislation Relating to Land in Ghana

Ghana has a British-based legal system, and a modern set of planning and land acts, which are summarized below. The tools are in place for an effective land regime in Ghana, what is yet missing is successful implementation. It is the author’s opinion that all the legislation needed to make the ECOWAS corridor wayleave happen successfully already is in place in Ghana.

Major legislation in Ghana relevant for the Thesis Research and in to account are;

- Laws Relating to Stool Lands and Expropriation
- Land Use and Spatial Planning Act 2016

3.1.1 Laws Relating to Stool Lands and Expropriation

According to interviewees, stool lands are communally-owned tribal land, usually overseen by a Chief. When money comes from stool lands, it is treated as a communal resource. 80% of Ghana is customary land (owned by stools, families, clans, and individuals), and 20% state land.

There are 3 options for government to acquire new lands.

The first is the statutory Wayleave Act. Under this legislation, compensation is paid from government to the stool when the stool land is expropriated and becomes unavailable for use by the stool. The Resettlement Policy Framework of 2007, which works within the Wayleaves Act, provides advice on expropriation in practice, and the general preference to avoid expropriation whenever possible. It is consistent with World Bank policy which essentially states that before expropriation occurs, a full resettlement plan should be created in which not just compensation but also relocation of buildings and livelihoods are worked out with communities in advance.

The second is the State Lands Act 125 of 1962. Under this act, the central government can expropriate anything it considers to be in the interest of the state, but again it must compensate the stool for what it expropriates. Regarding traditional lands, certain rites are required before construction can occur in spiritually significant places.

The third is the Administration of Lands Act 123 1962. Under this legislation, the government takes land for an institution, but pays rent rather than legally expropriating.

As stated in the previous section, the literature indicates that the Government of Ghana expropriated more land than it should have, mainly in the 1960s and 1970s, and then failed to appropriately redistribute the land, leaving large areas fallow.
This directly contributed to the creation of a squatter’s form of land tenure, which adapted into the culture and is a constant issue in all parts of the country.

### 3.1.2 National Development Planning Commission (NDPC) Act 1994

The NDPC is responsible to the President and oversees national planning. Leadership includes a representative from each region and the Bank of Ghana. It will be discussed in more detail later.

### 3.1.3 Land Use and Spatial Planning Act 2016

This legislation established the Land Use and Spatial Planning Authority, which implements the planning frameworks produced by the NDPC. It effectively strengthens the implementation capacity of the NDPC. The law creates national, regional, and district planning committees that each require attendance across government (excepting Railways) for the creation of coordinated national and regional plans.

Its primary goal is the judicious use of land and the equitable distribution of national infrastructure and facilities. The President approves the National Spatial Development Framework, and all other plans need to be consistent with it. However, the Land Use and Spatial Planning Act still lacks a direct mechanism of censure if local districts do not adhere to the planning framework.
3.2 Structure of the Government of Ghana

Ghana is not a federal country like Switzerland, as the central government in Accra has a strong role in defining and setting targets for the regions. Power is vested in the central executive, which is advised by a number of parties including ECOWAS, the African Development Bank, and others.

Figure 12 following is a simplified model of the structure of the Government of Ghana. In Figure 12, yellow indicates that an interview was held in the department. Red indicates the agencies directly responsible for land use planning in Ghana (interviews were also held at these agencies).

Figure 12 shows that sometimes Ministries and Authorities will have the same name, which imply that their jurisdiction overlaps. There is a pattern in the government of attempting to deal with long-standing issues of infrastructure maintenance by separating planning and construction work from operations and maintenance work. For example, the Ministry of Railways Development handles railway O&M, while the Ghana Railway Development Authority under the Ministry of Transport is responsible for planning new or enhanced railways. The thinking seems to be that breaking these functions will solve maintenance issues.

The implication of all these divisions is that a major challenge for development of a multi-use ECOWAS corridor is that it would need the active involvement and support by a half-dozen or more Ministries and agencies. With the tendency of the branches in any government to operate in silos (something certainly not limited to West Africa), this creates typical problems of effecting major strategies, which require involvement of multiple agencies. Creating that coordination within the Federal Government is a key role of the NDPC.
Figure 12: Structure of the Government of Ghana (Simplified).
3.3 Development and Land Use Planning in Ghana

3.3.1 Three Tiers of Planning Agencies
There are four planning agencies in different parts of the government, being phased down to three. The dashed line in Figure 12 indicates the umbrella structure of National strategies, national plans, and regional and district land use plans. These are developed and implemented through the:

- National Development Planning Commission (NDPC), for national strategies;
- Land Use & Spatial Planning Authority (LUSPA), for national planning coordinated to the regional level;
- various local physical planning departments for different parts of the country;
- Town & Country Planning Department played a role similar to the LUSPA until passage of the Land Use and Spatial Planning Act in 2016\textsuperscript{xix}. It is now being phased out, with its functions broken off to different locales or to the Department of Parks, or to LUSPA\textsuperscript{x}.

The NDPC is not a part of any Ministry, but reports directly to the Executive, and its planning frameworks, once approved by the office of the President, are binding on all Ministries. Technically, NDPC has the ‘teeth’, through its direct line to the Executive, to force Ministries, if necessary, to uphold their portion of national development strategies; although based on interviews this has not yet happened.

The author noted strong communication ties between the NDPC and the LUSPA, but not between LUSPA and the Accra Region. While there is a statutory requirement for District plans to fit with Regional plans LUSPA regards itself as having an advisory role. Districts will often diverge from stated District Plans, resulting in inconsistent application.

This disconnect between regional planning and local application means national planning priorities must be implemented by the national government to ensure consistent application.

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#5. Since LUSPA cannot enforce consistent application of planning strategies on regions, cities, or districts, a major interurban infrastructure wayleave must be designed and implemented at the national level with oversight from the Executive.

3.3.2 Ghanaian National Plans
The NDPC has created a number of comprehensive planning frameworks that encompass essentially all aspects of Ghanaian long-range development (the National Spatial Development Framework, Transport Infrastructure Framework, and Integrated Transport Plan for Ghana). The author of this thesis has not seen
better coordinated planning documents, across all sectors and at multiple scales, in any other jurisdiction, with the possible exception of the State of Kerala in India or Singapore. The issue, according to all interviewees, is implementation.

Figure 13, following, is a map produced by the NDPC showing a comprehensive vision for Ghana in about 30 years, including the results of all the national plans.

Figure 13: NDPC Vision of Ghana in the Future
Noteworthy there are two possible ECOWAS corridors through Ghana, one along the coast, the other running inland from Accra to the western border. Also prominent is the ‘triangle’ created by Accra, Sekondi, and Kumasi. Finally, as with other planning documents, there is a perceived need of the emergence of new inland centres, in this case Tamale.

### 3.3.3 Planning Priorities for National Infrastructure

#### 3.3.3.1 Roads & Highways

NDPC documents from 2017 anticipate that roads will receive a majority of new investment in the next 25 years, with the projected national system shown in Figure 14. This includes:

1. 72,000km to 253,000km of roads by 2047
2. Controlled number of new cars
3. 3 long-span bridges on Lake Volta
4. 4 circular roads and 9 arterial radials for Accra
5. Conceptual framework places highest priority on ECOWAS corridor and the Accra ringroad.
6. A national freeway system (shown in red)

The NDPC’s documents indicate that increased population combined with increased car ownership rates will make even this greatly expanded road system non-functional due to traffic across most of the entire network, and in response have proposed carsharing, limits on usage, and other factors, without details as to how these would be implemented. Also, NDPC considers that busses and passenger trains will have to carry the bulk of intercity passengers.

Considering these, it may be asked why Ghana would focus on road infrastructure improvement, when it has already decided that most of the country is too densely populated for roads to be an effective transport mechanism.
3.3.3.2 Railways
While total transportation infrastructure spending is anticipated as USD$250 billion over 25 years, which includes new airports, $26 billion is allocated to railways. The ECOWAS rail link, as shown below, is given 6th priority and allocated for post 2030. Figure 15 presents the Ghana national railway plan.

The investment in rail includes 160 station buildings across the country, commuter rail in the half-dozen largest Ghanaian cities, and a subway in Accra. NDPC notes that only 13% of the existing network is operational, and that there are three separate gauges in use in ECOWAS: two types of narrow gauge, with only Liberia and Guinea using standard gauge. New lines in Ghana will be standard.

Figure 15: National Railway Plan

3.3.3.3 Greenway System & Agricultural Corridors
The NDPC has created one of the world’s first national greenway plans, shown below in Figure 16. In many cases, notably the coastal route, there is a proposed greenway (or existing river corridor) parallel to a proposed road or railway. This supports the concept of a truly multimodal corridor.
Indirectly related to the greenway system is a National Agricultural Corridor (Figure 17), which anticipates focusing on agricultural expansion within 50km of the primary north-south corridor through Ghana, and from Accra to Togo. The idea is that ensuring that farmers can get product to market is likely to increase agricultural production and decrease reliance on imports. As stated in Volume 1 of the National Spatial Development Framework, the Agricultural Growth Corridor concept:

“...[NDPC] supports the conversion of land into commercial agriculture at an industrial scale. The idea is that provision of strategic infrastructure—roads, railways, irrigation, storage, processing and ports—will attract Investment and facilitate the development of commercial agriculture. Key requirements for an AGC include the following:

■ availability of large areas of land for industrial agriculture;
■ established infrastructure (roads, irrigation, warehouses, improved seedling);
■ linkage to ports and other countries;
■ strong private sector;
accessibility and proximity to large urban markets;
- small-holder farmers.

“Smallholder farmers are an important component of an AGC. AGCs are not meant to put existing farmers out of business but to encourage larger commercial enterprises to engage them as out-growers, train and equip them with modern farming methods, and provide them with higher incomes than they would generate on their own.

“Several African countries have developed successful agricultural growth corridors...Ghana could learn from these successes and start the process of developing its own agricultural growth corridor. NSDF has taken the first two steps and has (i) determined that Ghana has all the preconditions to establish agricultural growth corridor and (ii) defined its possible boundaries.”

Figure 17: Agricultural Corridor Concept

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#6. The ECOWAS corridor must also be designed as an eco-corridor and for the transportation of agricultural produce (which is often not a suitable user of motorways due to risk of creating flying debris).
3.3.4 Economic Development
The NDPC used Figure 18 below to describe how it hopes infrastructure investments will be coordinated by strategic business investments to kick start self-reinforcing patterns of socioeconomic development.

Figure 18: Overall Economic Development Strategy

The easiest way to think of this economic model is that instead of money flowing into Ghana from sales of raw resource exports and immediately flowing out for purchase of foreign-made products, it cycles around Ghana a few times, supporting a variety of domestic producers and manufacturers, before flowing back out of the country again.
3.4 Ending Economic Dependency: Two Approaches

Two broad categories of economic development were found in the literature. One is the more traditional, involving building up the primary and secondary sectors, then tertiary later. This is exemplified by the West Africa Growth Ring Master Plan (WAGRIC) prepared by the National Development Planning Commission and the Japan International Cooperation Agency (NDPC-JICA) in 2018.

The second, which was described in one article only by Ruelas-Gossi, encourages instead that different regions focus immediately on developing specialized, difficult-to-make products. These products should be so unique and so useful that the whole world comes to rely on them, and buys them regardless of economic situation. This insulates the economy against fluctuations in commodity prices.

3.4.1 WAGRIC and the Seven Economic Sectors

WAGRIC recommends strategically building up certain West African transportation corridors in order to create a region-wide network. The main upgrades would occur along the ECOWAS corridor. These transportation investments are coordinated with other new or revised policies in trade and economics.

WAGRIC states that development of transportation infrastructure without paying attention to economic needs will result in net financial failure of the investments.

The document calls for the development of strategic industrial and commercial nodes along the coastal ECOWAS corridor. It states there is a need for multimodality, including utilities, in some areas. Each proposed node has specific details for commodity-specific needs in that area and lists the commercial and industrial priorities for each node. As a physical and economic planning document, WAGRIC is very thorough.

In the transportation infrastructure plans, WAGRIC differentiates between “Economic Corridors”, which are essentially multi-modal and will support dense economic activity along their length, and “Transportation Corridors”, which focus mainly on getting from Point A to Point B as fast as possible. Figure 19 below is from WAGRIC Section 8.2 and shows where each type of corridor is proposed. The WAGRIC “Economic Corridors” line up closely with various other NDPC proposed corridors (already described). There is also a stated goal of extending economic development from the coast to inland areas.
Figure 20 shows WAGRIC’s 2040+ vision for infrastructure corridors (in this case, roads) for the region.
Following a review of economic and population conditions, the plan identifies the primary economic sectors as:

1. Processing industries for agricultural export products.
2. Export-oriented manufacturing (by importing raw material and spare parts to produce spare parts and intermediate products for electronic appliances and transport machinery).
3. Agriculture, livestock, and aquaculture targeting WAGRIC markets.
4. Manufacturing of processed food and drinks and other processed products oriented to WAGRIC markets.
5. Advanced service industries targeting WAGRIC markets.
6. Production of agricultural products for export.
7. Mineral resources development for export.

The Plan states (in its Section 6.2) that except for the last two of the points above, (numbers 6 and 7), the sectors are poorly developed and should be developed in the short term. However, point number 2, manufactured parts, should be developed only in the long term. In Section 6.3, the Plan compares three growth scenarios. The first is one where the WAGRIC region seeks greater economic self-sufficiency as a whole; the second where the Plan seeks greater national self-
sufficiency; and the third where all focus is on export markets. The Plan uses a matrix of assessment to select the first option as being the most appropriate.

