ETHIOPIA 2050

GRAND CHALLENGES & OPPPORTUNITIES

Launch Document
February 2019

Ethiopia 2050 GRAND CHALLENGES

Blue Ribbon Panel

(TBD)

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1. Ethiopian Academy of Sciences (EAS)
2. Ethiopian Association of Civil Engineers (EACE)
3. Ethiopian Society of Mechanical Engineers (ESME)
4. Ethiopian Society of Electrical Engineers (ESEE)
5. Ethiopian Society of Chemical Engineers (ESChE)
6. Association of Ethiopian Architects (AEA)
7. Ethiopian Urban Planners Association (EUPA)

February 2019

Ethiopia 2050
Grand Challenges & Opportunities

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1. **Integrated Water Resources Management**

2. **Large-Scale Urbanization**

3. **Food Security**

4. **Sustainability and Environment**

5. **Meeting Energy Demand**

6. **Advanced Manufacturing**

7. **Transportation Infrastructure**

8. **ICT Infrastructure Expansion**

9. **Access to Health Care**

10. **STEM Education, Workforce & Employment**

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List of Abbreviations

AAiT	Addis Ababa Institute of Technology
AEA	Association of Ethiopian Architects
BRP	Blue-Ribbon Panel
CPS	Center for Population Studies
EACE	Ethiopian Association of Civil Engineers
EAS	Ethiopian Academy of Sciences
ECTMPA	Ethiopian Construction Technology & Management Professional Association
EiABC	Ethiopian Institute of Architecture, Building Construction, and City Development
ESChE	Ethiopian Society of Chemical Engineers
ESEE	Ethiopian Society of Electrical Engineers
ESME	Ethiopian Society of Mechanical Engineers
EUPA	Ethiopian Urban Planners Association
ISC	International Steering Committee
PO	Professional Organizations
STEM	Science Technology, Engineering, and Mathematics
TC	Technical Committee

Ethiopia 2050 – Grand Challenges
A. Executive Summary

As Ethiopia's population continues to grow dramatically and is projected to reach 190-200 million by 2050, the scale of challenges that await the country in terms of basic and critical infrastructures in energy, water, food, housing, transportation, renewable resources, etc., are staggering. Unless proactive efforts in predicting these massive needs are carried out early and thoughtful plans to address these are prepared accordingly, it will be hard not only to eliminate poverty but also to avoid the threat of the accompanying highly destabilizing societal problems. Arguably, the next set of potential conflicts in our region could be driven by the competition for valuable resources such as water that will be further exacerbated by pressure from population increase and adverse effects of climate change.

A group of like-minded engineers who felt that engineering and technology professionals along with architects and planners are well positioned to appreciate these problems and offer thoughtful and practical solutions initiated an effort to formulate collective series of visions to address these societal challenges. With the critical support of the country's leading professional organizations, an international steering committee was then formed to **(a)** lead this effort towards completion through an international technical conference and **(b)** select **Blue Ribbon Panel** to write a comprehensive report. This forthcoming report which will be a product of the international conference on the subject is intended to serve as a starting point for national conversation amongst policy-makers, political and economic leaders, professionals and various stake-holder towards formulation of concrete and actionable sets of policies that could turn these challenges into opportunities. Specifically, through sets of grand visions and a series of peer-reviewed research reports and white papers by subject matter experts in a variety of engineering, technology, and planning disciplines, the report will offer bold, feasible, and actionable grand ideas for addressing the top 10 grand challenges of the country. **Blue Ribbon Panel** of independent professionals will author this "**Ethiopia 2050**" final report, the successful outcome of which will be measured through its impact in **(a)** influencing policy making in the years to come and **(b)** encouraging the subsequent launch of entrepreneurial, public, and government activities around the proposed solutions.

B. Introduction

Population growth projections for Ethiopia suggest that the country's population will reach 140 million by 2030 and a staggering 190 million by 2050 [1-3]. As things currently stand, the country's population is already projected to reach 126 million by 2025 positioning Ethiopia to be among the top 10-12 populous countries on the planet (see Fig. 1 and Table 1).

Among a multitude of potentially destabilizing societal threats that this population growth could bring, the issues of providing adequate food-security, energy, housing, transportation, and health-care for these additional 30-40 million Ethiopians in the next few decades stand out as sources of significant risk factors. For example, with regard to housing, it has been recently argued that

25 new cities with size equivalent to present Dire Dawa are needed or the current 10 cities such as Addis Ababa, Bahir Dar, Hawassa, Adama, Meqelle, and Dire Dawa will have to become mega cities of 10 million or more to accommodate this growth [4-5]. By 2050, the country's urban population alone is projected to reach 70.5 million with urbanization rate of ~37%, up from the current rate of ~16% [6]. In addition to this population increase, climate change, increasing and unsustainable societal gap in income and quality of life will pose additional pressures. How, then, can such monumental challenges that await the country be handled? How are we going to provide adequate drinking water for potential 10 million Addis Ababans? What sort of bold and innovative engineering solutions can be proposed to address these challenges [7]? What is the role of technology in meeting societal grand challenges? This report to be written by Blue Ribbon Panel will present some of the ideas generated by the best minds of our time to proactively address these challenges. This effort spearheaded by a steering committee of volunteers is inspired and influenced by similar large-scale efforts in the US, Europe, and other places around the globe. Examples include the US National Academy of Engineering's "*Grand Challenges for Engineering*" Report [8], NSF's 10 Big Ideas [9], and Consensus Study Report of National Academies of Sciences, Engineering, and Medicine [10].

B.1 Specific Challenges

The specific challenges addressed in this report were identified by the steering-committee and are given below. While the report focuses on these specific challenges, the recommendations and the approaches suggested here are, in general, applicable to other related societal challenges that may not be covered in this report. See Figure 2.

1. **Access to Clean Water and Equitable Water Distribution.** Supply of water to urban areas like Addis is dwindling. The competition for water access in arid areas like the Afar and Ogaden will eventually reach crisis stage as pressure from increasing populations mounts.
2. **Large-Scale Urbanization**. How do large cities like Addis Ababa grow and at the same time address displacement of farmers? What is the role of technology here?
3. **Food Security.** How do we increase agricultural productivity to keep pace with this increase? How can we achieve food availability, food access and food adequacy? How do we leverage science, technology and innovation to achieve and maintain food security?
4. **Sustainability and Environmental Issues.** How do we address pollution and climate change pressures on the Rift Valley Lakes, Lake Tana, and the major rivers?
5. **Meeting Energy Demand.** How do we scale-up energy generation and distribution, with particular focus on sustainability and renewable resources in mind? How do we develop an integrated approach to sustainable energy management?
6. **Advanced Manufacturing.** How do we prepare Ethiopia for Industry 4.0 with advances in intelligent manufacturing, additive manufacturing, and related manufacturing technologies?
7. **Transportation Infrastructure.** What is the optimum combination of transport modes that scales well and performs efficiently for the Ethiopian case?
8. **ICT Infrastructure Expansion**. How do we increase internet and wireless access/penetration to 70-90%? How do we build the physical and software infrastructure? What technologies and innovative approaches can we leverage to attain a strong and reliable infrastructure? What innovations and solutions are available to make internet access affordable to the masses?
9. **Access to Health Care.** How do we build a scalable healthcare system? What are the best practices to develop and sustain an accessible and affordable health care system? What are the innovative approaches and the role of preventative health services?
10. **STEM Education, Workforce Development & Employment.** How do we scale-up access to higher education and find employment to the tens of graduating young men and women? How do ensure the quality and type of education will enable the next generation better equipped to succeed?
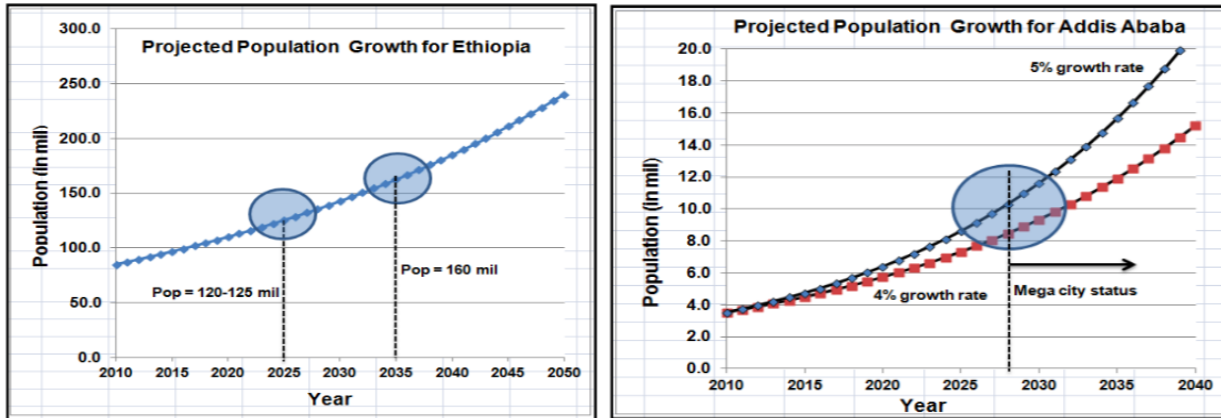
Figure 1. Population growth projections for (a) the whole country and (b) Addis Ababa [2-6].

