# Introduction & Literature Review

The success or failure of technological solutions within a professional organization or public institution is dependent on many factors going into the project itself. Variables as diverse as process, governance, financial investment, and executive sponsorship have direct influence. An often-overlooked factor, however, is the readiness of human resources beyond the simple communication of upcoming changes.

Employee training, though often included as part of the scope of overall management practices, has not been examined in depth in terms of its direct influence on the success of an organization as measured by that organization’s performance or the measured success of individual projects. Jakob Shneebacher provides a general examination of management practices throughout the United Kingdom, for instance (Schneebacher, 2021). In his analysis, Schneebacher cites a strong and significant relationship between management practices and measurements of business success. Employee training, however, is included as a part of a group of measures that include promotion and employee underperformance.

Similarly, Ochola (Ochola, 2018) examines employee motivation as a larger subject that includes employee training. Ochola does emphasize organizational performance in relation to motivation, stating that "the capability of drawing, holding and advancing employees that are talented are the main characteristics of a business that is successful" (Ochola, 2018). Training and skills development specifically are identified as key factors that ensure and employee feels empowered and is more likely to embrace organizational goals. Ochola does not engage in experimental analysis, though, and concentrates on a review of existing literature.

Additional analysis by Hanaysha (Hanaysha, 2016) has demonstrated strong relationships between employee training specifically and employee commitment. Commitment is roughly defined as whether an employee identifies themselves with the organization and aligns to the organization's goals and values. More directly, it is the willingness of the individual to remain associated with the organization (i.e. remain employed) and their commitment to their work. Employee commitment goes beyond merely doing the job and manifests as a desire to be productive within that job. Hanaysha examines employee empowerment and teamwork as well as employee training, and concluded that all three have a significant positive effect on employee commitment with training demonstrating the highest t-value of the three.

R.A. Khan et. al. (Khan, Khan, & Khan, 2011) provide the most direct association, showing that not only does training improve employee performance, but that improved performance leads to improved organizational performance. As with Ochola and Schneebacher, Khan et. al. state that employee performance is dependent on many factors including job satisfaction and management practices. Their analysis, though, concentrates on employee training, examining three factors of training: on-the-job (vs. through books or online), training design, and the delivery style of the trainer. The authors conclude all three variables have a strong positive influence on organizational performance.

Of note across much of the literature examined is the absence of experimental links between training employees on a skill set and the direct application of that skill set toward the success of an organization's projects or overall performance. Ochola's literature review (Ochola, 2018), though citing several other analyses, is noticeably lacking any experimentation. Hanaysha (Hanaysha, 2016) indicates an association between employee commitment and organizational performance but stops short at examining the commitment. Further, Hanaysha focused on the public universities in northern Malaysia, both limiting the geographical scope of the study as well as possibly biasing the outcomes based on individuals already committed to education.

Although the analysis conducted by Khan et. al. does include experimentation, they admit in their introduction that the results are "strongly based on the literature review" (Khan, Khan, & Khan, 2011). The actual experiment consists of analyzing 79 surveys with 15 questions, indicating the employees themselves have assessed the value of the training they have received with limited objective evidence of improved performance.

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The analysis in this document attempts to provide a more empirical demonstration of the direct relationship between training individuals on new technology and the success of those technological solutions. More specifically, through the analysis of survey data collected by the World Bank Group, I will examine the hypothesis that training has a positive impact on organizational success and on the outcome of specific projects.

## Hypotheses

*H0 [NULL]: The introduction of internal employee training programs on technology and data have no impact on the success of the implementation of that technology.*

*H1: Introducing internal employee training programs on technology and data improve the success rate of specific technology projects implemented within those organizations.*

*H2: Introducing internal employee training programs on technology and data improve the overall technological performance of an organization.*

# Data & Methodology

For this project, I will examine the success rate of implementing technological solutions within world government structures in relation to the inclusion of employee training on technology. Success will be measured based on two indicators:

* The GovTech Maturity Index (GTMI) score assigned by the World Bank Group (WBG), indicating the maturity of a country's digital government transformation.
* Outcome ratings (Satisfactory/Unsatisfactory) of WBG funded projects by country.

All data has been obtained from the WBG either through their annual GovTech Maturity Index (GTMI) Update or the Digital Governance Projects Database. The GTMI is a report on the state of Technology services and solutions as implemented by central governments throughout the world. The GTMI assessment includes 198 world economies obtained through surveys and remote data collected from non-participating countries.

