***Preliminary Project Proposal***Ray Chandonnet and Barrett Viator  
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***Basics***

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Working Title: ***Will Bridging the Digital Divide bring prosperity to the Second “Next Billion Users” and their home countries?***

**Background**

The Rural Electrification Act (“REA”), passed in the United States as part of President Roosevelt’s “New Deal” legislation in 1936, was designed to bring electricity (initially) and other infrastructure (later) to huge swaths of the country that were considered by industry to be unprofitable places in which to invest these infrastructure resources. By all accounts, it was a rousing success because “the act allowed the U.S. to grow rapidly in the postwar period and to attain the position of economic dominance it now enjoys…by investing in the development of the country” it “provided an economic springboard that propelled America ahead of other nations from the 1930s onward.” (Taylor, 2024)

The expansion of internet connectivity and digital technologies in the past decade globally may have produced a similar, contemporary opportunity to address long-standing global disparities in livelihood, economic participation, and education. While a significant portion of the world's population has been online for several decades, efforts such as Google's Next Billion Users initiative have been focused on developing applications and ways of connecting with the internet for those who reside in so-called under-developed countries. These users are in the developmental stages of global digital inclusion and often are accessing the internet through devices with less computational power and varying reliability and speeds of connectivity (Ranjan, 2022).

Advanced Meaningful Connection is defined as having at least 4G connection, unlimited internet data, access to a mobile device, and the ability to be online daily (A4AI, 2022). For the majority of the global population who are coming online and engaging in “meaningful connectivity,” the cost of an entry level mobile device can cost upwards of thirty-percent of their monthly income (GDIP, 2022). Historically, lack of access to information and resources has perpetuated cycles of poverty and limited educational attainment in many regions of the Global South. The advent of widespread, affordable internet access may serve to dismantle of these barriers, which may improve the economic wellbeing of the populations of these countries, and/or lift broad economic conditions for the nation states in which these populations live (depending on whether governmental and structural economic conditions are conducive to an equitable distribution of digitial inclusion and its potential economic benefits). One need look no further than at the impact of efforts to make connectivity more accessible by nations during the Covid-19 pandemic, which accelerated the spread at which more populations were able to engage in Advanced Meaningful Connection (A4AI, 2022). An increase in digital literacy and the access to online learning platforms provided individuals with the skills necessary to stay safer during the pandemic and to be able to obtain skills for the future that would allow them to participate in the modern economy through access to information that fosters improved health outcomes and greater civic engagement (A4AI, 2022).

The "digital divide" extends beyond mere connectivity and encompasses disparities in device ownership, digital literacy, and the availability of relevant and accessible content due to language bias. These challenges are often compounded for populations with disabilities, who face additional hurdles such as inaccessible physical environments, lack of assistive devices and technologies, and discriminatory societal attitudes. Globally, over a billion people experience some form of disability, and they disproportionately face adverse socioeconomic outcomes due to these barriers. As of 2025, it is estimated that only 3% of the internet is fully accessible for individuals with disabilities, and this statistic further impacts women who make up the majority of the Next Billion User population (Sabilano, 2024). Unfortunately, these groups face more barriers to connectivity and feel the impacts of the digital divide more than their male and non-disabled counterparts (Ranjan, 2022).

Recognizing these challenges, initiatives like Google's "Next Billion Users,” A4AI, and Level Access emphasize the importance of user research in low-income and middle-income countries to develop inclusive tools and products that address specific needs, such as limited storage on older devices, high data costs, and a preference for mobile-first experiences. This demographic represents more than just a new market, and the nurturing of socio-economic development and global engagement for these members is now at the forefront of humanitarian efforts that can be enacted upon more readily than before.

This project intends to utilize a variety of data science methodologies to highlight patterns within technology adoption and to predict the effects of digital inclusion both on national economic conditions and on the wellbeing of emerging user populations, with a core focus on ensuring equitable access and benefits for underprivileged individuals of minority status and those with disabilities. By analyzing patterns in digital inclusion, educational attainment, and economic indicators, we aim to pinpoint the most impactful drivers of positive transformation, and determine how impactful digital inclusion has been (and can be) to improvements in economic outcomes both at the national and individual level. This project will employ both supervised and unsupervised machine learning and predictive modeling methods to attempt to forecast economic outcomes and the impact of digital inclusion within “clusters” of countries / populations.

***Proposed Research Question***

The following novel research question builds upon prior efforts of large organizations to fill the need of synthesizing separate insights through combining data sets from multiple organizations :

*To what extent has growth in mobile broadband subscriptions influenced both national economic conditions and population wellbeing in more developed nations, and can that be used to predict improvements in educational attainment and well-being among global minority populations (the "next billion users"), and broad economic conditions for the low-income and middle-income countries where they reside?*

This question is worth the time and effort of exploring because if this correlation and predictability does in fact prove strong, it can significantly influence the efforts of governments and international aid organizations, and drive strategy and product design of many global businesses who will be engaging with the newly emerging user population. These policies and efforts span industries from traditional e-commerce efforts to education and to healthcare, to name only a few, and are important for improving global economic outcomes while driving industry profit growth.