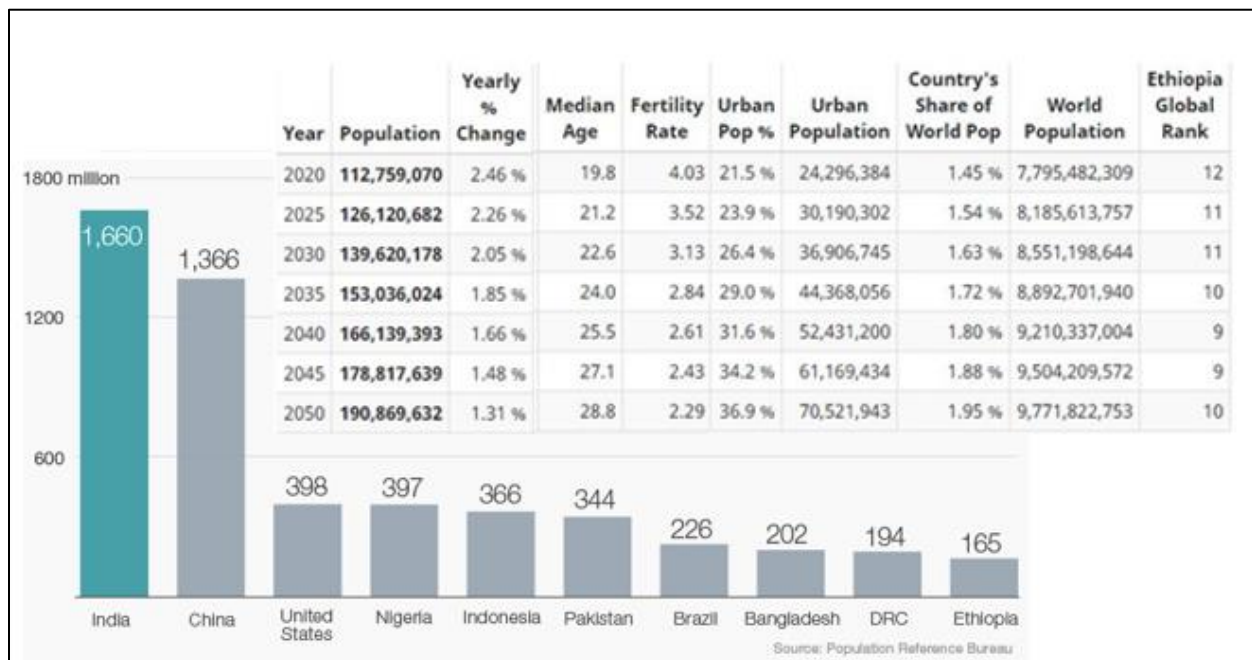|	Year	Population	Yearly % Change	Median Age	Fertility Rate	Urban Pop %	Urban Population	Country's Share of World Pop	World Population	Ethiopia Global Rank
	2020	112,759,070	2.46 %	19.8	4.03	21.5 %	24,296,384	1.45 %	7,795,482,309	12
	2025	126,120,682	2.26 %	21.2	3.52	23.9 %	30,190,302	1.54 %	8,185,613,757	11
	2030	139,620,178	2.05 %	22.6	3.13	26.4 %	36,906,745	1.63 %	8,551,198,644	11
	2035	153,036,024	1.85 %	24.0	2.84	29.0 %	44,368,056	1.72 %	8,892,701,940	10
	2040	166,139,393	1.66 %	25.5	2.61	31.6 %	52,431,200	1.80 %	9,210,337,004	9
	2045	178,817,639	1.48 %	27.1	2.43	34.2 %	61,169,434	1.88 %	9,504,209,572	9
	2050	190,869,632	1.31 %	28.8	2.29	36.9 %	70,521,943	1.95 %	9,771,822,753	10

Table 1. Population Project for 2040. Ethiopia is projected to be the world's 10th most populated country in 2035 [3]. Inset: population growth projections for Ethiopia as compared to the rest of the world [2].

B.2 Invited Authors and Institutions

The Steering Committee recognizes that solutions of these massive societal challenges require the combined and synergetic efforts of professionals from a wide variety of disciplines such as social sciences, political science, health-sciences, economics, physical sciences, engineering, and information technology. The Steering Committee also believes that the broad engineering and technology disciplines have a critical and leading role to play in addressing these grand challenges and offering compelling visions that will act as launching points for serious and informed national conversations.

As a specific example, the issue of providing clean water in an equitable and sustainable manner requires a collaborative work between policy-makers, hydrologists, environmental scientists, and engineers (agricultural, civil, electro-mechanical, environmental, etc.). As the eventual solutions

in terms of building, designing, and maintaining large-scale water storage, distribution, and recycling structures (reservoirs, dams, etc.) require the vision and service of engineers, such professionals play a key role in addressing this specific societal need. The Steering Committee, therefore, submits that visions presented by such technology professionals will act as a compelling starting point for a national conversation. The following is a sample of the broad categories of engineering, technology, architecture, and planning professionals and institutions who are invited to contribute to this report:

1. **Broad Engineering and Technology Areas** - Civil, mechanical, electrical, chemical, agricultural, environmental engineers, etc.
2. **ICT Professionals** – Computer scientists, software engineers, communication engineers, data scientists, etc.
3. **Architects and Planners** – Architects, city and urban planners, hydrologists, economists, social scientists, etc.
4. **Advanced Technology Professionals** – Robotics, artificial intelligence, machine learning, big data, statistics, advanced manufacturing, etc.