The author here lists 5 critiques of WAGRIC, while recognizing the herculean and highly useful and detailed structure of strategized economic development links and nodes. The key takeaway from WAGRIC is perhaps that spatial planning, economic policy, and phased infrastructural investment must move forward in a more-or-less coordinated fashion. This in turn implies the ECOWAS Corridor is not an infrastructure issue. It must be thought of as a growth/sustainability/transportation/health/suburbanization/marketing/land law/end of economic dependency issue.

1. Firstly, the assessment of economic sectors completely ignores the tremendous latent demand for low-skilled domestic manufactured products, such as building materials like tiles and roofing, and medium-skilled manufactured products like furniture. For example, the author observed that in Accra, every building he visited (about 100) was floored with expensive imported Italian tile, while there seemed to be much clay available locally which could be used for domestic production.

2. Secondly, the overall structure of WAGRIC is set up for extractive industries from the inland areas. In effect, the “growth ring” is actually three separate resource-extraction lines, all originating at Ouagadougou and terminating at either Abidjan, Accra, and Lomé. The Lagos-Abidjan coastal route is a separate high-capacity corridor connecting these great port cities. There is no inland east-west line, which would help build an intra-African economy. Although the stated intent of the plan is to support a more self-sufficient West African economy, the actual physical design of the infrastructure proposed is primarily designed for export.

3. Thirdly, the author is critical that on the one hand the document calls for West Africa integration, and states that both Kumasi and Abidjan will be mega-cities, yet does not show a Kumasi-Abidjan link.

4. Fourthly, WAGRIC’s separation of different modes is difficult to understand in light of its definition of “Economic Corridors”, which require both reliable transport and utilities to achieve long-range economic success in commercial and industrial development. It is apparent that the highest-priority lines, presented in the NDPC map (Figure 13: NDPC Vision of Ghana in the Future), should be multimodal in nature in order to support the great economic development that West Africa needs to see along these lines.

5. Fifthly, the focus of Section 10.3.2 of WAGRIC on a multilane highway from Lagos to Abidjan, with vague references to a high-speed rail system in the distant future, is understandable but may be too short a timeframe. It is not possible for a multilane highway of any width to handle a corridor with over 100 million inhabitants; and constructing a HSR after urbanization would be prohibitively expensive.
3.4.2 Product Specialization

Ruelas-Gossi (2016) wrote on how economies can end patterns of dependency. He criticizes traditional economic development theories, which basically encourage developing economies to focus on low-skill, low-wage employment. The theories state that as employment levels increase, workers will be able to seek higher wages.

The main issue with this theory, according to Ruelas-Gossi, is that the economy remains dependent on price fluctuations for raw goods and basic manufactured products, leading to economic instability. Also, labourers never get an opportunity to develop unique and refined skillsets, and so the vast majority remain trapped in the just-getting-by cycle of the working classes.

Citing examples from around the world, Ruelas-Gossi shows how certain regions would focus on a raw material that they had in abundance, and then develop a range of high-value, highly-useful products that will be in demand at all times.

For example, Chile developed systems to use copper on surfaces (like doorknobs) to reduce risks of infection transfer. New Zealand focused on milk products and have made dairy product manufacturing a major part of the country’s prosperity. Basque Country developed a range of perfected steel products.

Ruelas-Gossi identified five traits of a “race-to-the-top” strategy as he calls it:

1. Focus on the high value of market segments. Develop unique, high-value products that are genuinely useful and not that everyone can produce.
2. Deepen the science behind the business: support research and development in all potential uses of a given sector.
3. Continually research new ways to use existing technology. For example, the same copper plating systems Chile used for surfaces that are touched a lot (like the poles people hold onto while on the bus) are being tested in air filtration systems.
4. Create the regulatory and legislative environment that will maximize the selected economic sector and keep it competitive.
5. Attract foreign direct investment.

“Every geography in the planet possesses unique characteristics, and it is from the development of those characteristics that each nation must find a unique path of development and value enhancement. The right policy question is not where to enter an existing value chain but how to create an original value path, with the ultimate goal of sophistication and enhanced value.”

Ruelas-Gossi, 2015
### 3.4.3 Comparison of the Models

The WAGRIC document is written from the perspective of macroeconomic development theory of which Ruelas-Gossi is opposed. That WAGRIC missed an entire major economic sector in its plan (non-automotive domestic manufacturing) is consistent with a Ruelas-Gossi concern, and puts into question all results from the plan: bad data in, bad conclusions out.

However, it is not possible to go from almost no domestic production, directly to the development of an internationally-leading high-end product that can hold its value in the face of commodity price fluctuations. It is necessary to create a system whereby industry is stimulated and stable, before product specialization can take place. There is room for both models.

#### What are the factors that will likely lead to successful infrastructure investment in West Africa?

#7. Business parks, industrial yards, and agricultural lands should be adjacent to the wayleave and also have secure land tenure. These will come to rely on the new infrastructure, and in effect create a linear development corridor.

#8. The two ways government can help are to create the legislative and jurisdictional matrices that will foment the most promising high-end unique sectors in West Africa, while simultaneously *not* creating a subsidization program, thus leveraging the full potential of the free market.
3.5 Interview Summary of Discussions

Input from the interviewees has been woven throughout all the text in this thesis. Notes from each individual interview are listed here.

The interviewees were:

1) Felix Addo-Yobo, Director, National Development Planning Commission
2) Dr. Kwabena Adjei, Group Chairman Kasapreko Group of Companies
3) Sylvanus K. Adzornu, Head Urban Development Unit, Ministry of Local Government & Rural Development
4) Professor Akosa, Former Councilor of the National Development Planning Commission
5) Ms. Akyea, Africa Development Bank Transport Division
6) Mohammed Alhassan, Principal Town Planning Officer, Land Use and Spatial Planning Authority
7) Dr. Kwame Amezah, Director of Agricultural Extension Services
8) Patrick Amoah, Director of Operations, Office of the Administrator of Stool Lands, Ministry of Lands & Natural Resources
9) Godwin Gadikor, Ministry of Railway Development
10) Shelter Lotsu, Chief Engineer, Head of PPP, Ghana Highway Authority
11) Daniel Opoku-Mensah, Academic Affiliated with Swiss Universities
12) Patience Osei-Nyarko Puorideme, Deputy Director, Physical Planning Department, Accra Metropolitan Assembly
13) Henry Telli and Reindorf Perbi, Institute for Growth Management
14) Lands Commission Staff
   a. Mr. Addo-Yobo

Mr. Addo-Yobo plays an important role in the NDPC, which sets planning frameworks for all of Ghana. He assisted the author in initial orientation to Ghana and the NDPC.

b. Dr. Adjei

No actual interview was held with Dr. Adjei, instead a 2017 interview with Vaultz magazine him was utilized. Dr. Adjei runs a successful softdrink company out of Ghana. Key points:

- Ghana’s industrial sector has not grown significantly in 40 years.
• Key factor affecting growth is undue support for service sector from government and banks
• Industrialization is essential to achieving widespread poverty. A strong service sector, with most imports paid for through raw exports, is not sustainable.

c. Mr. Adzornu

Mr. Adzornu oversees a department that considers how Ghanaian cities are evolving. He was particularly concerned with governments and infrastructure being financially self-sufficient.

d. Ms. Akyea

The Africa Development Bank does not pay for maintenance of wayleaves, but the Transport Sector Working Group is funding research into finding ways to enforce wayleaves. This Group is working on a white paper, stakeholder workshop, and action plan on how issues can be resolved, followed by a transport forum or conference where stakeholders sign on to a plan.

e. Professor Akosa

Prof. Akosa was a former leader of planning in Ghana, and had a deep understanding of the issues facing the country. He asked why the ECOWAS corridor has not already been completed. There is a great amount of intra-West African trade. West African borders are very porous, and smuggling is the standard of trade. There is a need to stabilize and formalize trade relationships.

Trade was not allowed in West African during the colonial period; road and rail restrictions date to those times. The English-French nature of West Africa causes difficulties in communication.

In Ghana bridging the north-south divide led to priority for a railway to the north. The African Development Bank should be the anchor for the ECOWAS corridor, to ensure a thorough work and business plan is implemented and not just a wayleave in name only.

Past failures, especially relating to the disastrous dictatorships that arose shortly after decolonization, have demoralized the financial and business community. After the 1966 coup, everything was shut down, even established profitable factories. There is huge agricultural potential in West Africa, but European imports are a main source of food. The ECOWAS corridor needs to be more than infrastructure, it needs to be a place where primary and secondary industries can thrive. Mr Akosa provided me the most memorable interview experience while I was in Ghana, saying, “There is no reason we cannot feed ourselves!”.

f. Mr. Alhassan

Mr. Alhassan plays a central role in the development of land use plans in Ghana.
He stated that in Ghana, 80% of the land is customary land (owned by stools, families, clans, and individuals), and 20% state land. Stool lands are managed on behalf of a group of people in a traditional area by a Chief. Stool lands should be held in trust—the acquisition of any stool land requires a check and approval by the government, and concurrence by the land use planning authority. Stool lands may be given out as freehold or as a usufruct (a piece of land with many part owners).

When the government acquires lands for wayleaves, compensation rates are determined by consultation, and are to be paid promptly.

The Ministry of Highways has tended not to enforce encroachments by squatters, and they tend to delegate such enforcement to local departments.

He also agreed that setting up wayleaves, and then leasing unused land before infrastructure construction was an appropriate approach in Ghana. This could be done through caveats written on the land leases and then registered with the Lands Commission. The primary objective of such arrangements would not be to gain revenue, but to secure the space in coordination with people who might otherwise encroach, essentially turning squatters into custodians.

Mr. Alhassan stated that regional entities do not have the mandate to undertake direct execution, which leads to difficulties in implementation and enforcement of land use plans.

g. Dr. Amezah

Mr. Amezah was, like Prof. Akosa, a wealth of wisdom about his country. He said the House of Chiefs (the committee of lead Chiefs in Ghana) are involved in road development as it pertains to the ECOWAS corridor. The government must insist on full acquisition, with full compensation that eliminates any and all claims to the land, before a wayleave can begin.

The problem with the success of the ECOWAS corridor is not compulsion (Ghana has all the laws it could need), but education. Article 1-5 of State Lands Regulation Compulsory Land Acquisition and Compensation in Ghana says the government can take land in the public interest. The people need to understand the longer vision before they can help it become reality. Every year people will need to be reminded that the land is for infrastructural use and cannot be built on. He suggested that a successful ECOWAS wayleave project would start with meeting with chiefs. It would ensure that each assembly is in agreement with the corridor. It will be necessary to periodically and extensively inform the people through committees, churches and mosques.

When roads bypass a village, the village dies. The ECOWAS corridor must carefully plan on locations of where it goes and ensure that important access points remain.

Regarding traditional lands, certain rites are required before construction can occur, in order to appease spiritual or religious requirements. This includes
cemeteries. Passing the wayleaves through shrines is difficult but possible. Everything is open to negotiation.

Because the government has to prevent any use of the land to avoid potential claims of de facto ownership, Mr. Amezah does not think the leasehold idea will work. He thinks leaseholders may eventually think they own the land and then oppose the infrastructure when it is time to build.

h. Mr. Amoah

Stool lands are communally-owned tribal land, usually overseen by a Chief. When money comes from stool lands, it is treated as a communal resource, 10% going to the central government, 55% to district assembly for development of region, and the rest to the branches of stool.

Mr. Amoah stated that the Lands Commission will allow leases on wayleaves, and there are no legislative prohibitions for lessees to make money on land leased from the government, as long as they pay their lease. He stated this is the best tool to maintain wayleaves for extended periods of time, and would also provide the funds needed to prevent squatting.

i. Mr. Gadikor

Mr. Gadikor kindly offered me the Ghana Railway Master Plan and explained the structure of his organization.

j. Mr. Lotsu

Wayleave acquisition occurs right before project development, so resettlement becomes part of the cost. Executive Instrument – EI – announces government intends to develop a corridor, and tells everyone to submit written papers or letters to indicate their title or interest to any part of the land. Those claims are assessed using existing laws. The government is now using Public Private Partnerships (PPPs) to help finance and program new growth, but to do so, the government must have clear, unencumbered, and undisputed title to the entire wayleave.

There is no long-range coordinated infrastructure plan currently in place.

k. Mr. Opoku-Mensah

A passionate Ghanaian, Mr. Opoku-Mensah is working to collect better economic data on Ghana to provide more effective economic development plans.

l. Mrs. Puorideme

Mrs Puorideme kindly gave me a large portion of her busy morning with no advance notice. She described some of the local plans in the Greater Accra Metropolitan Area (GAMA). The first Accra plan was in the 1990s, and since then the city has been divided into very small areas. There are now multiple local plans, all for small areas. Definitely need an overarching plan for the larger city.
Protecting wayleaves falls under federal jurisdiction, but the city assists. Temporary licenses are possible, with squatters getting legal rights to land after they have lived in a place ten years with no contestation. The courts have recognized a humanitarian precedent for losing squatted land, which is why they created legal protections.