***Proposed Hypothesis***

A working hypothesis with potential for modification has been suggested as follows:

* Increased digital inclusion, regardless of whether it is via broadband or mobile means, is a significant factor contributing to overall national economic growth and the education and wellbeing of the "next billion users" in low-income and middle-income countries.
* In addition, mobile broadband likely accelerates this due to its relative ease and inexpensiveness versus fixed broadband - portending well for newer technologies such as satellite-based broadband access.

***Prediction***

Our current working prediction (with the ability to be modified after further collaboration and research) is as follows:

* We expect the data to show that growth in digital inclusion has strong predictive value in influencing economic growth, and thus can be extrapolated as a significant potential driver of economic growth for global minorities within the "next billion users" in low-income and middle-income countries.
* We expect digital inclusion to be a stronger predictor of national economic conditions than of population wellbeing, since governmental, societal and economic structure differences may influence how broadly and equitably those benefits are distributed across the population.
* We expect that increases in mobile broadband will have stronger positive effect on the response variables
* We expect that we may need to cluster countries to maximize predictive accuracy due to noisiness associated with different forms of government, social structure and norms, and geopolitical factors as well as other noise factors we cannot predict.
* All that being said, we also expect performance of any model attempting to predict economic strength and wellbeing based solely on digital inclusion to be directionally useful but quite imperfect. Because there are many other factors that impact these absolute outcomes, it’s likely that our models will be best suited to predict the INCREMENTAL impact of digital inclusion - which is still incredibly useful for guiding policy and investment in the developing world.

***Data & Analysis***

* **DATA**
  + A full list of public data sources we are considering can be found in Appendix A
  + This includes separate data files containing time series and other data for most countries as well as groupings of countries:
    - “Development” indicators across the globe - things such as economic conditions, wellbeing, access to and use of resources, crime rates, pollution etc, going back 60+ years (further back than we need)
    - Categorization of nations and nation groups as being Low Income, Lower Middle Income, Upper Middle Income, and High Income
    - Frequency of disabled individuals in some of these countries but not all - unclear why some (like the USA) are missing
    - Employment, broken down by age, gender and disability
    - Internet, fixed broadband and mobile broadband usage
    - Educational status / level attained
* **EXPECTED DATA PREPARATION**
  + CLEANUP / DEDUPLICATION / DEALING WITH NULLS
  + DATA “TIDYING”
    - Most of the data is in “wide” format - it needs to be made tidy to be usable for machine learning, predictive modeling, and visualization for EDA and other purposes
  + UNIFICATION
    - Data will need to be joined into one contiguous data set by liking data files using common “Country codes” and year timestamps.
  + FEATURE REDUCTION AND TRANSFORMATION
    - The development data that serves as the core of the data set contains over 400,000 “wide” rows, which would translate into millions of “tidy” rows.
    - In addition, it contains over 1,500 discrete “development” data points, which fall into 88 “Topics” (categories).
    - This is an extremely large and complex dataset - as such we will reduce the size and dimensionality of the problem using the following methods:
      * FEATURE REDUCTION: Features we deem duplicative, covariant, or simply not germane to our thesis will be eliminated. We will also eliminate all data prior to 1995 which is the very beginning of the advent of the internet (given our thesis).
      * DIMENSION REDUCTION:
        + We will grouping the data into far fewer categories than the 88 “topics” that map to either inputs (features) or outputs (responses), using a methodology to be determined
        + We will create “indexes” that reduce the dimensionality much further, and transform the feature and response data from raw quantitative data into normalized data scores
    - Finally, we will reflect a time lag in our analysis, which will likely be accomplished as part of the feature and/or response transformation process. This is crucial because changes to economic inputs (such as access to broadband, mobile, internet) take time to ripple through and be reflected in economic and wellbeing data.
* **MODELING METHODOLOGY**
  + MODEL STEP 1: We will develop both statistical (regression, tree-based etc.) and machine-learning models that look to predict both future national economic conditions and population well-being, either on a “point in time” basis or using period-to-period change, as a function of digital inclusion
    - FEATURES: Subset of features representing digital inclusion
    - RESPONSE: Index of national economic conditions and population well-being developed during the dimension reduction exercise. (Note this makes it a categorization / classification exercise rather than a strict mathematical predictor)
    - MEASURING OF SUCCESS: We will measure success using overall model accuracy, an NxN confusion matrix, precision and recall. We will deem the first question (“can we predict change in economic output and/or wellbeing based on digital inclusion”) answered if the model either is pretty accurate (e.g. “YES”) or pretty inaccurate / random (e.g. “NO”). The “YES” scenario would prove this most rigid component of our hypothesis
  + MODEL STEP 2: If the answer to question one is “NO” we will proceed to modeling the data to answer the question differently, as follows:
    - We will build and run the first model seeking to predict economic growth and well-being using the broader set of transformed features representing additional potential inputs to the problem
    - We will build and run a second model, using the first model but EXCLUDING the digital inclusion features
    - We will compare the results of the two models to determine whether including the digital inclusion data adds to the predictability of the model.
  + MODEL STEP 3: We will build both a qualitative and a quantitative (algorithmic) clustering model that seeks to cluster the countries based on common characteristics in order to glean further insights into the potential relationship between digital inclusion and economic outcomes.
  + MODEL STEP 4: If time permits, we will look at building predictive models using only data from countries within certain segments to see if predictions improve, and then seek to apply learnings. For example, we could create a cluster of countries that we know lifted themselves out of low income into higher income categories and assess the impact of digital inclusion, then extrapolate that onto the remaining low income countries.
* **OTHER TECHNICAL INFO**
  + *Languages / platforms used:*  Python (primary), R (secondary / EDA), PostgreSQL (possibly for data prep), Tableau (presentation visuals)
  + *Github Repository:* <https://github.com/Merrimack-Capstone/MSDS-capstone>
  + *Other resources:* None contemplated at this time