Professionals from industry, professional organizations (EAS, EACE, ESChE, ESME, ESEE, ECE, AEA, and EUPA), universities and research institutions inside Ethiopia (such as AAiT – Addis Ababa Institute of Technology), EiABC – Ethiopian Institute of Architecture, Building Construction, and City Development, CPS – Center for Population Studies, and the various universities) as well as international institutions of higher education will be invited for this process. To get a different and fresh perspective, professionals with a background in macroeconomics and authors from other African countries, China, Korea, and the US will also be invited by the **Steering Committee**.
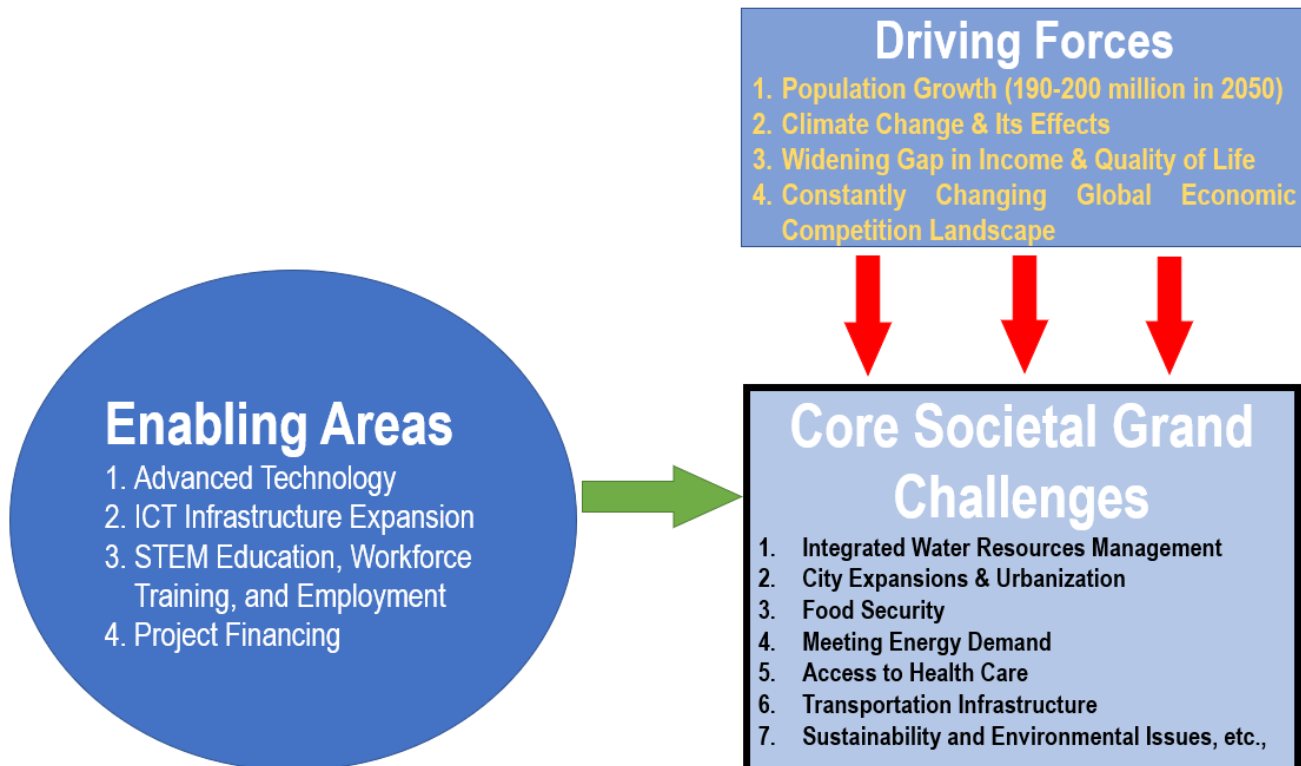

Figure 2. Large population growth, climate change, widening gap in income and quality of life, and rapidly and constantly changing global economic landscape are the driving forces for the key societal grand challenges identified in this report. Enabling areas offer vision and means for tackling these challenges.

C. Target Audience & Dissemination

The target audience for this report include key stake-holders at awareness, policy-making, and implementation levels. The Steering Committee believes that each and every Ethiopian has the right and obligation to develop an appreciation of the societal challenges that the country faces in the years to come. Policy-makers also need to be exposed to fresh ideas, views, and proposed solutions as they commit limited national resources to address these challenges. On the other hand, implementors such as city and urban planners, developers, investors, engineers, technology professionals, and the like need to think through the implications of such large-scale societal challenges. These considerations, we believe, should influence not only policy formulations, but also investment decisions by a variety of stakeholders. For wider dissemination, this report and selected key research papers will be published in open-access journals as well.

There will be **two sets of publications** and reports that will come out of this effort:

1. Final Comprehensive Panel Report: A key outcome of this initiative will be a final comprehensive report by the **Blue Ribbon Panel (BRP).** This will contain a consensus report that reflects the shared vision of the panel based on the contents of the research papers and conference papers submitted. BRP will be made of independent practitioners and academic scholars with track records of engagement in large-scale initiatives and publication of comprehensive reports. The top 15 papers selected by the **BRP** will be included in the report. The report will also contain recommendations for action by stake-holders.

2. Conference Proceedings: The proceedings of the joint conference that will be hosted by the steering committee and professional organizations will also be published as "**Ethiopia 2050 Conference Proceedings**". The Technical Committee will oversee the compilation, review, and editing of the Conference Proceedings.

The professional organizations who have been contacted and are in the process of collaborating with the Steering Committee in organizing this conference are:

1. Ethiopian Academy of Sciences (EAS)
2. Ethiopian Association of Civil Engineers (EACE)
3. Ethiopian Society of Mechanical Engineers (ESME)
4. Ethiopian Society of Electrical Engineers (ESEE)
5. Ethiopian Society of Chemical Engineers (ESChE)
6. Association of Ethiopian Architects (AEA)
7. Ethiopian Urban Planners Association (EUPA)

D. Organization

As the scope of the effort is significantly large and the expected outcome ambitious, the combined efforts of many volunteer professionals and professional organization is required to make this initiative succeed. The following organizational chart (Figure 3) describes the tasks that will be assigned to each of the volunteer groups and the interactions between these groups.
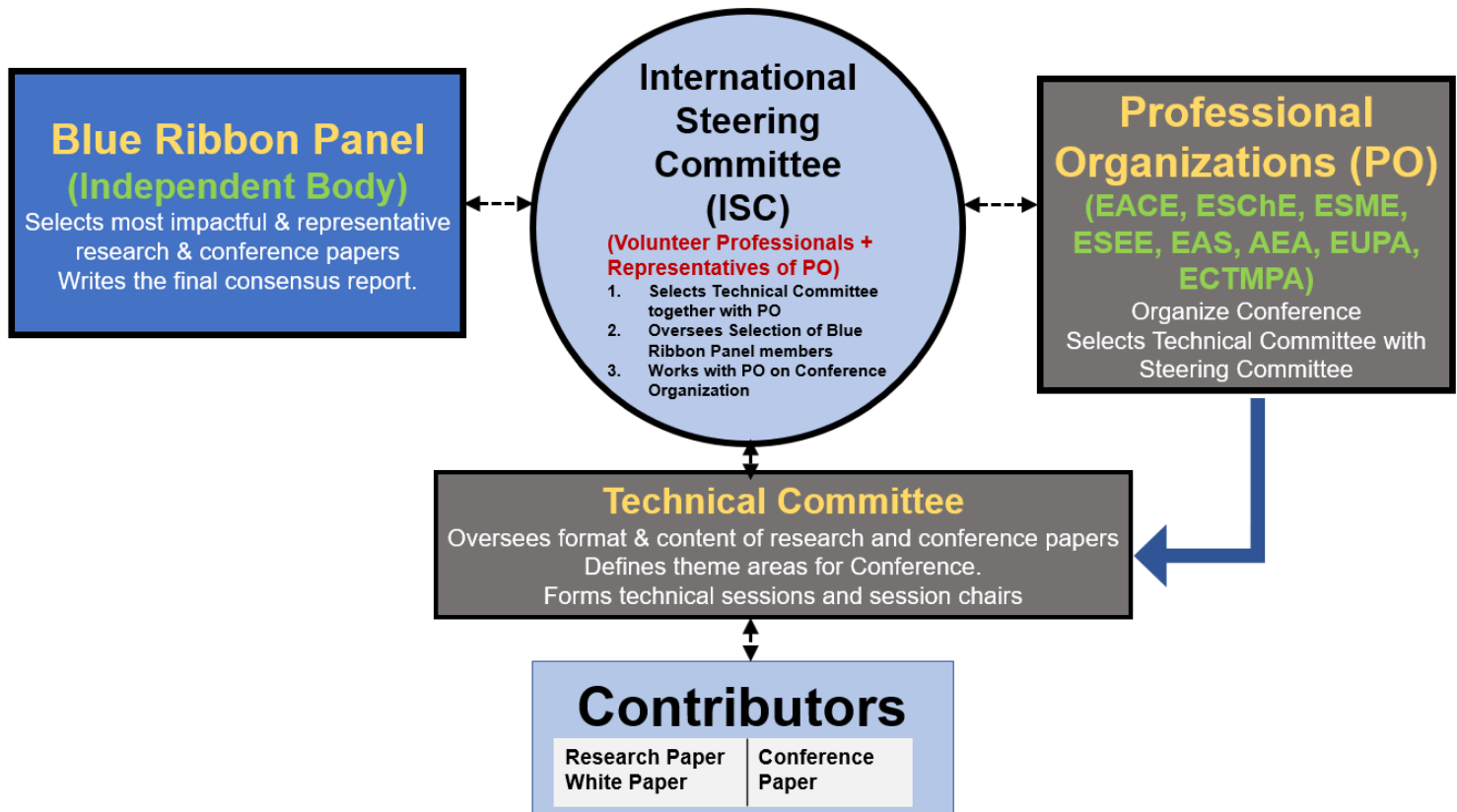
Blue Ribbon Panel
(Independent Body)
Selects most impactful & representative research & conference papers
Writes the final consensus report.