There are rail corridors in GAMA. Some of the suburban districts have violated the rail corridor, allowing development in it. The regional level needs more teeth – spatial aspects of the regional frameworks are missing. Planning is strong in Ghana, but there is difficulty in implementation.

m. Henry Telli and Reindorf Perbi, Institute for Growth Management

Mr. Perbi and Mr. Telli provided a fantastic amount of logistical support in Ghana, and made the project possible.

n. Lands Commission Staff

Indicated that expropriation of land for wayleaves is straightforward in Ghanaian law. They stated they are not using any regular means of ensuring adherence to existing wayleaves, either on the ground or through use of satellite imagery.
4 Metroplex Theories and Mega Projects

In 2018 the Global Metro Monitor stated\textsuperscript{xii}:

“More than half the world’s population now lives in urban areas, and the 300 largest metropolitan economies in the world account for nearly half of all global output.”

In 2018 Citylab stated\textsuperscript{xii}:

“Simply put, the world is no longer organized around nation-states. Cities and mega-regions are the basic building blocks of the global economy. But the rise of global cities is not a panacea. Left unchecked, today’s clustered urban economy generates a small group of winners and a much larger group of losers, across cities as well as within them.”

Further, Citylab stated in 2019\textsuperscript{xiii}:

“...this obsession with nation-states does not fit the reality of today’s highly-clustered knowledge economy, centered in and around global cities. And, it’s not just individual cities and metropolitan areas that power the world economy. Increasingly, the real driving force is larger combinations of cities and metro areas called mega-regions.

...“We ultimately identify 29 mega-regions as the real regional powerhouses of the global economy.”

A number of different terms are used around the world to describe situations when proximal metropolises grow into each other, including:

- Urban Agglomeration
- Mega-Region
- Megalopolis
- Conurbation
- Macrometropolis
- Megacity

The meanings may vary slightly depending on the author and location (for example, Megalopolis is an informal name for the Boston-to-Washington corridor, while Macrometropolis is the official name for Greater São Paulo Brazil) but for all intents the terms are synonymous. Metroplex is used most commonly in this document.

In metropolitan development, the key point is that unregulated metropolitan areas tend to over-centralize, creating central cities that are so large that externalities like traffic, crowding, real estate prices, and pollution become more important factors than the benefits of service access and community that should be the benefits of urbanization. The central cities get too big, when more attention should have been paid to the satellite cities or alternative metropolises. A much higher long-term standard of livability can be achieved through early strategic
decisions in land use zoning and infrastructure investment that keep urbanized areas smaller and separated from one another.

This image from NDPC (Figure 21) also helps show how each metropolis itself is not uniform, but a complex econo-ecosystem unto itself.

Figure 21: Main Components of a Metropolis
4.1 The Case for Creating Wayleaves Before Urbanization

El Shakhs (1997) wrote on the need for a combination of market-sensitive land decisions combined with land administration and zoning approaches sensitive to governmental capacity to implement them, coordinated with strengthened and empowered self-reliant local governments. An extended section of his work is presented in Appendix 1; the key paragraphs of note [emphasis added]:

“Thus, policies for the development of mega-city regions should give particular attention to the growth potential along intense transportation corridors linking them to other major cities, both within the national urban settlement system and between countries. ...

El Shakhs, 1997 [underline added]

The statement by El Shakhs on “intense transportation corridors” provides a strong theoretical justification for the topic of this thesis.

Intuitively, all other factors being equal, rural lands are cheaper to purchase than urban lands: thus a wayleave purchased in a rural area will be cheaper than a similar-sized wayleave purchased in an urbanized area. All interviewees agreed with this presupposition. Several of the Union Internationale des Chemins de Fer (UIC) speakers the author heard in Paris in April 2018 stated that as a rule-of-thumb, overall project costs for major infrastructure are half if the land is acquired before urbanization.

Real-world examples of this are legion. From the author’s own experience, growing up in Vancouver as the metropolitan population tripled over 30 years, the dependence of transportation planners on the rights-of-ways established 50 years earlier was constantly obvious. Where no rights-of-ways were established at an early date, major projects invariable had to go up onto stilts or down underground, both at enormous cost; or follow circuitous paths. Williams et al stated (2004):

“the long term safety, operational, and fiscal benefits of purchasing additional limited access ROW at interchange areas greatly exceed the initial up front costs of acquiring additional limited access ROW.”-p. 1

Barnes and Watters stated in 2006:

‘...early acquisition is not a good investment in the most general sense, given the average rate of land price increase and the cost of money as well as other costs associated with early acquisition. The one clear exception is land that is in imminent danger of development. A major limitation of this work is that it viewed land prices only in the aggregate and did not specifically examine the immediate vicinity of the right-of-way. The research did find some support for the notion that certain types
of land in specific locations can appreciate in price much faster than the average. It is not clear, however, that it is possible to predict these situations with sufficient accuracy to take advantage of the potential cost savings.-p. 127

The Barnes & Watters may be considered to argue that there is a need to consider land values in the immediate proximity of new infrastructure in terms of their relationship to that infrastructure.

This thesis would argue that since a new major inter-urban wayleave can create its own forces of “imminent development”, as described by Barnes & Watters, a project of grand scope, connecting two or more existing major nodes, in some ways can create its own economic macrocosm. It can create its own forces of imminent development through careful planning and design.

4.2 Large Metropolis vs. Metroplex

Massive urbanization may arise through the steady growth of a small number of cities that grow to extraordinary size (e.g., Tokyo, Cairo, Lagos); or, there may be a larger number of smaller cities in proximity to one another that gradually grow such that their suburbs begin melding into one another (e.g., Ruhr Valley, US Northeast, Pearl River Delta). Where political sovereignty is more divided, as we see in West Africa, the probability of metroplex instead of huge metropolis increases. A foundational assumption of this thesis is that population growth in the Abuja-to-Abidjan corridor is almost certain to create a metroplex (or mega-region as Citylab would call it).

While the Hoornweg & Pope assessment, already described, laid out the case for a great deal of urbanization in the Abuja to Abidjan ECOWAS corridor, they themselves describe the weakness of making long-term predictions for any one metropolis (p.4):

“Projecting city growths typified by Lagos growing from 10.6 million in 2010 to 88.3 million in 2100 obviously calls for a fulsome measure of skepticism; many variables could change. However, in the absence of more accurate projections, these estimates are important. Long-lived infrastructure and resource development plans are developed with time horizons extending to the end of this century. These estimates should be regularly refined with new census data and as urban borders change.”

Their data considered current population, population growth rates, urbanization rates, and the availability of cities to move to. If new cities are developed in the next 2-3 generations, the populations projections for the currently dominant cities would decline; however, the overall regional urban population projection would remain the same.
In other words, in 2100 the Abuja to Abidjan corridor is very likely to have between 100 and 150 million urbanized residents regardless of what planning decisions are made. However, the pattern of distribution, and the percentage of the total population within certain cities, may be very different from what is seen today.

One key factor of uncertainty is the rise of new, unforeseen cities. These sometimes occur when a large metropolis becomes large enough that the benefits of migration to a city outweigh its costs, exclusive of externalities. These are not common; more normally, an agricultural community on the outskirts of a major city will evolve into a bedroom community, then a small town, then an exurb, then a satellite metropolis, and then be absorbed by the ever-expanding greater metropolis and became a secondary centre. Examples of this pattern of urban growth are legion, on all continents. Figure 22 presents this conceptually, where grey represents urbanized areas.

Figure 22: Unplanned Exurb-Based Metroplex Growth.

Alternatively, some major geopolitical or economic shift may occur, resulting in the founding of an entirely new capital or trading city. There may be lower population growth in the older centre.

A classic example of this is to compare France, which has been (more or less) a unified state for millennia, to Germany, which was only genuinely unified in the 19th century, and then re-divided again for half of the 20th. Paris contains about 20% of the French population. It is a single very large city, presiding over what for the most part is a very lightly-populated and rural France. Central Paris itself has some of the best urban environments on Earth; yet the suburbs of Paris are more often than not places of poverty and despondency.

Political fragmentation in the past has created today a Germany with many smaller cities. It is debatable which is truly the largest German metropolis. Berlin, associated with the former powerful Kingdom of Prussia, is the largest single city, with about 5% of the German population. However, the Ruhr Valley, which most of its history was divided into multiple medieval duchies, has urban density
throughout and 15% of the German population. But no one can say if the center of the Ruhr is Cologne, Duisburg, Essen, Bonn, Dortmund, Düsseldorf, or Wuppertal. The cities of the Ruhr gradually grew into one another, but continue to operate as many smaller cities in one metropolex, surrounded by multitudes over other moderately-sized cities. None of these Ruhr cities are known as a particularly exciting place to be (in part due to the mass destruction of heritage that occurred in World War 2), yet the overall quality of life in the Ruhr is perhaps better than the suburbs of Paris.

These observations are supported by literature:

“... evidence indicates that at some point in their development, after initial periods of very rapid growth, mega-cities slow down considerably in their population growth rates. Although their populations may continue to increase in absolute terms, they grow at rates lower than those of other intermediate and smaller cities in their systems.... The United Nations, in fact, has had to revise its large-city population projections downwards at least three times over the past two decades.

...“If such trends continue, the processes and problems of concentration at both national and regional levels may eventually give way to the reverse processes and problems of de-concentration and dispersion. This is clearly contingent on active governmental efforts as well as the market processes that tend to spread development outside the mega-cities.

“no one can be certain exactly how big African mega-cities are now, or how rapidly they are expanding or going to expand in the future. However, mega-cities ... in general, and in Africa in particular, will likely continue to grow rapidly in the foreseeable future. In the process, such growth expands the city's influence and functions over a much wider region, including other cities and rural settlements and a frequently uncontrolled and unplanned periphery.

El Shakhs, 1992

Unplanned metropolexes will tend to form as rural communities become exurbs of metropolitan cores, and then those exurbs sprawl one into the other, eventually creating a single urban mass where before there was more than one distinct metropolis. The structure and functioning of the ECOWAS corridor may consider development of intentional new metropolises, and use various strategies to direct growth to them instead of the exurbs. As shown graphically in Figure 21, if the Abidjan to Abuja corridor is connected by suitable infrastructure, new intentional cities (in blue) may form, by intent or by accident, thus reducing population
pressures on existing overcrowded centres and retain greenspace around the cities.

**Figure 23: Planned Metroplex Growth with New Intentional Cities. (More large cities, fewer mega-cities.)**

El Shakhs (1997) wrote:

“Independent settlements located along major corridors of interaction provide attractive alternatives for both basic and service industries, as well as for migrants, and thus constitute rational choices for incremental decentralization moves out of the mega-city. They also enhance the potential for development of intermediate cities and regional centres within the national settlement system.

“...An alternative development process should attempt spatially to separate new urban development by green belts or reserves of open land, and create independent communities as an approach to expanding the urban land market. This approach would distinguish these communities from the core built-up area of the central city and reduce their dependence on its utilities and service systems.

*El Shakhs, 1997 [underline added]*

The statement by El Shakhs can be interpreted to support deliberate decentralization. This means anticipating that big cities will tend to grow more slowly as the externalities of population expansion begin to show themselves on a day-to-day level for residents and newcomers alike, and creating new cities or supporting smaller cities to grow in lieu of the larger center.

The reader must juxtapose the long-terms cost-savings of early Wayleave establishment, with the improved quality of suburban life that seems to be associated with metropolitan decentralization.

The results of the 2019 Citylab projectxiii, although not explicitly evaluated, are evident visually, and are copied in Figure 24 below:
It is apparent that the most geographically expansive ‘mega-regions’ tend to be in the West, most notable in the US where urban sprawl is most expansive; and in Germany and Italy, which have been affected by the political disunity of their medieval history (discussed earlier). The large area of the Seoul mega-region is questionable, as it includes many parts of South Korea that are not that heavily populated. Most of the newer ‘Mega-regions’ in the Global South are smaller, even if they have larger overall population. The author would argue that these evidences the tendency in rapidly-urbanizing areas to over-centralize.

A metroplex wayleave can act as a connector between emerging great cities, while encouraging development in smaller centres, which helps maintain quality of life in both. At the same time, the wayleave in itself can become a linear city.

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#9. Future growth nodes along the ECOWAS corridor should be identified and encouraged through local autonomy. In most cases, these will involve restructuring the jurisdictional divisions of existing small towns. Opportunities for these smaller places to grow, directly at the expense of continued growth of the existing large cities, should be pursued by local, regional, and national authorities.
4.3 Arcology

The architect Paolo Soleri was one of the more accomplished of the 1960s utopian architects. He developed a design paradigm he called arcology, which was in effect building enormously large buildings that were intended to be, in effect, entire towns. He put a great deal of effort into how to design both big and attractive places. He argued that such structures would operate as semi-contained ecosystems, able to recycle wastes, produce food, and function with limited impact on the environment. A test village, called Arcosanti, was built outside Phoenix, Arizona and still operates today.

The author of this thesis believes that 1960s futuristic utopianism, especially when combined with humanist-atheist-communist philosophies, created the lifeless Stalinist residential architecture from the Projects of Chicago and the Bronx, to Brasilia and Canberra, to the suburbs of Moscow, Paris, and Beijing that were (and are) universal failures worldwide on every objective and subjective measure imaginable. In retrospect, the biggest issues with these massive projects had to do with their costs, their inability to adapt to changing social circumstances, the rigid bureaucratic way in which they were built, the manner in which local cultures were downtrodden during construction, their compartmentalization of diurnal activities, and their horrific lack of design. However, what was built was never what the innovating architects had envisioned, as they had envisioned modern places of beauty. More current designers have developed a mixed toolbox that combines multiple building styles, diurnal thinking by neighbourhood, cultural and natural appropriateness, and flexibility by building more diversified building styles in order to maintain flexibility with changing economic and social conditions.