***Proposed Use of LLM / Generative AI to assist with this project***

* LLM can be extremely effective at assessing the existing “topics” (categories) and collapsing them into a much smaller set of categories for dimension reduction
* Given the complexity of the data set, we may use a LLM for suggestions (NOT CODE) on how to visualize the EDA to see if our hypotheses have a chance of holding water
* Away from this, use of LLM will be limited to suggestions on debugging code we wrote, and grammar / spelling / flow of our presentation materials - **no code or presentation / report text or other content included in the project will be LLM-generated**

**APPENDIX A: POTENTIAL DATA SOURCES**

| **File Name** | **Underlying Data Source** | **Contains** |
| --- | --- | --- |
| Active Mobile Broadband Subscription.xlsx | ITU Data Hub  <https://api.datahub.itu.int/v2/data/download/byid/11632/iscollection/false> | Country, Year, Year Value |
| Classification by Income.xlsx | WORLD BANK GROUP  <https://datacatalogfiles.worldbank.org/ddh-published/0037712/DR0095333/CLASS_2025_07_02.xlsx> | Classification of each country into an Income “bucket” |
| Disability Data - Overall Prevalence.xlsx | WORLD BANK GROUP  <https://disabilitydata.worldbank.org/en/indicator/adj_al_alot_dfcl> | Overall prevalence of disability by country |
| Employment by sex, rural v urban areas and disability status.xlsx | International Labour Organization  <https://rplumber.ilo.org/data/indicator/?id=POP_XWAP_SEX_GEO_DSB_NB_Q&lang=en&type=label&format=.xlsx&channel=ilostat&title=working-age-population-by-sex-rural-urban-areas-and-disability-status-quarterly> | Country, Sex, Area Type, Disability, Time, Observation Value |
| Fixed Broadband Subscription.xlsx | ITU Data Hub  <https://api.datahub.itu.int/v2/data/download/byid/19303/iscollection/false> | Country, Year, Value for Year (per 100 People) |
| Internet Users by Country and Year | ITU Data Hub  <https://api.datahub.itu.int/v2/data/download/byid/11624/iscollection/false> | Country, Percent Using Internet, Year |
| Education Preparedness Data.xlsx | UNESCO  <https://databrowser.uis.unesco.org/view#aths=&geoMode=countries&geoUnits=&timeMode=range&view=table&chartMode=multiple&chartHighlightSeries=&chartHighlightEnabled=true&indicatorPaths=UIS-SDG4Monitoring%3A0%3APREPFUTURE.1.MATH%2CUIS-SDG4Monitoring%3A0%3APREPFUTURE.2.MATH%2CUIS-SDG4Monitoring%3A0%3APREPFUTURE.1.READ%2CUIS-SDG4Monitoring%3A0%3APREPFUTURE.2.READ> | Indicator ID (Primary/Secondary: Math/Reading), Country, Year, Value |
| World Development Indicators.xlsx | WORLD BANK GROUP  <https://datacatalogfiles.worldbank.org/ddh-published/0037712/DR0095336/WDI_EXCEL_2025_07_02.zip> | Over 1,500 “development” indicators within 85 “topics” for over 200 countries going back 60 years |

**APPENDIX B: REFERENCES**

A4AI (2022). Advancing Meaningful Connectivity: Towards Active & Participatory Digital Societies.

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Ranjan, P. (2022, March 15). An anthology of insights, for a more inclusive internet. Google. <https://blog.google/technology/next-billion-users/anthology-insights-more-inclusive-internet/>

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