International Steering Committee (ISC)
(Volunteer Professionals + Representatives of PO)
1. Selects Technical Committee together with PO
2. Oversees Selection of Blue Ribbon Panel members
3. Works with PO on Conference Organization

Professional Organizations (PO)
(EACE, ESChE, ESME, ESEE, EAS, AEA, EUPA, ECTMPA)
Organize Conference
Selects Technical Committee with Steering Committee

Technical Committee
Oversees format & content of research and conference papers
Defines theme areas for Conference.
Forms technical sessions and session chairs

Contributors

Research Paper White Paper	Conference Paper

Figure 3. Organizational plan. The **International Steering-Committee** (**ISC**) will coordinate the efforts and is made up of volunteers who advocated for this initiative and representatives from each of the professional organizations (EAS, EACE, ESME, ESEE, ESChE, AEA, and EUPA). ISC will also manage the day to day activities of this initiative till publications of the final report. The **Blue Ribbon Panel (BRP)** is the independent body that will ultimately write the final report. BRP will be made of leading professionals who are nominated by the steering committee and the professional organizations (**PO**). BRP members are independent practitioners and academic scholars with track records in engagement at large-scale initiatives and publication of comprehensive reports. The **Technical Committee** (**TC**) is responsible for defining the scope of the conference and will set up panels and sessions of the conference and will edit the conference proceedings.

E. Research Papers & White Papers

In the following sections, topics and questions for peer-reviewed research papers that specifically address each of the societal technical challenges identified in this report will be presented. The suggested **templates** of these papers are also provided here and in the Appendix. While authors are expected to exercise their intellectual freedom in defining the contents of their research papers, the following outlines are provided as guidelines. These guidelines are designed to encourage originality while offering uniformity in flow of the ideas developed. They should be used more as guidance to help in specifically identifying problems and offering visionary and bold solutions based on sound principles of engineering, and technology. Authors could opt to use their own style as long as the minimum requirements of the following are met. Research papers should be submitted to Ethiopia2050@Gmail.com.

I. Introduction
Description of the problem from a professional's point of view.
1. Provide a clear description of the problem/challenge with proper framing of the problem, i.e., provide purpose, scope, and perspective
2. Provide evidence, including figures and both qualitative and quantifiable arguments why this challenge is a grand challenge and why it has to be addressed
3. Provide the required background information and additional details to the target audience to help develop an appreciation of the problem and expected outcomes
4. If possible, give a world-wide perspective by identifying similarities with grand challenges faced in other parts of the world. Lessons learnt could also be incorporated as starting point.

II. Methods Section
Description of proposed solutions
1. Provide clear description of the challenges and offer solutions that are ***bold***, ***sustainable, innovative, inclusive, resilient, job creating, integrative, efficient and or cost-effective*** approaches.
2. Provide relevant and reliable information about the proposed alternative solutions
3. Provide information that is trustworthy, unbiased, and comes from authoritative sources
4. Provide clear values and trade-offs of proposed method(s). The values (stakeholder preferences, outcomes) should be measured against the trade-offs that can be made.
5. Provide sound reasoning behind the proposed solution. This involves integration of alternatives, information, and values that lead to recommendations to the best alternative engineering and technical solution given the information available.
6. Reports or papers can be structured using principles applied in good decision making
7. Where possible, provide alternative engineering/technical solutions that are creative and relevant to local requirements for mitigating the identified challenges.
8. Provide maps, figures, charts, tables, etc. that clearly illustrate the proposed solution and inspire confidence in its applicability
9. Provide – where possible - call for action and practical approach for implementation of the recommendations.

III. Discussion and Conclusion Section
1. Provide a summary that incorporates your definition of the problem
2. Summarize your proposed qualitative and quantitative solutions
3. Provide distinct and bold calls for actions.

IV. Resources and References
Additional resources and references will be presented here.

E1. Integrated Water Resources Management

This broad area includes discussion on access to clean water and equitable water distribution, especially in urban areas. Projections regarding water needs and usage in the whole country, and specifically urban areas in 2050 will be discussed. For example, the particular cases of Addis Ababa and Gondar - where demand may far exceed the known close-by resources of drinking water supply - may require out-of-the-box thinking in terms of suggesting bold technical solutions.

A recent paper puts the estimated water resources of the country as 124.4 billon m^3 (river water), 70 billion m^3 (lake water), and 30 billion (groundwater) [11]. Another paper puts the ground water capacity as 2.6 billion m^3 [12]. In the coming 40 years, water demand in the country is estimated to be 79 billion m^3, out of which, 54 billion m^3 is for drinking [13].

Questions to be addressed in this societal challenge area include:

1. What is the projected demand for drinking water in the year 2050 in urban areas (particularly the large cities like Addis Ababa, Hawassa, Meqelle, Adama, Gondar, Bahr Dar, etc.)?
2. What are the major sources of water in the country that could potentially meet all or part of this projected demand in a sustainable and affordable manner?
3. What are some of the out-of-the-box ideas regarding ability to supply clean drinking water to the projected 10 million population of Addis Ababa? How about Gondar and similar cities that have limited water supply for a rapidly increasing population?
4. What are the prospects in introducing water management schemes at building-level, development-level, and smaller domains? What are the technologies available for this?
5. What are the prospects of introducing ground water recharge from recycled water?
6. How can technologies in the horizon enable bolder technical solutions that were once considered impractical and too expensive? For example, will photovoltaic and concentrated solar cell technologies offer enough power to drive massive pumping for drinking water supply from lakes and rivers?
7. What are the biggest threats that we face from climate change in water resources in the Ethiopian context? Can this be broken down to specific threats?
8. What are the technology developments in the horizon that can have an impact in clean water supply, distribution and recycling? How can some of the innovative water harvesting technologies introduced recently be scaled-up?
9. How do current integrated water resources management master-plans foresee the grand challenges identified in this report (explosive population growth and climate change)?
10. How can Ethiopia plan for equitable distribution of water from trans-boundary rivers such as Abay, Wabi-Shebelle, Tekezze, and Omo-Gibe (Lake Turkana) in a holistic manner?
11. What are some of the technological advances in sustainable irrigation schemes that are applicable to the Ethiopian case?