While Soleri’s ideas never came to fruition directly, they did influence both architecture, which has moved more towards larger multi-use buildings (although more recently we see in Arabia a re-adoption of the megabuilding ethic), and planning, which has moved towards favouring densification with condensed programmed ecological systems built into the urban fabric.

The intent here is not to argue for or against arcology in West Africa. What may be applicable in this context, in which wayleaves must be economically programmed and phased, is the ‘sideways’ version of arcology: the linear city. Soleri argued later in his career that high-speed transportation systems would allow for cities to be spread lengthwise instead of upwards. The fastest trains would connect the largest urban nodes, while secondary slower trains would connect smaller nodes. This concept appears to be consistent with El Shakhs statement in the introduction about “intense transportation corridors”.

In the context of a metroplex of over 100 million people, the concepts of linear cities and arcology do have resonance, especially in terms of maintaining
agricultural land and of maintaining close access to transportation. The statements by El Shakhs, already quoted at length, support this concept. The concept obviously suffers from excessive density, blocking all wildlife corridors, and inability to adapt to changing situations (possibility of ghetto-ization), but as a model of extreme urbanization it is worth considering for its positive aspects and what use these ideas may have in the coming West Africa metroplex.

What are the factors that will likely lead to successful infrastructure investment in West Africa?

#10. The infrastructure corridor may be thought of as a future linear city in its own right, and not just a link between other cities.

Following are some of Soleri’s concepts, brought to life by Kim in 2012, showing his ideas for the linear cities of the future.

Soleri’s concepts are about highly-compact, walkable communities, connected by fast reliable public transportation, with minimal population outside the community. This is so wilderness is easily accessed by all. In this photo, one gets the sense that residents of this linear city can walk to the lakeside within a few minutes, but also note the artist deliberately keeps the area on the other side of the linear city dark. Apparently these are wilderness or agricultural areas. Residents live in a dense, high-tech world, with wilderness at their doorstep.
Figure 25 shows a conceptual Soleri linear city at night.

Figure 26: Linear City, Kim 2012

Figure 26 shows a conceptual Soleri linear city during the day.

Figure 27: Soleri Mega-Linear-City Concept: Helicopter View

Figure 27 shows a conceptual Soleri linear city from the side. The emphasis on wilderness preservation is apparent.
Figure 28: Linear City, Side View (Kim, 2012)

Figure 28 shows a conceptual Soleri linear city from the side.

Figure 29: Linear City Up-Close (Kim, 2012)

Figure 29 shows the interior of a conceptual Soleri linear city. Note the focus on greenery, water supplies, and the integration of railways and residential areas while maintaining a sense of openness.
4.4 Decision-Making on Mega-Projects

This section is a literature review of a collection of papers, edited by Priemus, Flyvbjerg and van Wee in 2008. Their book is called *Decision-Making on Mega-Projects: Cost-Benefit Analysis, Planning and Innovation*.

The key theme of the book is that mega-projects are big business, and where big money is involved, the worst in human nature can often be found. The way most projects are built is that construction companies decide what they want to build based on their capacities, and then they hire consultants to underestimate costs and overestimate usage. They have friends in government who enthusiastically push the project from within the bureaucracy. In other words, they start with a solution and go in search of a problem.

The greatest risk to making good mega-decisions, ironically, is that few people feel qualified to be involved in such decisions. Evidence indicates that mega-decisions are more commonly made in a semi-corrupt bureaucratic system where skilled communications specialists and deft politicians provide the distraction needed to keep the public confused and docile.

In decisions on infrastructure, there is a long tradition of construction companies and consultants deliberately underestimating costs and overestimating usage. These factors effectively render greenfield infrastructure forecasting irrelevant.

In engineering models, there are very complex models that can draw on a number of quantitative systems to develop high-quality forecasts. The actual models are useful only in the region for which they are tailored. These models are proprietary and are closely guarded by their owners, which creates opaque processes vulnerable to the abuses described in the previous theme.

Actual decisions on mega-infrastructure, or more closely to the point of this thesis mega-wayleaves, are not much more complex than more everyday examples of significant investments. They are just much bigger, and have more parts, which can be broken down and assessed piece by piece.

The main casualty of this is the death of good projects, that actually would have been tailored to the needs of the region, for which costs, usage, and risks/benefits were honestly reported. Not only are the ‘white elephants’ a waste of money, their real cost is at least double, as every infrastructure dollar misspent is a dollar not available for something useful; also, in the wasted opportunity of building a better life for all and giving stronger morale to the people. In addition, these white elephants build a body of radical ‘BANANAs’ (an acronym for ‘Build Absolutely Nothing Anywhere Near Anything’) who assume all projects are corrupt and actively oppose everything, including good projects.

Priemus et al. recommend that the solutions to this state of affairs lie in better planning processes before projects are built and in open discussion of the cost and
usage forecasts that have been prepared. The book also provides review of the forecasting model tools available to planners. These tools are mainly focused on broad decision-making.

4.4.1 Project Decisions Often Made in Advance of ‘Planning’

The introduction by the lead editor summarizes the main points of the book,

... “Mega-project ideas frequently originated in the public sector and were then ‘sold’ to prospective constituencies. Even when the initial impetus came from private groups, energetic and skillful public-sector leadership was still required in most cases to widen the base of public support, mollify critics, secure resources at higher levels of government and generally manage conflict”. -p. 12

In essence, presented is evidence that a large part of consulting is a sham. Numbers are fudged and social support is created for projects that the proponents cynically know will have limited positive impact. At the same time, the flexibility with truth is used by opponents of projects. The victims are society in general and good projects in particular. The next section discusses this in some detail.

"The most effective planner is sometimes the one who can cloak advocacy in the guise of scientific or technical rationality...Risk is not a result of error but of misinformation. The consequence is a Machiavellian make-believe world of misrepresentation. which makes it extremely difficult to decide which projects deserve undertaking and which do not. The result is, ... that too many projects proceed that should not. One might add to this observation that many projects don’t proceed that probably should have, had they not lost out to projects with ‘better’ misrepresentation”. -p. 216

4.4.2 Exaggerated Forecasts Are the Norm

The editor summarizes the aspects of corruption related to mega-projects. The key finding is disturbing:

“Strategic behavior is found to be a major cause of the underestimation of the costs and overestimation of the benefits of possible new infrastructure projects” p. 48

The consistency of failures of forecasts indicate that forecasting is a fine art, but that consultants make the changes necessary to help the project be approved. A statistically-valid sampling of the accuracy of cost and use forecasts for about 258 completed mega-projects, mainly in the West, revealed extreme and consistent levels of white-collar crime.

“......in 9 out of 10 cases, the costs of mega-projects are underestimated...The actual costs for rail projects are, on average, 45
per cent higher than the projected costs. The differences are so great and so consistent that it is possible to rule out the likelihood of coincidence...incorrect information can lead directly to squandering of taxpayer's money...”

“...Forecasting accuracy appears to be constant over time and space. Estimates of travel demand have not improved for 30 years, cost estimates and overruns not for 70 years... Cost underestimation and benefit overestimation are used strategically to make projects appear less expensive and more beneficial than they really are in order to gain approval from decision-makers to build them.”

“...this does not bode well for political decision making...governments and parliaments base their decisions on deliberately fabricated incorrect information...It is highly risky to rely on forecasts of travel demand and cost in developing large transportation infrastructure schemes” pp. 7-17, 200-235

4.4.2.1 Need for Transparency

The authors of the book make a case that the only way to ensure that project costs and usage are accurately forecast is to open up the models to outside criticism during the planning process and to hold the creators of false forecasts to financial and/or criminal account. However, industry practice is to closely guard the details of the complex models that are built at considerable cost (and then filled with exaggerated data).

“Greater efforts should be made to explain the planning methods to a broad expert audience. Secrecy about forecasting methods, modelling assumptions, model selection criteria, and, in particular, the determination of planning objectives, can make people suspicious of planning outcomes...Even if the quality of a planning process is beyond reproach, it is not always certain that the outcomes will be directly translated into political decisions and then implemented...There is also a dire shortage of reliable and competent ex-post evaluations.” p. 49

By creating a transparent decision-making process, in theory, false forecasts will be weeded out, and projects will be tailored to regional needs and thus far more likely to be successful. The authors also argue that by strategically leveraging the consultation process, organized opposition can be avoided. There remains the problem of the BANANAs, who will oppose all projects positionally or on principle. The authors describe 4 categories of the public that tend to be opposed to megaprojects (p. 225). The first two have legitimate concerns:

1. Potentially affected residents who try to stop the project because it might prove detrimental to their living conditions.
2. Green organizations, which fight for a minimization of environmental disturbance.

The second two do not:

1. Land owners who resist as long as possible, in order to maximize the compensation that has to be paid for the loss of property.
2. Radical groups that fight against any big projects (aka, Greenpeace, Tides).

The recommended strategy is to integrate the first 2 groups as soon as possible into a planning process, in order to incorporate their input, thereby reducing the power of the two opponent groups.

“Momentum is built by imagining concepts, promoting legitimacy and selling a project configuration such that partners, affected parties and governments accept what is proposed. Risk seminars and decision conferences are used to shape the value proposition and identify risks. To ensure that investments are protected against opportunistic behaviours, risk-sharing agreements will be developed.” p. 215

Even for legitimate projects, some marketing and strategization will be needed to overcome opposition. The main tool here is branding, providing opportunity for political leaders to enhance their career by supporting a project.

4.4.3 Need for Alternatives Assessment in Early-Stage Planning

All the papers in the book were universal in stating the need for problem definition before projects are designed and built, so that they can be tailored to the location in which they will be built. As summarized by the book:

“Mega-projects are high-stakes games characterized by substantial irreversible commitments...and high probabilities of failure...The journey from initial conception to ramp-up and revenue generation takes ten years, on average. While the ‘front end’ of a project – project definition, concept selection and planning – typically involves less than one-third of the total elapsed time and expense, it has a disproportionate impact on outcomes, as most shaping actions occur during this phase. ...The seeds of success or failure of the individual projects are this planted early and nurtured over the course of the shaping period.

“Often, in the earliest phases, we see lobby groups hard at work mobilizing support for a particular solution that is thought to be superior. Feasible alternatives are not even put forward. pp. 5-7

“Often, in practice, it is much more difficult to define alternatives...It takes vision and a design approach to come up with options that are unlikely to occur to players with no imagination...mega-projects follow a dynamic, iterative and - often - chaotic course, which should be
reflected in project-management architectures. This does not, however, dispense with the need to conduct a proper problem (and a risk opportunity) analysis in the start phase and to formulate and flesh out alternatives from the earliest stages.

“Sometimes a mega-project is the solution, sometimes it is the problem.”
-p. 115

In addition, “Project alternatives are often not compared on a lifecycle basis” -p. 49. Meaning that when alternatives are undertaken, they are not reviewed from the context of the full project cycle.

### 4.4.3.1 Alternative Assessment Models

The need for appropriate alternatives assessment is central to successful outcome of major projects, arguably even more so than transparency.

The first and most common form of alternatives assessment is Cost-Benefit Analysis (CBA). CBA renders all impacts of a project into dollar terms, and then compares pros and cons. This is the most commonly-used system for decision-making system, but it is poor at mega-projects as it cannot adequately factor in indirect effects, externalities, economic agglomeration multipliers, the importance of major decisions over the very long term (when discount rates reduce the importance of those decisions to near-zero), and of course social and environmental costs and benefits.

“Basically CBA is an overview of all the pros (benefits) and cons (costs) of a project. These costs and benefits are as far as possible quantified and expressed in monetary terms. But this is over-simplified in real world terms. There is far more debate about the indirect effects (effects additional to the direct effects due to a reduction in generated transport costs) and environmental effects... reason for the popularity of CBA is the often-assumed ‘neutral’ characteristics compared to its main competitor: multi-criteria analysis (MCA). In MCA effects are presented and weighed using weights per effect. Setting the weights is not at all value-free. It is therefore much easier to manipulate the final outcomes of an MCA compared to a CBA. However, CBA is not completely value-free either...Nevertheless, there is a broad consensus that CBA is much more value-free than MCA.” p. 41.

The next model focuses on interaction of land use and transportation. The next model focuses on interaction of land use and transportation. This is not a popular model, as it is very difficult to accurately predict all the land use effects of transport investments, and multipliers are usually unknown.

“using a land-use and transport interaction (LUTI) model would allow the researchers to indicate the land-use changes resulting from
transport changes, and then the related economic, social, and environmental impacts. We realize that a reliable LUTI model is often not available.” p. 50.

The third model attempts to be comprehensive, and is a form of MCA.

“HEATCO (a University of Stuttgart model, short for Harmonized European Approaches for Transport Costing and Project Assessment) provides guidelines for such projects with respect to decision criteria, the treatment of non-monetized impacts, the project appraisal evaluation period, the treatment of future risk and uncertainty, discounting, intra-generational equity issues, no-market evaluation techniques, value transfer, the treatment of indirect socioeconomic effects, marginal costs of public funds, and the producer surplus of transport providers. ...it elaborates on the value of time and congestion, the value of changes in accident risk, environmental costs, and costs and indirect impacts of infrastructure investments.” -p. 55.

A last model, reference forecasting, is perhaps the simplest, and in the author’s opinion, the most reliable. Take something similar that has been done before, and find out what it cost once it was completed.