E2. Large-Scale Urbanization

Question such as how urbanization will play out in Ethiopia in the next 30+ years will be discussed. With the country's urban population alone projected to reach 70.5 million people in 2050 with urbanization rate of 37.5%, this societal technical grand challenge remains to be one of the most pressing ones. It requires new thinking with sustainability, affordability, and quality of life considered right from the design stage. Lessons from other countries such as Nigeria and Egypt that have abandoned their capital cities and have moved or are in the process of moving them to modern cities to cope with increasing urbanization pressures could inspire bold visions without the massive capital expenditure of these countries. Wise plans made at this stage could save the country billions of dollars of unnecessary and avoidable expenses at a later stage.

Specific questions that need to be addressed include:

1. What are the unique aspects faced by each of the potential mega cities of Addis Ababa, Hawassa, Bahir Dar, and Dire Dawa?
2. What sort of challenges do each of these cities face in terms of providing adequate infrastructure and utilities?
3. How can engineering and technology offer a framework for urban expansion while minimizing risks associated with conflicts between groups?
4. Can technology allow ways around these issues?
5. What does the technology horizon look like for modern urban planning, project management methodologies and tools for Ethiopia for planning, execution and completion of urban development projects?
6. What is the role of engineering/technology in expanding cities around existing legacy infrastructure that are not adequate for meeting the needs of the current population?
7. What are some of the approaches for integration of systems (housing, energy supply and distribution, transport, waste management, etc.) for improved efficiencies either during construction or operation of these systems?
8. What are the scopes for water recycling and reutilization treatments for sustainable local water supplies in urban areas?
9. What sort of visions can be formulated to enable provision of innovative community infrastructure financing and ownership models, for maximizing local options without resorting to large-scale publicly funded interventions?
10. What are some of the thoughts regarding availability of innovative finance, ownership models, and community participation for urban housing?
11. What sort of large-scale risks do urban areas face from natural disasters such as earthquakes and floods? What are the prescribed risk mitigation practices?
12. What kind of plans should be made to maintain existing and new infrastructure for increased reliability, availability, and lower total cost of ownership?
13. **CITY WASTE MANAGEMENT** – considering the amount of construction debris created, why the need to eliminate waste? How to? Where?
14. **TRAFFIC MANAGEMENT** – How do we establish a sense of orientation and fundamental logic in the mobility of pedestrians/automobiles, elevate the citizen's perspective.
15. **YOUTH UNEMPLOYMENT IN THE CITY** – How do we handle the rise of petty crimes and burglary by the youth and the under-capacity for police to handle complaints?

E3. Food Security

Food security has always been one of the defining challenge areas for Ethiopia, even when its population was barely 30 million or so in the 1980s. While there has been some progress over the years, with only 5% of our land mass irrigated, there is plenty of room for addressing this challenge [14]. As shown in Figure 4, the country still faces food deficits from year to year; at times the deficits reaching almost 2 million metric tons. Particular focus is the availability of new technologies and approaches in soil management, agriculture, irrigation, and crop science that could help further improve food production in the country.
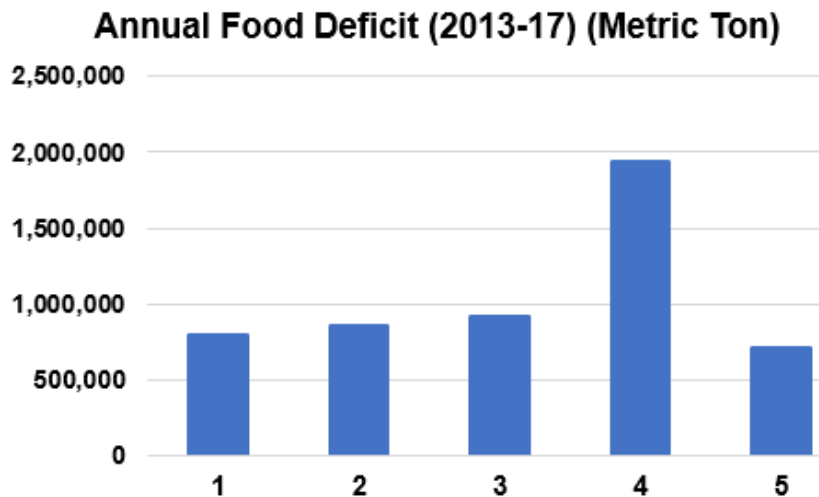
Figure 4. Food deficit in Ethiopia (Metric Tons) between 2013-12017 [15].

Specific questions to be addressed include:

1. What is the role of biotechnology and emerging technologies for increasing yield and utilization of secondary land in a sustainable manner?
2. What sort of "out-of-the-box" infrastructural progresses are needed to drive food production capabilities consistent with population growth?
3. What sort of technological progress in the horizon are specifically relevant to the two classes of food producers in the country, (a) smallholder farms and (b) large mechanized farms?
4. How do we increase the efficiency of water usage, both for the growing of food and its subsequent processing?
5. What is the prospect of mechanization, including automation and robotics in food security? How do we balance that with need for safeguarding jobs?
6. What is the scope for reduction of post-harvest losses through appropriate infrastructure, distribution knowledge and storage capability?
7. How does new technology help address better land use management through improved drainage and control of salinity and alkalinity?

E4. Sustainability & Environment

The broader areas of sustainability and environment protection form one of the key societal challenge areas. Here, sustainability in terms of any of our natural resources from minerals to forests is considered. The threat posed by environmental degradation varying from air pollution, water pollution, and solid waste in urban areas to deforestation will be discussed. In addition, the wise use of precious resources will be discussed.

Some of the fundamental questions that should be addressed include:

1. How can we stop and reverse the effects of environmental degradation and respond to climate change in Ethiopia?
2. What specific regions of the country could provide large sustainable reforestation areas for carbon sequestering?
3. How can Ethiopia capitalize on carbon cap and trade?
4. As population pressure increases, what are the strategies that can be proposed to address transportation, industrial, and other types of pollutions?
5. What are some of the considerations for formulating appropriate and practical national emission standards with clearly defined and enforceable targets?
6. What sort of technology advances hold promises to reduce residential house generated air pollution through wood burning?
7. How can technology support and enable environmental sustainability for precious clean water reserves of Rift Valley Lakes and Lake Tana?
8. What are the long-term threats faced by these resources of water?
9. What are the new approaches in sustainable mining of mineral resources that have implications to Ethiopia?
10. How should long-term industrialization plans be designed and executed with considerations for sustainability and holistic use of natural resources?

E5. Meeting Energy Demand

Questions regarding the available power generation capacity of the country (hydroelectric, wind, geothermal, etc.) and the projected power requirements in 2050 will be discussed. Innovative ideas in grid management and power transmission will be discussed by the various research papers.

The discussions will also include formulation of energy strategies that consider such drivers like supply and demand, climate change, new technologies, changing regulations, etc.