“Reference class forecasting consists in taking a so-called 'outside view' on the particular project being forecast. The outside view is established on the basis of information from a class of similar projects.” -p. 134.

Usage of these four possible models requires understanding of a number of factors, which are described below:

1. Cost. “Without a price, demand tends to be limitless” (p. 110).
2. Network Effects, which look at the complex interactions of all modes on an infrastructure network and not just the proposed new construct.
3. Indirect Effects, which are created by the users and secondary economic activities associated with new infrastructure (closely related to externalities). For example, congestion, accidents, and pollution. “Indirect effects can be positive or negative” (p. 60). And unfortunately,

   “As [indirect impacts] estimate requires a substantial extra analysis effort; these impacts are seldom taken into account.p. 59

4. Discounting. The Net Present Value (NPV) function tends to make costs and benefits that will occur more than 25 years in the future so small as to be negligible to the decision at hand. However,

   “A problem with discounting is that benefits or cost in the very long run hardly have any impact on the outcomes. Intuitively this does not
always seem to be correct….argument for tapering of long-term benefits.” p. 52.

A classic example of this is establishing a wayleave for infrastructure long before said infrastructure is needed. Issues of failing to do this are legion around the world; recently the City of New York is looking at spending over a billion dollars for the space for the entrance and access ramps of a new tunnel to New Jersey. The required surface area for these works is relatively small, perhaps a hectare or two, but acquiring the land through expropriation is the driving cost. Preserving this land in the year 1850, when it was becoming clear that the New York Metropolitan Area would grow to great size, would have been a minor cost at the time. But using NPV for a CBA in 1850 would have utilized property values at the time and shown that preserving the space for the tunnel access ramps was not the most profitable solution.

5. Economic Multipliers. Related to network effects and indirect effects, refers to how much a piece of infrastructure is likely to cause overall economic expansion. For example, the construction of the Canadian Pacific Railway (CPR), 150 years later, led to a chain of settlement and the creation of 4 new Canadian provinces with a total population of ten million. Such multipliers are of course extremely rare, but this example shows how unpredictability plays a major role in major investment decisions.

“Models that show economic effects outside the transport sector can have different theoretical backgrounds” p. 59.

A major weakness in multiplier calculations is that there is a lack of research on the impacts of improved freight transport on the overall economy. Indeed, in West Africa, the lack of reliable freight transport is frequently cited as the primary reason that primary and secondary industries of scale have rarely taken root. Without this process methodology, it is simply not possible to predict the economic impacts of major new infrastructure.

“Freight transport is an important determinant of welfare, competitiveness and social equity. The evaluation instruments (models) needed to assess the impacts of freight transport policy in these dimensions are usually inadequate or unavailable.” p. 58.

6. Agglomeration Effects. These are a form of economic multiplier that relate more to the economic activity likely to be encouraged along new infrastructure and especially at new interchanges. These are more predictable than broad-scale economic multipliers.

“…better transport reduces transport costs, which influences the advantages of agglomeration. Agglomeration effects refer to advantages of economic density, which may or may not yield additional benefits in CBA. The consequences of agglomeration are well known, but
its causes, its specific nature, and quantitative relations are not...Secondary, intensive use of land reduces urban sprawl and makes it possible to preserve open spaces. In CBA, the valuation of open space is still a challenge, because not only the agricultural value of land is important, but also its recreational use and external effects. The third issue is related to rail. Rail is a ‘land-use-efficient’ transport mode, compared to road transport...” p. 50.

7. User Experience, Including Reliability of Transport Mode. Given the choice, and all other factors being equal, almost everyone would rather take a metro line than a bus, due to the higher likelihood that the metro will get to its destination without delay.

“Research shows that the negative value of unreliability is roughly in the order of magnitude or at least a substantial percentage of the negative value of travel-time losses due to congestion.” p. 52.

The author can describe a good example of this. The City of Toronto recently spent a great deal of money on a shuttle rail service between the international airport and downtown (each respectively the largest in Canada). The rail service is losing a great deal of money and is almost always empty. Why? It runs every ten minutes and is reasonably costed. The author’s visit revealed the answers: no systems for getting from car or taxi to the train, no system for dealing with luggage (not even luggage carts), unhelpful and unknowledgeable staff, very poor signage, and a minimum 500m walk from the nearest road through a complex building to the actual trains, with poor signage compounding the difficulty.

The small things make a big difference on colossal projects. Implementation and attention to detail can make or break a project.

The assessment of all possible alternatives must be made with at least these factors in consideration.

4.4.4 Moving from Project Management to Process Management
The key takeaway from Priemus et al’s Decision-Making on Mega-Projects is that projects must be designed to be flexible and adaptable. Circumstances change even during construction, and clever design can both save a project and protect it from irrelevancy. Especially in the case of West Africa, where there are so many unknowns, where corruption remains a very real threat, and economic and social opportunities abound, flexibility must be the beginning and end of the ECOWAS corridor.

“The process followed by a mega-project can be likened to a series of learning curves in which new, cutting-edge ideas are constantly casting
a new light on the solution. An Echternach procession (two steps forward, one step back) may creep in from time to time and decisions may end up being taken more than once. p. 115.

“Uncertainty or volatility may actually increase the value of a project as long as flexibility is preserved and resources are not irreversibly committed. p. 146.

“Selected projects are not selected but shaped...Successful sponsors...do not escalate commitments, and they abandon quickly when they recognize that projects have little possibility of becoming viable. p. 164.

The wise planner will assess the situation and so structure data and contracts to ensure legitimate concerns are heard, that finances do not encourage false forecasts, and that the project is as adaptable as possible.

4.4.5 Discussion: Applicability of Models: American, European, or African-Style Transport

Any sort of traffic forecasting model used in Africa has a poor chance at best of making successful predictions. The economy is too dynamic, too fast to take advantage of every possible source of income. The culture is quickly changing. There is enormous latent demand for locally-manufactured products and local agricultural produce...create the right situation and things will proceed with extreme rapidity. If a model is wrong, which is likely, a construction work will languish from lack of morale and likely fail if it makes it to completion. There is also enormous latent frustration with how slow existing transportation systems are. Get something fast, reliable, and culturally appropriate, and it will draw very high levels of use.

For example, traffic forecasting in Britain has proven non-reliable, in large part because of inability to account for 'soft' resistance to many major works and a lack of attention to user experience; while in France, where there is popular support for national projects and also close attention to end user experience, forecasting is usually highly accurate.

The decision is as much political as economic. If anything, it is a collective decision of the body politic on how Ghana should be built, because indeed the ECOWAS Corridor (or corridors) is a nation-building exercise.

To date, the British-built railway system in Ghana has languished, while the American-style (sometimes American-built) multilane highway system is generally clogged. Africans do love their cars, and they will use their minibuses to excess while public buses, which are perceived as dirty, hot, and unreliable, remain almost empty. Security is a major factor in transportation decisions...either being in one’s own car or packed in with many strangers in a small bus are both ways to be safe.
The literature is almost universal in its focus on the use of small retail markets to make projects succeed or fail in Africa. If markets have a place to operate, they will prevent crime, bring people together, and provide rents. Fail to do so, and the markets will come anyway, using squatted land and encroaching on wayleaves. Infrastructure investment in Africa must be according to an African mindset. Trains and buses need to be safe; luggage needs to stay near its owner; there must be space for salesmen to hawk their wares on trains.

With the example of the rapid adoption of cellular technology, which bypassed the development of phonelines, the question may be asked whether should Africa adopt advanced transportation systems and bypass the development of extensive conventional rail and/or road systems. These and other questions reinforce the need for flexibility in the ECOWAS Corridor.

**What are the factors that will likely lead to successful infrastructure investment in West Africa?**

#11. The forecasting models used for many infrastructure projects will not work in West Africa due to:

- lack of appropriate statistical data,
- the models have not been tailoured to the West African socioeconomic situation (which is something of a trial-and-error),
- West African traveler tastes and preferences are not clearly understood and categorized. These factors have been shown to make or break transportation projects.
- the socioeconomic and cultural situation is changing rapidly and unpredictably, making any quantitative model difficult or impossible to effect, and
- these models are more frequently than not manipulated so that the project that is the most profitable for the construction company appears to be the best.

#12. The infrastructure wayleave must be designed to be highly adaptable over the long-term. As a nation-building project, there needs to be genuine national interest and support at the grassroots. West Africa has a grand tradition of community meetings, consensus-building, and excellent public speaking. These may be its strongest assets in leveraging future major development.

### 5 Success Themes and Factors

Through a combination of literature reviews, interviews, and personal observations, below are listed all the factors that will likely lead to successful infrastructure investment in West Africa.

#1. The corridor must be capable of handling enormous traffic loads, as the metroplex may end up having a population over 100 million.
#2. In West Africa successful projects incorporate small-scale retail. These will improve security, by putting eyes on the street; and also allow for upward-mobility by creating ample entry-level business opportunities for unskilled workers on an emerging trade corridor.

#3. To maximize the economic multiplier effect of an interurban infrastructural wayleave, there must be allowance given in the design for provision of utilities along the route, as well as local feeder roads.

#4. Land tenure within and beside the wayleave must be secure. Government needs to ensure that lands are secured, and all alternative claims are legally, categorically, and forever extinguished through compensation, contract, and legislation, before selling or leasing those lands to investors.

#5. Since LUSPA cannot enforce consistent application of planning strategies on regions, cities, or districts, a major interurban infrastructure wayleave must be designed and implemented at the national level with oversight from the Executive.

#6. The ECOWAS corridor must also be designed as an ecocorridor and for the transportation of agricultural produce (which is often not a suitable user of motorways due to risk of creating flying debris).

#7. Business parks, industrial yards, and agricultural lands should be adjacent to the wayleave and also have secure land tenure. These will come to rely on the new infrastructure, and in effect create a linear development corridor.

#8. The two ways government can help are to create the legislative and jurisdictional matrices that will foment the most promising high-end unique sectors in West Africa, while simultaneously not creating a subsidization program, thus leveraging the full potential of the free market.

#9. Future growth nodes along the ECOWAS corridor should be identified and encouraged through local autonomy. In most cases, these will involve restructuring the jurisdictional divisions of existing small towns. Opportunities for these smaller places to grow, directly at the expense of continued growth of the existing large cities, should be pursued by local, regional, and national authorities.

#10. The infrastructure corridor may be thought of as a future linear city in its own right, and not just a link between other cities.

#11. The forecasting models used for many infrastructure projects will not work in West Africa due to:

- lack of appropriate statistical data,
- the models have not been tailored to the West African socioeconomic situation (which is something of a trial-and-error),
- West African traveler tastes and preferences are not clearly understood and categorized. These factors have been shown to make or break transportation projects.

- the socioeconomic and cultural situation is changing rapidly and unpredictably, making any quantitative model difficult or impossible to effect, and

- these models are more frequently than not manipulated so that the project that is the most profitable for the construction company appears to be the best.

#12. The infrastructure wayleave must be designed to be highly adaptable over the long-term. As a nation-building project, there needs to be genuine national interest and support at the grassroots. West Africa has a grand tradition of community meetings, consensus-building, and excellent public speaking. These may be its strongest assets in leveraging future major development.

The author distills these points down to 4 primary themes:

1. **Flexibility and Reliability.** The proposed solution needs to be able to adapt to changing circumstances and a growing population and economy. Additionally, the reviews of the quantitative forecast models have indicated that no results from these models may be considered reliable. An ECOWAS multimodal wayleave must be able to adapt to the unexpected, and to adapt to enormous on-going change.

2. **Personal security and security from squatting or false land ownership claims.** The first is derived by incorporated residences and small businesses into every aspect and every location of the wayleave. The second is perquisite to the first: when the government expropriates the land for a new right-of-way, it must immediately compensate the former owners fairly, re-subdivide the land and dispose of it quickly using a fair and transparent process.

3. **LOCAL.** Must be built for real people but supported by the Executive, meaning those who are financially limited, or handicapped, or old, or young, or sick, or in need of personal security. The project must be actively supported at the Presidential level, with detailed design by local expertise and much consultation.

4. **Must have potential capacity for enormous amounts of freight and passengers and be multimodal.**

### 6 A Wayleave Design for West Africa

The first portion of the research question, “**What are the factors that will likely lead to successful infrastructure investment in Africa?**” has been answered in the previous section.
The next part of the research question is “what might an infrastructure wayleave look like at a conceptual level once those success factors are applied?” This section approaches this question with a hypothetical solution.

Considering the long history of failed or fraudulent projects in Africa, it is necessary to contextualize any recommendations with humility. There are no simple solutions, and ultimately the people of Africa will define their success, and then succeed or fail. Interviewees have stated that African Development Bank should be the anchor for the ECOWAS corridor, to ensure a thorough work and business plan is implemented and not just a wayleave in name only.

### 6.1 Logistical Considerations

Development of a multi-modal ECOWAS Corridor would by necessity be phased, with the width of the corridor comprising the sum of the necessary widths of all the modes, and the turning radius set by that mode with the widest requirement.

For required wayleave width, Table 3 presents a general guide. The information source for this is the author’s experience in planning for Transportation and Utility Corridors (so-called ‘TUCs’) in central rural Alberta.