Questions to be addressed include:
1. What are some of the innovative visions for transitioning to non-fossil based energy sources?
2. What are the prospects of renewable energy resources in meeting these demands?
3. What new technological advancements and innovative approaches in grid management are available for effectively handling intermittent power blackouts?
4. What are some of the technological developments in the horizon that could offer a sustainable and credible off-grid power generation and storage?
5. In the Ethiopian context, what are some of the most promising energy storage technologies for power generated by renewable resources such as wind and photovoltaics?
6. What are the evidence-supported prospects for exporting power to the African market? The estimate for hydroelectric power generation capacity is currently at 15-30 GW (159,300 Gwh/year) [16].

E6. Advanced Manufacturing
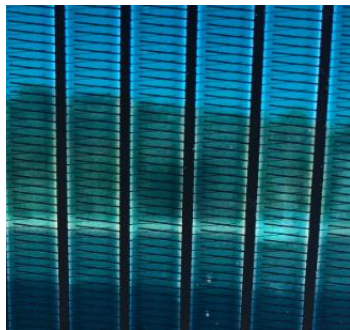
Advanced manufacturing based on emerging technologies such as 3D printing has the potential to provide employment, generate foreign exchange, and build sustainable innovation ecosystem. Industrial Development Strategic Plan (IDSP) (2013-2025) document of Ethiopia offers a good starting point [Appendix].

Questions to be addressed include:
1. What specific product lines (machine components, medical devices, automotive parts, agricultural machinery components, etc.) could offer compelling competitive edge for Ethiopia?
2. How do we integrate advanced manufacturing clusters with the current industry parks model?
3. What are the prospects for "green manufacturing" in Ethiopia?
4. How do we encourage the expansion of the so-called "gig economy" in advanced manufacturing?
5. How do we prepare Ethiopia for Industry 4.0 with advances in intelligent manufacturing, additive manufacturing, and related manufacturing technologies?

E7. Transportation Infrastructure

Transportation infrastructure has always been a major factor in the country that had huge bearing on several factors varying from security to food distribution.

Specific questions to be addressed include:

1.   What are the respective new thoughts and philosophies in transportation technology to address rural and urban transportation problems?
2.   What are the scopes of scaled-up public transport in solutions that can offer cost-effective solutions for congested cities like Addis Ababa?
3.   Is underground urban commuting transport a potential solution?
4.   What are some of the current and evolving thoughts in terms of integration of Ethiopia with the rest of the African transport infrastructure?
5.   Given needs based on security concerns and geopolitical uncertainties, what are the opportunities available for redundant land transport networks inside the country as well as to ports?
6.   How does urban transportation design affect urban planning?

E8. ICT Infrastructure Expansion
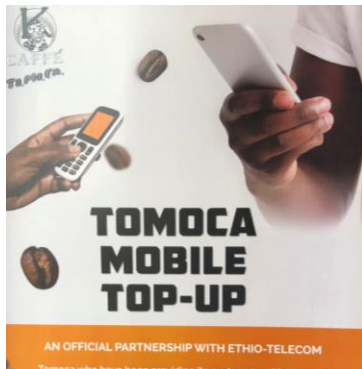
ICT carries tremendous power in creating jobs and enabling development. Despite some progress in wireless access expansion, internet penetration is still among the lowest anywhere in the world.

Specific questions to be addressed include:

1.   What are the technologies in the horizon that could help the country develop high-level of wireless and internet penetration?
2.   How do we scale-up the infrastructure to handle the needs of 190-200 million people?
3.   What are the major barriers that need to be addressed to enable ICT expansion?
4.   What is the scope of contribution of ICT and related specific technologies like data science in improvement in agricultural production?
5.   What are some of the key lessons that Ethiopia can learn from countries like Kenya that have gone through better internet penetration?

6. How do we establish ICT-focused innovation ecosystem at the level of institution of higher education?

7. How do we tackle challenges of building modern ICT infrastructure to make the service cheaper, better and faster? Large ICT infrastructures such as telecom carriers, Internet Providers, Data Centers are currently owned and run by the government. Although some of the agencies are profit making, they still compete with others similar agencies in the government budget allocation and prioritization, and hence they are not able to grow as fast as possible to meet the demand. The topic deserves a holistic look and deeper research as outcome could be a justification for economic liberalization.

8. How do we boost ICT penetration through privatization of telecom carriers and internet service providers? Introduction of wireless technology and mobile phones resulted in rapid growth of ICT in developed and in many developing nations. Especially, the growth in mobile phone penetration in some low to middle income countries had produced significant growth opportunities. However, such level of growth and in mobile phone and wireless technology penetration is not realized in Ethiopia as it should. How do we reproduce this in the Ethiopian context?

9. What is the broad role of ICT in democratization of society and government? The role of ICT in helping and speeding up the democratization process must be studied in the current Ethiopian context. How can it help bridging the gap between the elites and the ordinary folks? Could it help speeding up vote counting, combat ballot box fraud and so on. What could be done in terms of polling and rating our emerging political parties and leaders. This may not an undertaking for a faint-hearted, nonetheless, if it is tackled soon, it will have immediate benefit.

10. What is the role of ICT and poverty reduction, health care, education, agriculture, transport, and manufacturing? Time and again, we have seen several developing nations leveraging ICT to grow their economies and alleviate poverty, improve health care, increase the quality of education. ICT also boosts the productivity of the work force. Therefore, there is a need to look into all available data and published works to make comparative analysis with other emerging economies and to find out where we are at and what we need to do, if the evidence suggests that there a huge gap.

11. How do we promote entrepreneurship in ICT hardware, software and professional services? Entrepreneurship is an area that will be of immense help with the growing population of the majority under 30s. ICT related entrepreneurship is proven to be the one with the lowest cost of entry. What our brave young men and women need to have is their bright mind, college education and a few thousand dollars to start their own computer business. A formal research is needed to gauge the potential on how government or non-government agencies provide incentives and protections.

12. What are some of the key foresights towards ICT regulatory bodies? As ICT has so much to offer, it also pauses challenge in terms of fraud, theft and other security risks from individuals and state-sanctioned actors. Invasion of alien culture with unnecessary products and services is detrimental to the economic growth of the country which the ICT is touted to bring about. Therefore, a study must be conducted in how other emerging and developed economies handle the issue.

E9. Access to Healthcare

Providing adequate and affordable healthcare at a large-scale will be one of the key challenges of the country where technology could make meaningful and significant contribution.

Specific questions to be addressed include:
1. How can technology help in providing a scaled-up level of health-care for both urban and rural areas?

2. How can technology be used to narrow disparities in healthcare access between urban and rural areas?

3. How can recent advances in robotics, AI, big data, and the like be used in the Ethiopian context effectively, for equitable healthcare delivery?

4. What are the new approaches and technology pieces that are uniquely applicable to the current Ethiopian conditions?

E10. Education, Workforce, and Employment

Education that prepares the youth for 21st technologies and contributes to narrowing the income gap through tertiary and other models of education will be discussed. We should also explore the potential for education as an **export opportunity** where trained Ethiopians could take up jobs in other African countries and generate foreign currency for the country. It is already clear that a number of Ethiopian professionals (engineers and ICT professionals) are currently working in various parts of Africa. Educational centers of excellence can also bring other African nationals, and potentially other countries, to Ethiopia to learn, research and exchange knowledge.

Therefore, related to this, the following questions should be addressed:
1. How do we strengthen STEM education in Ethiopia?
2. How do we prepare a world-class STEM workforce that is ready not only for the needs of the country, but also capable of participating in the African knowledge market?
3. What are the innovations in education required to enable production of globally competent workforce?
4. How do we develop centers of excellence and research hubs to develop local innovation and attract students, researchers, institutions and companies from abroad.
5. What sort of policy frameworks are needed for enabling high-tech (STEM) education as an area of export?
6. How do we formulate STEM education as a critically important step in creating jobs and wealth, where success should be measured by workable solutions that students propose to leverage science, technology, engineering, and math to address infrastructure needs?
7. How do we teach entrepreneurship for technologists and academics with emphasis on situations (legal, regulatory, cultural challenges) in Ethiopia?

F. Panel Findings & Recommendations

This section offers a tentative template that could be used in the final Ethiopia 2050 Report. The template is meant to be an informative indicator of the form of the report.

The following are the major findings of the panel. Specific recommendations are also provided in this section.

F.1 Major Findings

The major findings of the panel that are based on the research papers and conference papers submitted as well as the discussions generated in the joint conference are reported below.

> Detailed discussions on major findings by the **Blue Ribbon Panel** are presented here. The report will be based on a consensus among members of the BRP.

F.2 Recommendations

To translate the recommendations to actionable initiatives with clearly defined scope and outcome, the **Blue Ribbon Panel** proposes the following methods that have been tested elsewhere with documented results.

1. X-Prize Model
2. University-Based Research
3. etc.,

> Detailed discussions on recommendations for action by the **Blue Ribbon Panel** are presented here. The report will be based on a consensus by members of BRP.

G. Timeline

G.1 Report Timeline

The following is a timeline for this initiative.

Tasks	February 18, 2019	March 29, 2019	July 1, 2019	July 21, 2019	October 15, 2019	December 20, 2019	March 1, 2020
Invitation to Contribute	X						
Expression of Interest		X					
Research Paper Submission			X				
Editorial Response				X			
Revised Paper Submission					X		
2-Days Addis Ababa Conference						X	
Final Report Released							X

2-Day Conference
The highlight of this process will be the 2-days conference that will be carried out in Addis Ababa. The conference will be carried out as a joint effort between this panel and
1. **EAS** (Ethiopian Academy of Sciences)
2. **EACE** (Ethiopian Association of Civil Engineers)
3. **ESME** (Ethiopian Society of Mechanical Engineers)
4. **ESEE** (Ethiopian Society of Electrical Engineers)
5. **ESCE** (Ethiopian Society of Chemical Engineers
6. **AEA** (Association of Ethiopian Architects)
7. **EUPA** (Ethiopian Urban Planners Association)

The proceedings of the joint conference will also be published as "**Ethiopia 2050 Conference Proceedings**".

G.2 Research & Conference Paper Submission

Please submit your papers by the deadline of June 30, 2019 through email at: **ChallengeEthiopia2050@Gmail.com**.

G.3 Editorial Timeline

The following is a timeline to be used only for editorial purposes in the process of writing this report.

| Tasks	January 5, 2019	January 10, 2019	February 1, 2019	March 1, 2019	May - August 2019
Distribute beta-draft to Editorial Board and Technical Committee members.	X				
Incorporate changes, edits, feedback, etc.		X			
Start official conversation with POs such as EACE, ESME, ESEE, etc.			X		
Tweak report structure, delivery, paper submission mechanisms etc. based on outcome of input from EACE, ESME, AEA, ESChE, ESEE, EAS, and EUPA				X	
Planning for Conference in Addis Ababa					X

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Appendix

Geographical distribution of contributors to this report.
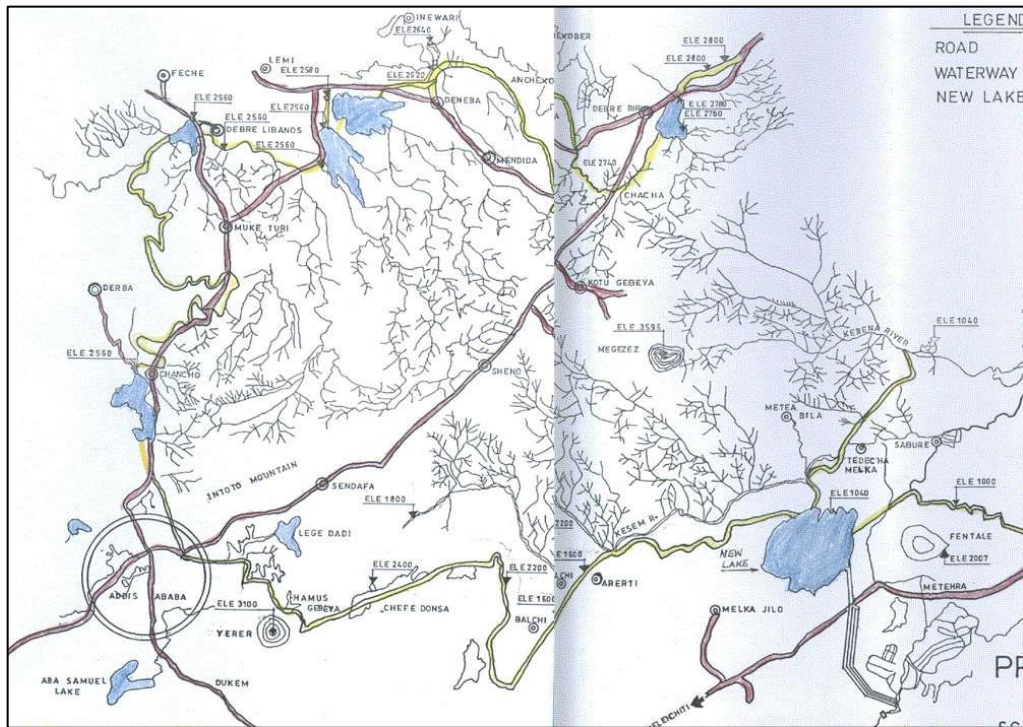
2002 Proposal by Engineer Tadesse of Berta Construction for diverting N. Shoa rivers.

Template for Research Papers & Conference Paper
Conference Papers have similar content and flow, but will be shorter version
Title – Research Paper – Education and Employment
Authors Affiliations

Abstract
Summarize the description of the challenge addressed and the proposed solution. Highlight key innovative, bold, and rational aspects of the proposed solution.

I. Introduction
Description of the problem from a professional's point of view.
1. Provide a clear description of the problem/challenge with proper framing of the problem, i.e., provide purpose, scope, and perspective
2. Provide evidence, including figures and both qualitative and quantifiable arguments why this challenge is a grand challenge and why it has to be addressed
3. Provide the required background information and additional details to the target audience to help develop an appreciation of the problem and expected outcomes
4. If possible, give a world-wide perspective by identifying similarities with grand challenges faced in other parts of the world. Lessons learnt could also be incorporated as starting point.

II. Methods Section
Description of proposed solutions
1. Provide clear description of the challenges and offer solutions that are ***bold***, ***sustainable, innovative, inclusive, resilient, job creating, integrative, efficient and or cost-effective*** approaches.
2. Provide relevant and reliable information about the proposed alternative solutions
3. Provide information that is trustworthy, unbiased, and comes from authoritative sources
4. Provide clear values and trade-offs of proposed method(s). The values (stakeholder preferences, outcomes) should be measured against the trade-offs that can be made.
5. Provide sound reasoning behind the proposed solution. This involves integration of alternatives, information, and values that lead to recommendations to the best alternative engineering and technical solution given the information available.
6. Reports or papers can be structured using principles applied in good decision making
7. Where possible, provide alternative engineering/technical solutions that are creative and relevant to local requirements for mitigating the identified challenges.
8. Provide maps, figures, charts, tables, etc. that clearly illustrate the proposed solution and inspire confidence in its applicability
9. Provide – where possible - call for action and practical approach for implementation of the recommendations.

III. Discussion and Conclusion Section
1. Provide a summary that incorporates your definition of the problem
2. Summarize your proposed qualitative and quantitative solutions
3. Provide distinct and bold calls for actions.