Table 3: Modal Factors

<table>
<thead>
<tr>
<th>Mode</th>
<th>Approximate Wayleave Width Requirement</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-Lane Expressway with Express Lanes</td>
<td>Up to 0.5km</td>
<td>Canadian rural standards for wayleaves tend to be extremely large. The TUC around the City of Calgary is between 750m and 1km wide. However, in the City of Toronto, the 20-lane Hwy 401 fits within a 250m corridor.</td>
</tr>
<tr>
<td>6-Lane Divided Freeway</td>
<td>Up to 250m.</td>
<td>In Vancouver, the 8-lane TransCanada highway is 70m wide, with a concrete barrier between lanes. In suburban Vancouver, there is no constructed barrier, but alternative directions are separated by an unused strip 25m wide, with the wayleave being a total of 125m wide, which uses 9.3 hectares per route km. One portion of Highway 45 between Mexico City and Queretaro is interesting: opposing lanes split far enough apart that the entire village of San Francisco, which is a suburb of Rinconada de San Juan, is inside the freeway. There are almost 600 meters between the opposing traffic direction. The village actually seemed a clean and tidy place, and felt very safe. Traffic was far enough to keep the noise down, while there was a sense of security created by knowing that a constant stream of cars was able to see every part of the community. In some parts of West Africa, portions of infrastructure may work better being far apart than close together.</td>
</tr>
<tr>
<td>2-Lane Highway</td>
<td>Up to 100m.</td>
<td>20m-50m is typical.</td>
</tr>
<tr>
<td>2-Lane Roadway</td>
<td>Up to 50m</td>
<td>10m-25m is typical. May also be designated or used by animal-drawn carts.</td>
</tr>
<tr>
<td>2-Lane Service Road</td>
<td>Up to 40m</td>
<td>8m-20m is typical. May also be designated or used by animal-drawn carts. May be tied into a system of retail or business locations to be strung along the length of the corridor.</td>
</tr>
<tr>
<td>1-Lane Patrol Road</td>
<td>Up to 30m</td>
<td>4m-10m is typical. This is often unpaved, and is used by service staff for maintenance or emergency access.</td>
</tr>
<tr>
<td>Freight Rail and Intercity Standard Rail²</td>
<td>Up to 25m for double track</td>
<td>Low speed trains can be placed immediately adjacent to other modes. A 25m corridor will normally be wide enough to allow for a service/patrol road next to the rail line. Freight trains are heavy and slow, although turning radius can be very small at low speeds. Freight trains and HSR do not work well on the same tracks.</td>
</tr>
<tr>
<td>Commuter Rail and Light Rapid Transit or Bus Rapid Transit</td>
<td>20-25m for double track</td>
<td>These modes usually require security against encroachment or vandalism, and therefore often may be clustered with HSR. They are often not heavy enough to protect them from being knocked over by the pressure wave that precedes HSR trains.</td>
</tr>
</tbody>
</table>

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² Obeng-Odoom (2015) argues that the colonial rail system in Ghana fell out of favour with the Ghanaian elite in the 1960s and 70s and was actively allowed to decay. This was in part because the system was designed only for the export of raw resources, not for encouragement of a domestic economy, and because of Western (mainly World Bank) belief that railways were out of date and roads were the way forward. The result in Ghana today, according to Obeng-Odoom, is the non-functioning railway system and a vastly overloaded road system. He also mentions that cycling has better cultural acceptance in northern Ghana than southern. There are 1300km of railways and 947 of wayleaves for rail in Ghana.
Putting all the modes together in the single ECOWAS corridor would result in a corridor a total of between 500m and 1km, depending on the mix of uses required along different portions (for example, an expressway will not have to be 20 lanes wide the full distance from Abuja to Abidjan, and light rapid transit is likely only to be needed within 50km of the largest cities in the metroplex).

The core multimodal corridor should be surrounded on both sides by free title lots, sold by the government, and unencumbered by stool regulations. This would create, in effect, a linear Special Economic Zone.

It is apparent also that any ECOWAS multimodal corridor, if constructed, would best be built from the outside in, with the slower, less expensive modes being built first, and the faster, more expensive modes being built last near the centre of the wayleave.

There is an issue of existing railways in Africa having different gauges. Most new railways are intended to be built at standard gauge. ECOWAS should come to an agreement on which gauge should be used for the whole corridor, and spurs.

### 6.1.1 Urban and Suburban Considerations

In suburban areas, the multimodal concept would be revised. Farmsteads would instead be residential areas, there would also need to be commuter rail, and HSR would need to be on viaducts to ensure the security of the line. Figure 30, from UIC, helps describe this mix of high speed and local rail service.

<table>
<thead>
<tr>
<th>Pipeline</th>
<th>20m for double line</th>
<th>Will typically be buried, with a service road paralleling the pipeline.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bikeway</td>
<td>Up to 10m</td>
<td>2m-4m is typical. Lightly-used bikelanes may be only 1m wide, while those with heavier traffic requiring a separator line must be at least 2m wide, preferably 3m (1.5m per direction)</td>
</tr>
<tr>
<td>Ecological Migration Corridor</td>
<td>Dependent on Ecological Targets</td>
<td>In West Africa, the author is not aware of any species that require on-land migration corridors that parallel the coast; however, there are few remaining wild macrofauna in the area. More likely, certain bird species would benefit from having a string of safe nesting and feeding sites. This must be balanced against the spread of undesirable creatures, such as rats or poisonous insects. In Ghana, the planned network of ecological corridors in many cases parallels future infrastructure. Hence rivers and greenways are likely to be essential parts of any multimodal infrastructure corridor.</td>
</tr>
<tr>
<td>Storm Drainage Line</td>
<td>Dependent on Engineering Specifications</td>
<td>West Africa has periodic torrential rains in isolated locations. The ECOWAS corridor must take this into account.</td>
</tr>
<tr>
<td>Canal or Water Main/Fibreoptic Cable</td>
<td>Dependent on Engineering Specifications</td>
<td>Canals are wider and less expensive to build than mains, but cannot keep water potable. They are therefore more useful for agricultural purposes. Buried water mains can be very narrow, are expensive to build, and can keep water potable. In Ghana, many of the proposed ecological corridors parallel a river, and also parallel preferred routes of new infrastructure. So canals may not be needed, just bulk water supply from the nearest river and some manner of treating wastewater.</td>
</tr>
<tr>
<td>Electrical Lines</td>
<td>Variable</td>
<td>Can typically be placed above other modes</td>
</tr>
<tr>
<td>Market Corridor</td>
<td>Depends on Market</td>
<td>Provides space for market stalls along the corridor, plus egress by retail vehicles and shoppers.</td>
</tr>
<tr>
<td>High Speed Rail</td>
<td>100m (if isolated)</td>
<td>HSR tracks are not like conventional rail tracks. They are built to a much more robust standard due to the pressure wave that precedes the trains, and curves are usually banked. HSR is narrow, but at 300km/h+, the trains create a strong wind blast up to 15m on either side of the train. It must either be separated by other modes (except standard-speed trains) by this distance, or a concrete air pressure barrier must be constructed. In multi-modal corridors, this can be addressed by placing the HSR designation between two compatible other modes, such as ecological corridors, pipelines, or other railways. Current High-Speed Rail technologies, which bank the track at an angle along curves, require between 4km and 6 km turning radius for 300km/h trains, and 7km and 10 km turning radius for 350km/h trains. Switches between HSR tracks must usually be 250m long, which limits trains to about 220km/h at switches. HSR and Expressways can be complimentary in terms of speeds and turning radii. Additional information on HSR in Appendix F.</td>
</tr>
<tr>
<td></td>
<td>30m (if placed between compatible modes)</td>
<td></td>
</tr>
</tbody>
</table>
In urban areas, the multimodal corridor in most cases will need to break apart into its constituent components, each responding to the unique situation presented. This is a major reason why the wayleave should be established well in advance of urban development, so that it can take on its ideal form. However, in many cases, near the downtown areas, HSR trains will have slowed down enough that they can share an elevated track with commuter rail, which also creates space for ground-based LRT systems. Figure 31, from UIC, shows this graphically.
6.2 Conceptual Design of a Major Interurban Infrastructure Wayleave for West Africa

Taking into consideration all the factors and themes listed in Section 5, plus the logistical requirements listed in the previous section, the author now proposes a wayleave tenure design in response to the second part of the research question.

The author’s suggested wayleave design is based mainly on leasing land that is not immediately needed for infrastructure, to local people. These landowners would use the land for household food production, and prevent squatting, in the years or decades in advance of construction. The cadastral (land tenure) layout is also set up so that the corridors allocated for different transportation or utility modes would continue to serve residences, businesses, and industries after build-out. Also, the positioning of households and businesses will act to prevent crime, by perpetually keeping the eyes of microbusiness owners on the street.

Finally, thought is given to what modes should be placed next to one another, or kept separate. In the case of multilane highways, service roads must be included.

The end result is a multimodal corridor with a cadastral layout that looks something like that in Figure 32. The author made this image.

Figure 32: Conceptual Cadastral Layout of 250 metres of a 1km-Wide Portion of the ECOWAS Multimodal Corridor

In Figure 31, the black lines are the cadastral layout (the lot lines). Light green denotes lots that are for farming (or households) and will permanently remain for farming. The other coloured strips denote corridors for one or another future transport or utility mode (one set for each direction). The farm (or household) would lease the neighbouring small squares of property, each square being a short section of the wayleave for a particular mode. So for example, the farmer who owns the long narrow farm property on the top left of Figure 31, would also lease the brown, blue, orange, grey, and red squares immediately to the right side of his farm. These leased squares may only be used for annual crops-no multiyear structures. As new modes of infrastructure are built, the area s/he has available...
to farm would gradually diminish; however, s/he will have years or decades to build up roadside business, or farming operations, or other income generator, that will more than make up for the loss of the plots of land that were once used for annual crops. This presence of landowners creates the security and stewardship of the entire wayleave system.

This system keeps space secure for multiple modes, while allowing decisions to be made in the future on which modes will be built, and in what order. The point here is the wayleave system is flexible.

This approach is designed to protect wayleave land from squatting, to build a resident population right into the corridor in order to keep crime low, and to allow for multimodality, which in turn creates reliable access to the transportation, services, and human resources needed.

Figures 33, 34, and 35, drawn by the author, take half of two rows of the concept laid out in Figure 32, and describe graphically how land use would evolve in sync with the development of the multimodal corridor.

**Figure 33: Envisaged Initial form of the ECOWAS Corridor**

![Figure 33: Envisaged Initial form of the ECOWAS Corridor](image)

Figure 32 represents one-half of the conceptual corridor, from the left side to the middle. The other half would be a mirror reflection, from the right side of the image and extending off the page to the right.

Someone flying over the wayleave directly from the left, would first pass over ~0.4km of farms. These farms may be planted with annual or perennial plants or both. Each farm is 25m wide, and so 1 hectare in size total. The flyer would then pass over 2 rows of trees with a fairly wide open space between them, and then a side space wherein farmsteads were under construction. The two treed strips mark either edge of a future canal.

A small dirt road marks the boundary between the land of a farmsteader who has stewardship of the land and responsibility to prevent squatting, and a homesteader whose livelihood comes from both retail and gardening. On the other side of the road are spaces for market stalls, then two lines of trees that mark the
future bikeway, a line of homes, another line of trees, and then an area of annuals. This last area is the space for the future freeways and railways.

Continuing, the flyer would move off the right side of our page, and see everything just described, but in reverse.

Between ten and thirty years later, our flyer will see that things have changed considerably (Figure 33). The trees have matured, the canal has been dug, the dirt road has been paved, and a conventional railway and a 4-land divided highway have been built. Traffic along the newly-paved farm road is maintaining a continuous line of retail shops, whose owners appreciate their proximity to their homes and their gardens as well as the accessibility of living within an emerging transport corridor. Much of this traffic is generated at the industrial nodes that are being developed at the major intersections of the ECOWAS corridor, roughly every 5-10 km. The farmers do not appreciate the need to maintain rope-based footbridges over the new canal, but do appreciate the secure source of water for their farms and having enough land to feed their families. The narrow farm lots provide security by keeping their farmsteads close to their neighbours.

Figure 34: Envisaged Partially-Complete form of the ECOWAS Corridor

A half-century or so after the initial visit, our flyer will see that the ECOWAS corridor is at build-out (Figure 34). Multilane super-highways as well as side service roads, and high speed rail service now complement the conventional rail line. A bikeway has been established between the homesteads and the market stalls—a very pleasant route that for its full length has established homes on one side and market stalls on the other, while it is fully roofed by the mature trees. It is possible to bike for hundreds of kilometres under tree cover, and shop the entire time. The concept of the 'Market Way' is untested, but may be consistent with West Africa cultural-economic systems. The thought is that the Market Way would become the centre of the life of the multimodal corridor; as well, bringing civic life to act as protection against squatting and criminal activity.
Parking areas exist along the line of markets, and tourism buses make frequent stops. These active markets make up for the loss in agricultural income to the homesteaders that occurred as the highways and railways were built. The farmsteaders have sold their homes on one side of the canal for construction of apartment buildings, setting up on the other side of the canal their quieter new homes. Their small farms provide needed products to the larger farms located further from the corridor, although some farmers still prefer roadside sales. Fish in the canal also provide some sustenance.

Figure 35: Envisaged Final form of the ECOWAS Corridor

Cross-sections of the built-out ECOWAS wayleave follow in Figure 36. The text in the image below explains the conceptual land tenure situations for different parts of the corridor. Unused infrastructure land would be leased for food production from annual plants until construction occurred.

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Some farms may devote some of their land to energy production. 1 hectare solar panels to produce about 1MW. This equates to 5km of 2m wide solar panels. So each HSR trainset (40MW) would require 200km of trackside solar panels. But when the Khamsin storms come in December, all the solar panels will need twice daily cleaning. So consider microgeneration where households can sell solar power to the grid, and get paid for the amount of power produced so they have financial incentive to keep the panels clean.
Figure 36: One-Half of a Hypothetical Rural Multimodal Corridor

Purple Lots: Fee-simple farmland. The farmsteader will own space for his house on one side of the canal and the farm immediately on the other side of the canal (although he may build an additional shelter for family and paid help on the far side).

Orange Lots: Owned by Government, Leased to Farmsteader. Requirement to allow no permanent structures, prevent squatting, plant no perennials (annual crops and grazing allowed). As new infrastructure is built, the government will collect strings of these leased micro-lots. When canal is built, government to build anchor towers every 200-500 along canal so farmsteaders can build and maintain ropebridges.

Government-owned right-of-way. Road to be built immediately upon establishment of multimodal corridor.

Red-Yellow Lots: Owned Permanently by Homeowner, for home and shop. Must agree to help maintain short stretch of bike and walkway that will be built between their home and shop.


Cyan: Owned by Government, Leased to Homeowner. Requirement to allow no permanent structures, prevent squatting, plant no perennials (annual crops and grazing allowed). As new infrastructure is built, the government will collect strings of these leased micro-lots.

Farms

5m Vegetated Buffer/Drainage Swale

15m Canal/Drainage

5m Vegetated Buffer/Drainage Swale

10m Farmsteads

10m Above- and Below Ground Utilities

10m Rural Farm Road

15m Market Way

12m 2-way Bikeway, treed both sides

10m Micro-Homes for Retailers/Land Guards

8m Vegetated Buffer/Drainage Swale

8m Medium-Speed Conventional Rail

15m On/Off-Ramps & Parallel Roads

25m 5-Lanes One Way Highway

5m Service Road and Concrete Barrier

5m HSR One-Way

Midline of Right-of-Way
The following table summarizes how the above concept meets the success themes from Section 5.

Table 4: How Proposed Wayleave Design Meets Ghanaian Needs

<table>
<thead>
<tr>
<th>SUCCESS THEME</th>
<th>HOW PROPOSED DESIGN FITS NEED</th>
</tr>
</thead>
</table>
| **Flexibility and Reliability**                    | 1. Multiple wayleaves packaged together, which may be developed in different orders as priorities and funds change.  
   2. Service road, feeder road, and freight railway are all integrated into the overall plan, allowing for access to all parts of the wayleave.  
   3. Buffer strips help ensure that if one mode fails, it not shut down other modes.  
   4. Anticipated need for major intersection every 5-10km along future multiple-lane highways. |
| **Personal security and security from squatting or false land ownership claims.** | 1. Space for a market stall every 25 metres along full length of service road and bikeway, each market stall associated with a household on a fee simple lot.  
   2. Lots are small enough that most families could afford to purchase and lease. Development starts with gravel access road, which would be used mainly by the new owners; and by eventual inclusion of bike & pedestrian routing. |
| **LOCAL. Must be built for real people.**          | This will require careful implementation and consultation-rich preliminary design which is directly supported at the Executive level of the Ghanaian Federal Government. |
| **Must have potential capacity for enormous amounts of freight and passengers and be multimodal.** | Total proposed width of all modes for the wayleave is minimum 250 meters, which includes:  
   a) High Speed Rail Line in the centre  
   b) Up to 5 lanes of freeway on either side of the HSR, plus two, 2-way servicing roads on either side of that,  
   c) Bikeway with residences and markets on both sides,  
   d) Two, 2-way local roads, each on one side of the wayleave,  
   e) Wayleaves for utilities, drainage, and water supply,  
   f) Appropriate buffer strips. |
6.3 Funding the Overall Program

Although establishing a major wayleave through the future West African metropolex will be unimaginatively expensive and much cheaper if done in the near future, doing the same in the densely-populated urbanizing area of West Africa is still an expensive proposition. More so is building the infrastructure that will one day be within it.

Much of this paper has focused on maintaining the wayleave, by leasing out portions to farmers and retailers who would use the land for personal gain before different infrastructural components are constructed. These farmers and retailers would be able to maintain their financial position in spite of gradually working with smaller and smaller landbases, due to increased exposure to traffic and in some cases through densification.

However, this does not answer the issue of sources of funds for the initial establishment of the wayleave, or sources of funds to build the infrastructure. Typical responses to these challenges would involve international aid, foreign investment, bank loans, private-public partnerships, or even crowdfunding. This thesis will not review these as it is outside its purview. There may however be another model appropriate to this situation, which is called the “asset light model”, used in Malaysia for provision of water supply to most of the country. This model may be similar to the one used by Canada in the 1870s for construction of its first two transcontinental railways, each about 5,000km long, when the population was only about 4 million.

6.3.1 Malaysian ‘Asset Light Model’ For Water

In the asset light model, the federal government of Malaysia leveraged its ownership of water resources through the National Water Services Commission (SPAN). As described by Mr. Thomas Joseph Thomas during a lecture in January of 2019, the differing Malaysian states were provided funds to establish water operations firms, which then build and maintain the infrastructure under the purview of the federally-owned company PAAB, and the federal regulator, SPAN. “Operations” specifically includes maintenance, both long-term and short-term. The states set their rates such that the initial investment is gradually returned to the federal government over a very long amortization.

In the author’s option, too often, the financing model for infrastructure is that the government builds the infrastructure at taxpayer’s expense, or with money borrowed from private banks, and then they leverage the long-term asset by cutting maintenance to a minimum in order to keep costs down. Or alternatively, a private corporation cuts maintenance expenses to artificially inflate the appearance of the return on the infrastructure, in order to increase the resale value.
In effect it appears the Malaysian government monetized the inherent value of a natural resource, loaned that amount out to government agencies at a non-inflated value to build the infrastructure to appropriately access said natural resource, all the while ensuring returns were adequate to maintain the infrastructure into perpetuity while paying the federal government back for the value of the initial natural resource. The result is good water for the population, good infrastructure, stable jobs, economic growth because of reliable infrastructure, and no debt. Because the federal government leveraged its own resources rather than borrowing money, it can hold interest costs to the bare minimum.

This Malaysian financing model could conceivably be adapted to the circumstances of the ECOWAS Corridor Wayleave by using anticipated future value of productive land adjacent to infrastructure. Indeed, Canada experimented with this concept successfully in the 1870s.

### 6.3.2 4 Million Canadians Build World’s Longest Railway in 4 Years

Canada used something comparable to the Asset Light Model in the 1870s to build what became the world’s longest railway, by paying the railway company partly in land. As stated in Wikipedia:

“...an entirely Canadian route would require crossing ... rugged terrain ... To ensure this routing, the government offered huge incentives including vast grants of land in the West.

“... In 1879, the federal government floated bonds in London ...[in] October 1880, a new syndicate, ... signed a contract with the ... government ... to build the railway in exchange for $25 million (approximately $625 million in modern Canadian dollars) in credit from the Canadian government and a grant of 25 million acres (100,000 km2) of land. The government transferred to the new company those sections of the railway it had constructed under government ownership, on which it had already spent at least $25 million. But its estimates of the cost of the Rocky Mountain section alone was over $60 million. The government also defrayed surveying costs and exempted the railway from property taxes for 20 years. ... [in] 1881, legislation confirming the contract received royal assent, and the Canadian Pacific Railway Company was formally incorporated the next day. Critics claimed that the government gave too large a subsidy for the proposed project but this was to incorporate uncertainties of risk and irreversibility of insurance. The large subsidy also needed to compensate the CPR for not constructing the line in the future, but rather right away even though demand would not cover operational costs.

“Building the railway took over four years. ...

“By 1883, railway construction was progressing rapidly, but the CPR was in danger of running out of funds. In response, on 31 January 1884, the
government passed the Railway Relief Bill, providing a further $22.5 million in loans to the CPR. ... the government ... subsequently reorganized the CPR’s debt and provided a further $5 million loan. This money was desperately needed by the CPR.

“On 7 November 1885, the last spike was driven ... The successful construction of such a massive project, although troubled by delays and scandal, was considered an impressive feat of engineering and political will for a country with such a small population, limited capital, and difficult terrain. It was by far the longest railway ever constructed at the time.”

There are two factors to consider from this brief financial history of the construction of the Canadian Pacific Railway:

Firstly, the Government of Canada used land as currency. Undeveloped land was transferred to the railway company, so the company then could seek investment or loans secured against that land, partially on the assumption that the future value of the land would be higher after railway access to the land was available. This was probably the largest single contributor to the financial capacity of the railway.

Secondly, the article did not raise the question of where the Government of Canada got the money that it gave to the railway. We are told that the total financial contribution to the railway was about $80 million in 1875 dollars, or about $3-4 billion in today’s currency. That seems like an impossible sum to raise through customs duties (there were no sales taxes or income taxes back then), with a population of 4 million mainly under-capitalized farmers. These articles also note that in 1875, Canada used a variety of currencies, ranging from US Dollars, dollars issued by different provinces, British Pounds, valuable metals, and bank notes issued by banks. So raising money was challenging. Where did the Government of Canada get all this cash? No source has been found that answers this clearly. Many sources do answer this, but none are as reputable as a government agency or university: they all are one form of fringe special-interest group or another. Yet all of their answers are consistent. These sources indicate, in essence, that Canada was on the gold standard in 1875, and so the Bank of Canada simply printed cash, leveraged against the gold on deposit. Since the abolition of the gold standard, governments have the ability to print fiat currency at will. If newly-minted currency is used for constructing infrastructure at non-inflated prices, there will not be inflation. This is because the size of the economy, increased by the introduction of new infrastructure, is simultaneously matched by an equal influx of new currency. So the size of the economy and the amount of currency increase by equal amounts at the same time. Efforts to refute this argument were sought, but none were found.

These two points have important potential ramifications for the proposed ECOWAS Corridor Wayleave. They appear to suggest that an option for the
ECOWAS governments to establish the wayleave, it to expropriate the wayleave and pay for its appraised present value (no higher) with locally minted currency. In theory, this would not cause inflation, as the value of currency put into circulation would be equal to the value of the land acquired by the government (the land value has been liquidated). The lease payments paid by the occupants of the wayleave would pay for maintenance of the wayleave. But for actual construction of the infrastructure, it may be possible to acquire developable lands adjacent to the corridor, at fair present value using newly-printed coin, and then give these lands to infrastructure builders, who would then leverage them at future value.

Indeed, Smith & Gihring stated in 2006:

“The authors maintain that it is now time for transit/land-use research to move from hypothesis testing to practical applications of value capture. Longitudinal models can help predict land-value increments over a period of time, yielding estimates of the total capturable revenues that would support the debt financing of transit improvement projects.”

-p. 751

This statement is effectively stating that the future higher value of lands adjacent to an infrastructure corridor can and should be used to help finance the development of said infrastructure. The lack of clear models of this is a significant, and perhaps surprising gap in the literature.

6.3.3 Future Research: Unique Financing in Africa

There is a long history of mega-project corruption in Africa, a history where the few examples of success have perhaps paid more attention to the financial accountability than to the project itself. In this circumstance, the concept of leveraging land to create liquid capital that is then reinvested in infrastructure seems risky. However, considering general lack of good alternatives (for example, Chinese investment seems always to accompany undesirable, pseudo-colonial terms), it may be the only route forward. This is an area which should be considered by economists, using both standard infrastructure financing models and versions of the currency-creation financing models that have been shown success in Malaysia and Canada.
7 Next Steps

This research project has a large scope and uses the situation in Ghana as a case study. It fits well into current developmental planning work in West Africa, as the Africa Development Bank is focusing on issues of land security and wayleave land administration in 2019. The WAGRIC study effectively completed the national and transnational multimodal routing work that has been undertaken under the leadership of the NDPC over the last few years. The work on this thesis takes a closer look at the legal land tenure workings of how to make the envisioned corridors a reality.

It would seem reasonable that once accepted by EPFL, that this thesis be submitted to the agencies and persons who contributed to its development. The author will be available for further work on this topic if those parties find the findings compelling.

Detailed planning of the corridor would require a significant planning effort, meeting with a statistically relevant sample set of people in each region that the ECOWAS corridor will pass through (at least 1,000 people in each of 5 or 6 provinces). The purpose of these interviews is to collect any and all information pertinent needed to take the model presented here and adapt it to the specific needs and circumstances of different areas. This is more than just an engineering exercise: the envisioned wayleave is designed to effectively become a linear special economic zone, and then transition eventually into being a linear, living city with a high population density. The information needs presented in sections 4.4.3, on Alternatives Assessment, and of course section 5, Success Factors and Success Themes, may be used as the foundation for establishing a detailed communications and consultation strategy.

While structured questions can be useful (income, propensity to travel, etc.), also valuable would be open interviews where government agents, members of the public, and corporate leaders are asked their opinions, and common themes are pulled on routing, service market preferences, and economic development. The overall project must also have a sense of universal buy-in and support from the people to ensure full implementation.

Detailed planning will also require information on how West Africans manage their projects and processes to ensure applicability of results.