IV. Resources and References
Additional resources and references will be presented here.

Format: Single-space, Maximum of 20 pages including figures and tables, font-size of 11.

ESME's View on the "*Ethiopia-2050 Grand Challenges*" Initiative
(Draft)

As outlined on the Industrial Development Strategic Plan (IDSP) document of Ethiopia, the vision of the industrial development is stated as:

> *"Building an industrial sector with the highest manufacturing capability in Africa which is diversified, globally competitive, environmentally-friendly, and capable of significantly improving the living standards of the Ethiopian people by the year 2025"*

According to the IDSP, the overall goal of the industrial development strategy is to bring about structural change in the economy through industrial development. Specifically, it aims at increasing the share of the industry sector as % of the GDP from the current 13% to 27% by 2025, and also increasing the share of the manufacturing sector as % of the GDP from the current 4% to 17% by the year 2025. In accordance to this overall goal, specific strategic objectives are set.
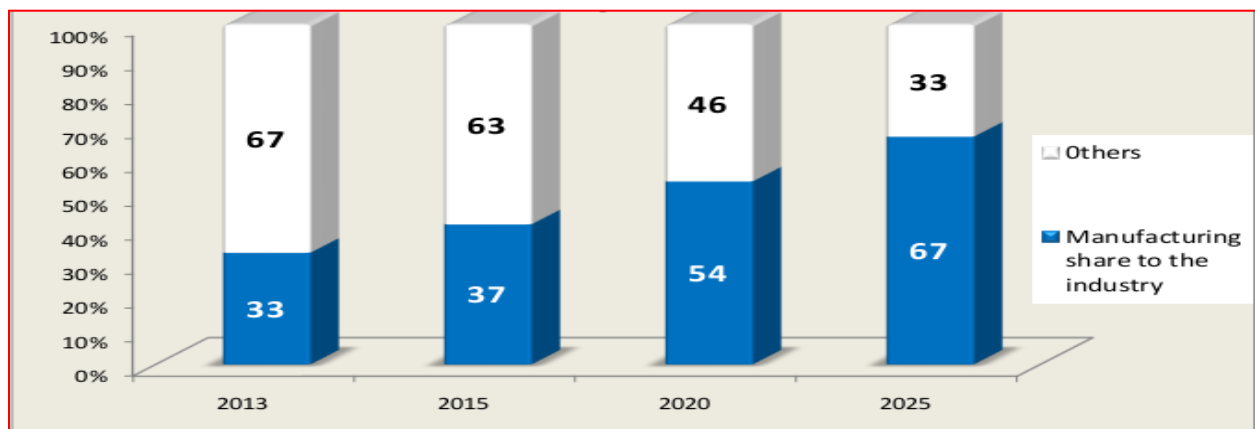

Figure 1: Current and Projected Share of the Manufacturing Sector from the total Industrial Sector GDP (*Source: - Ethiopian Industry Development Strategic Plan (2013-2025), Ministry of   Industry*)

The five strategic objectives, according to IDSP, which guide the implementation of strategies and programs, are:-

- To further expand and develop the existing manufacturing industry priority sectors;
- To diversify the manufacturing sector to new sectors;
- To enhance Enterprise Cultivation and Entrepreneurship;
- To increase public, private and foreign investment; and
- To develop and operate Industrial zones and cities.

The IDSP also highlights that the six major programs that are designed to achieve the five strategic objectives of the industrial development strategic as:
- Priority Sectors Expansion Program;
- New Manufacturing Sectors Development Program;
- Industrial Enterprise and Entrepreneurship Development Program;
- Local (Private) and Foreign investment Promotion Program;
- Government (Public) Sector Investment Program; and
- Industrial zone Development Program.

For the strategic objectives highlighted above, the key intervention strategies that need to be pursued in order to achieve the vision for industrial development of Ethiopia, according to the IDSP document are:-
- Ensuring conducive business environment;
- Availing competent human resource;
- Availing quality industrial inputs for value- addition;
- Developing and diversifying local, regional, and global markets;
- Enhancing technology development & transfer; and
- Developing and providing institutional support.

According to the situational analysis conducted by the Ministry of Industry, there is still a big gap with respect to succeeding in the efforts in the strategic interventions. Some of the weaknesses (with relevance according to the scope of professional associations like ESME) are presented below.
- Limited capacity of the existing Institutions to implement policies and strategies
- Limited quality service delivery of the public institutions
- Weak transport and logistics services
- Limited capacity and inadequate alignment of the capacity building programs of the existing HEI,TVET, and R&D Institutes to train qualified professionals and specialists for the industry
- Absence of technological innovation, application of indigenous technology and inadequate technology transfer
- Lack of machinery maintenance, rehabilitation, modification, and replacement.

In reference to the IDSP of Ethiopia, it is evident that there is still a need for continued efforts with respect to the strategic interventions so as to enable Ethiopia achieve the vision for the manufacturing sector. In this regard, ESME believes that the "Ethiopia-2050 Grand Challenges" project shall in some way address the strategies and challenges of the national industrial development agenda. Consequently, ESME believes that the inclusion of the current and upcoming challenges, evident in the situational analysis, as part of the "Ethiopia-2050 Grand Challenges" initiative would complete the picture envisioned by the initiative.

In this regard, ESME is working, to its level best, so that our professionals play rudimental roles in helping our country realize the national vision for the industrial sector. And it is with this belief that ESME has even chosen the theme for the current year to be:

"***The Role of Mechanical Engineering in Improving the Competitiveness of Manufacturing Industries in Ethiopia***" with specific focus given to application areas of mechanical engineering such as: *Product Commercialization Technologies, Manufacturing Technologies, Production System Improvement, Production Process Innovation.*

In conclusion, we would like to once again appreciate your drive and dedication to come up with such a substantial and national initiative with far reaching implications for the next generations. Moreover, we would like to express our willingness to participate in the Ethiopia 2050 initiative and help in the relevant areas to the best of our ability.

ETHIOPIA 2050
Additional challenges that cannot be overlooked
Contributed by Rodas Girma Seyoum, Publication Chairwoman of AEA

The proposal has highlighted key challenges that are always at the core of debates in several governmental or non-governmental institutions in Ethiopia. These issues also touch every citizen all around Ethiopia, particularly those that live in rural parts of the country (a little over 80% of Ethiopia is rural[1]).

Having stated the above, I believe the proposal overlooks challenges of city living. It is very crucial that the proposal should also drive agendas to develop a shared vision of our future cities, for the purpose of creating an action plan that will empower our communities. As we grow and prosper, discussion of such agendas will equip us with foresight that will help create livable cities.

For instance, for our emerging capital Addis Ababa, we need to confront our patterns of city planning, as Addis strives to become a model city for other cities of Ethiopia to follow. Addis Ababa unofficially hosts one quarter[2] of the people of Ethiopia that live in urban areas and is the hub for services which accounts for almost 44% of GDP[3]. In spite of such capacity and growth, Addis Ababa is slowly becoming an urban planning disaster.

Evaluating the proposal put forth by the steering panel, as a city dweller leaving in the capital city of Addis Ababa, the below challenges need to take center stage of the upcoming discussions. (In order of priority):

1. **CITY WASTE MANAGEMENT** – considering the amount of construction debris created, why the need to eliminate waste? How to? Where?

2. **TRAFFIC MANAGEMENT** – establishing a sense of orientation and fundamental logic in the mobility of pedestrians/automobiles, elevate the citizen's perspective.

3. **YOUTH UNEMPLOYMENT IN THE CITY** – the effect, rise of petty crimes and burglary by the youth and the under capacity for police to handle complaints.

Ethiopia 2050

GRAND CHALLENGES & OPPORTUNITIES

FEBRUARY 2019

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