The route with the highest chance of initial success in Ghana would be that which connects the two largest cities of Kumasi and Accra. This would be the most appropriate place to start. The midway-point on this link would be appropriate for a connection to Abidjan, while eventually the link ending at Accra would be extended to Lomé.
8 Conclusions

Following the introductory section, the second section of this thesis provided an argument for the likelihood of a metroplex forming from intense and continued urbanization along the Abuja to Abidjan Corridor. This conclusion is supported by literature and by the current policies of government and ECOWAS. The argument was made that land use decisions made today may have significant impact on the eventual form of the metroplex. In particular, the establishment of a wayleave would be timely as this wayleave would ensure a path for the significant infrastructural investments that will be needed along the length of the metroplex.

In the second section was also a review of West African economy and land-related legislation. The lack of secure land tenure, combined with the need for reliable lines of transport and trade are top factors in economic development.

The third section reviewed the Ghanaian context and applicable legislation. The structure of the Ghanaian government was described, as support for why certain individuals in certain departments were interviewed. The National Planning Framework was summarized and critiqued. The most recent solution-oriented planning documents regarding major transportation development in West Africa vis-à-vis socioeconomic development were summarized and critiqued.

The fourth section discussed at a high level some of the theoretical concepts underlying the form and character and options for metroplexes which may have over 50 million residents.

Transportation design models were summarized and critiqued. Transportation forecasters normally and deliberately inflate anticipated use of proposals and under-estimate costs, in order to get funding for mega-projects. The societal costs for this behavior are extreme, as the infrastructure that is actually needed does not get built, and society is left with a missed opportunity and an underused mega-project. However, the models themselves are sound, and when used properly, have been shown to have extremely accurate if enough high-quality data is available. Unfortunately, detailed socioeconomic data on West Africa is lacking and difficult to collect; and regardless West Africa is in a state of extremely high rate of change so such models would have limited utility anyway.

The fourth section included an argument that a Metroplex-scale wayleave must respond to West African socioeconomic realities by maintaining flexibility in what kinds of infrastructure may be accommodated and in the timing of their construction, while protecting against squatting and petty criminal activity.

Section 5 reviewed what are It then reviewed the logistical considerations needed for a design for a multimodal interurban wayleave. The first part of the research question, “What are the factors that will likely lead to successful infrastructure investment in Africa?” was answered.
The sixth section responds to the second part of the research question: “**What might an infrastructure wayleave look like at a conceptual level once those success factors are applied?**” The author argues that the wayleave should be designed to functionally initially as a corridor for micro-agriculture and micro-commerce, providing secure stool-free land to Ghanaian families, who would steward small portions of future infrastructure wayleaves for their own benefit. The corridor would gradually evolve into a linear economic zone and linear urban ecosystem.

The closing of the sixth section discusses unique and successful ways that Malaysia and Canada were able to monetize natural resources in order to pay for essential national infrastructure, and argued this is an area appropriate for additional research.

The seventh section calls for extensive national consultations, supported by the Executive level, for detailed design planning before any work is actually done.

The implications of the results of this thesis are a significant departure from the transportation planning approaches currently used; however the results are consistent with the results of both literature and 3 weeks’ worth of on-the-ground research.

West Africa need not remake the mistakes of other major urban regions. It has the opportunity bypass unnecessary costs and congestion, and jump straight to building linear cities.
9 A Final Word

I conclude this thesis with a sense of disappointment. When I commenced this project, I looked forward to a significant advancement of my quantitative skills in transportation planning, forecasting, feasibility analysis, and econometric multiplier application. I learned that the models that are practicable are secret, the data is difficult to gather, and the feasibility models consider only traffic and ignore land use next to infrastructure anyway (which disallow monetization of land future value as a method to pay for nation-building projects in a debt-free manner). Skills, tools, and techniques I had assumed were available, are not. Instead I find econometric and engineering professionals calling for their creation, or for ending their frequent misuse in most jurisdictions.

I also conclude this thesis with a sense of defiance. Malaysia provided good drinking water to tens of millions of people in a few short years. Canada built a 5,000km railway in 4 years, through mountains and near-deserts, and the endless swamps (mixed with granite outcrops) of northern Ontario: why can’t Africans build a 1,000km corridor to connect their great cities? Without relying on outside money? The engineers and economists cannot...they are unable to...add to what is already common knowledge: West Africa needs an east-west corridor. West Africans are best to design and build it, and little reason to rely on much outside expertise.

I have worked with all sincerity to design a conceptual (flawed I am sure, but it is a start) model to establishing and maintaining the wayleave that will be needed by the future 150 million residents of the ECOWAS Metroplex to conduct their everyday affairs. This model may be used as a starting point for a program to create the spine of the future largest city in the world.

The results of this thesis indicate that the IGLUS program may need to broaden somewhat, from a metropolitan governance focus to one also inclusive of metroplex governance. These issues are emergent, pressing, and their effective response (or lack thereof) has potential to impact many many people over the long term.
APPENDIX 1: Section from El Shakhs 1997 Paper

This paper was a wealth of information that informed this thesis on many levels. As it is difficult to locate, a large portion is reproduced here. Emphasis is added.

“...at some point in their development, after initial periods of very rapid growth, mega-cities slow down considerably in their population growth rates. Although their populations may continue to increase in absolute terms, they grow at rates lower than those of other intermediate and smaller cities in their systems. Cairo, Calcutta, Mexico City, Buenos Aires, São Paulo, and Seoul, among others, are already experiencing such processes, as have mega-cities in advanced countries before them....

“...It appears that, when African cities grew, they not only developed major diseconomies of urbanization but also became the loci for intensifying social and political problems within their societies. Not the least of these are deterioration in order and control, unemployment, urban poverty, squatters, and homelessness.

“...It is not surprising that mega-cities frequently receive a disproportionate share of government attention and planning activities. It is not clear, however, that such planning processes take full account of: (a) the socio-economic and political context within which planning activities occur, (b) the capacity of the state bureaucracies to plan and implement, or (c) the uncertainties and dynamics of the long-range processes of restructuring within regions and urban settlement systems

“...existing urban planning structures and processes in Africa are generally inadequate to deal with the scale of the urban problems confronting mega-cities.

“...Existing planning processes are often adapted from models developed outside of Africa. This leads to over-complex planning processes, driven in a top-down manner by the state planning bureaucracy. Thus plans are developed with little or no local input or consultation. Further, even if these models were in themselves adequate as planning exercises, their implementation is generally beyond the resources and delivery capacity of the existing planning structures. Governments’ ability to enforce rules and regulations is generally very weak in Africa, particularly when they relate to unrealistic standards or activities that go against the grain of market forces. Plans are often not respected even by those government bureaucrats and politicians who approved them in the first place.

...Thus, policies for the development of mega-city regions should give particular attention to the growth potential along intense transportation corridors linking them to other major cities, both within the national urban settlement system and between countries. A close look at the growth patterns of large cities would show that such potential may have already generated major growth areas (e.g. the Cairo-
Alexandria and the Lagos-Ibadan corridors) and created significant urbanization economies extending considerable distances out of such cities, particularly at the transportation centres in between. Experience indicates that the development of such urban regions is inevitable and is in fact under way in many less developed countries. Independent settlements located along major corridors of interaction provide attractive alternatives for both basic and service industries, as well as for migrants, and thus constitute rational choices for incremental decentralization moves out of the mega-city. They also enhance the potential for development of intermediate cities and regional centres within the national settlement system.

“...An alternative development process should attempt spatially to separate new urban development by green belts or reserves of open land, and create independent communities as an approach to expanding the urban land market. This approach would distinguish these communities from the core built-up area of the central city and reduce their dependence on its utilities and service systems. At the same time as they are given separate physical and administrative (governmental) identities, they should be made easily accessible to, and identifiable with, the mega-city itself. This would extend the glamour and mystique of the mega-city to them and thus increase their attractiveness to population and economic activities and their viability as growth alternatives. Such examples existed in the development of Heliopolis and Maadi (and more recently 6 October) outside Cairo and Ikeja outside Lagos. Unwittingly, however, horizontal expansion of the central city and lax or inappropriate land-use controls allowed developments in the interstices between them and the main built-up areas.

“Thus a multi-nucleated regional development pattern requires a two-pronged strategy of increasing the supply of accessible urban land in planned locations, on the one hand, and tightening land development and preservation controls on the other. The first requires the expansion of convenient, inexpensive, and energy-conserving mass transit links to outlying development centres. Such links should be designed to leapfrog (by limiting access) intermediate areas where development is to be discouraged or halted, for example agricultural areas or open space. Land development and control concepts such as regional zoning, manipulating accessibility through the provision of roads and utilities, designation of priority zones for development, green belts, land banking or pooling on the outskirts of central cities, acquisition of development rights, transfer of development rights, or outright public acquisition of existing and/or potential urban land provide examples of the many tools that may be used to enforce such policies.

“...Development and planning policies should be designed in a way that would help identify established communities and community centres within mega-cities, through a bottom-up participatory approach, and strengthen them through land-use, transportation, and redevelopment assistance plans (for example, this was recommended in the 1970 preliminary strategic plan for Greater Cairo and
elaborated as the "homogeneous sectors" in the 1983 development plan; see chap. 4). Decentralization of business, cultural, and governmental activities into secondary business subcentres can help reduce extreme centrality and create a more balanced poly-nucleated pattern of viable communities. The boundaries of communities can be sharpened, for instance by redevelopment of the often marginal uses and transitional areas at the edges.

“The first step in facing the challenge of mega-city growth is to establish meaningful and workable mechanisms for region-wide planning and coordination and control of development. These should articulate a division of authority and responsibility that maximizes local participation while preserving integration at a regional scale. Such mechanisms and institutions, be they jurisdictional or networks, should be flexible enough so that their authority and its boundary can be frequently adjusted to fit the phenomena.² Local initiative and control at the small scale of towns and districts would enhance chances for self-reliance and sustainability for many urban functions and make it feasible to attract qualified personnel. This would reduce the burden on the mega-city government and thus enable it to cope with the increasingly complex regional functions such as transportation, communications, utilities, public safety, and protection of the environment. In order to be effective, local administrations must have a say in or control of capital investment, priorities, and local resources. Only a strong local official (a mayor or manager) with powers to deliver can cut deals with private enterprises and community groups in a relevant, timely, and responsive manner at the local level.”
Appendix 2: Essentials of High-Speed Rail

The author attended a 40-hour course entitled “Training on High Speed Systems” at the International Union of Railways (UIC) headquarters in Paris in April 2018. The information below is derived from that course. Since knowledge of HSR is not as common as for more well-established modes, these points are included here for the information of the reader.

1. The beauty of high speed is its ability to integrate with all other systems. The stations must be downtown.
2. There are now 40,000km of HSR either built or under construction. 5000 trainsets. Heavy growth since 2008
3. HSR lines are cheaper than conventional rail to build, because the trains have the power to go up steep slopes up to 35%
4. Is affordable in developing countries because the costs are in the infrastructure, and workers can be paid local fees.
5. Hexagonal network is most cost efficient
6. Expansion of tenable suburbs should reduce urbanization pressures on main centres. Creation of single market area.
   a. In the case of Spain, a lot of profit from exurban commuting services.
   c. In Japan, some suburbs took 20-30 years to grow out.
   d. In Taiwan, ridership is 1/3 that estimated because the stations were not located in downtown cores. Combined with high costs (land assembly, terrain) system in great financial struggle.
7. HSR has proven in Europe and Asia to be the most economic mode of mass transportation for distances between 200 and 500km, and competitive up to 700km with air. The cost of a HSR trainset with a capacity for 500 is about USD$25 million. The only aircraft with comparable seating capacity is an A380, which retails at about $USD450 million.
8. In China, completion of HSR typically increased the amount of passenger traffic between cities on the line by over 100% (Bullock. 2012).
9. Raghuram, 2016:
   a. Uses 3.2 hectares per route km.
   b. Costs in China average €16.5 million per km, in Taiwan where almost the whole route is elevated, €40 million per km
   c. Business travelers are the main recipients
   d. Traffic Density of 40-50 million annually for break-even on 350km/h HSR lines; 25-30 million for 250 km/h
   e. Out-of-city HSR stations have a significant negative impact on time value of the service.
10. 20-40MW to run each HSR trainset
11. Time cost savings are often 50% of the benefit of HSR. Transit time needs to be considered from door to door.
12. PPPs have generally not been successful.


Ghana Railway Development Authority of the Ministry of Transport (2013). Railway Master Plan of Ghana


Scholz, 2019


ENDNOTES (WEBSITES USED)

i https://eros.usgs.gov/westafrica/physical-geography

ii https://worldview.stratfor.com/article/niger-river-basin-supporting-west-africas-empires

iii https://cdn.thinglink.me/api/image/644546563430940672/1240/10/scaletowidth


v http://www.fragilestates.org/2012/05/02/west-africa-ethnic-divisions-state-fragility-and-regional-solutions/

vi http://blog.cpsindia.org/2017/02/

vii https://eros.usgs.gov/westafrica/node/156

viii https://static-content.springer.com/image/art%3A10.1007%2Fs12571-013-0260-1/MediaObjects/12571_2013_260_Fig2_HTML.gif

ix http://www.luspa.gov.gh/establishment.html


xiv Various information sources from the Union Internationale des Chemins de Fer (UIC) training course on High Speed Rail Systems, taken in Paris April 2018. https://events.uic.org/14th-training-on-high-speed-systems-level-i

xv https://en.wikipedia.org/wiki/Minimum_railway_curve_radius

xvi https://en.wikipedia.org/wiki/Canadian_Pacific_Railway