The GTMI was launched in 2020, and all data is published by the WBG in the GovTech Dataset ([GovTech Dataset | Data Catalog (worldbank.org)](https://datacatalog.worldbank.org/search/dataset/0037889/GovTech-Dataset)). However, due to restrictions in accessing this dataset through the API, I chose to make use of the published data in the Excel files downloaded from the site. GovTech data published in October 2022 includes results for the dataset published in December 2020. I did not include the 2020 data due to specific indicators/metrics that were not implemented that year. More specifically, the metrics used for this analysis were not in the 2020 dataset.

Additional data used for this analysis came from the Digital Governance Projects Database ([Digital Governance Projects Database | Data Catalog (worldbank.org)](https://datacatalog.worldbank.org/search/dataset/0038056/digital-governance-projects-database)). This provides details of 1,449 projects funded by the WBG in 147 countries, including cost, duration, and outcome ratings of completed activities. For this analysis, I focused on the success rating of projects within countries also evaluated in the GovTech Dataset. Again, data from the October 2022 data set was used through a download of the available Excel file at the site. Additionally, country lookup data was established through code to account for mismatched country names between the two data sets.

## Data Tables

The following tables show the variables extracted from each file. Although each file includes an extensive set of variables, only the variables listed in these tables will be considered for the purpose of this project. Note that several variables were renamed from the original source for ease of reference within this project. In the following tables, the original name from the data source is provided (Original Name), along with the name to be used in this project (Project Name).

### Data Source: WBG\_GovTech Dataset\_Oct2022.xlsx (GovTech)

<https://datacatalog.worldbank.org/search/dataset/0037889/GovTech-Dataset>

|  |  |  |  |
| --- | --- | --- | --- |
| Original Name | Project Name | Description | Values |
| Code | Code | Standard WBG Abbreviation for a country. | Text (3 characters) |
| Economy | Country | The name of the country | Text |
| Population | Population | Population of the country in thousands | Numeric |
| Level | IncomeLevel | Income level (abbreviation) | H (High) / UM (Upper middle) / LM (Lower middle) / L (Low) |
| Reg | Region | Mapping to the World Bank regions (abbreviation) | AFR / EAP / ECA / LCR / MNA / SAR |
| Grp | Group | GovTech Maturity Index group: | A: Very high (>= 0.75) B: High (>= 0.50 and < 0.75) C: Medium (>= 0.25 and < 0.50) D: Low (< 0.25) |
| GTMI | GTMI | GTMI score | 0 to 1 |
| CGSI | CGSI | Core Government Systems Index score | 0 to 1 |
| PSDI | PSDI | Public Sector Delivery Index score | 0 to 1 |
| DCEI | DCEI | Digital Citizen Engagement Index score | 0 to 1 |
| GTEI | GTEI | GovTech Enablers Index score | 0 to 1 |
| I-45 | DS\_Strategy\_Program | Is there a government strategy/  program to improve digital skills in the public sector? | 0 = No, 1 = Yes (Only strategy or program), 2 = Yes (Both strategy and program) |
| I-45.4 | FocusArea | Focus areas of the DS strategy | 0 = Unknown, 1 = Basic digital skills, 2 = Basic digital skills + Data literacy, 3 = Advanced digital skills + Data literacy |
| I-45.5 | DSProgram | Is there a DS program? | 0 = No, 1 = Yes |
| I-45.5.1 | DSProgramType | If Yes > Type of primary DS  program(s) | 1 = Academic program, 2 = Public sector program, 3 = CSO/Private program |
| I-45.5.3 | DSProgramMandatory | If Yes > DS program mandatory for  new public employees? | 0 = Unknown, 1 = Not mandatory, 2 = Mandatory |
| I-45.6 | DSProgramExternal | Are there digital skills programs offered by governments for  citizens/schools? | 0 = No, 1 = Yes (fee-based programs), 2 = Yes (freely available programs) |
| I-45.7 | DSProgramPublished | Publishing of the results/progress in DS programs? | 0 = No, 1 = Yes (internal, not published), 2 = Yes (public, published) |

### Data Source: WBG\_DG-GovTech\_Projects\_Oct2022.xlsx (Projects)

<https://datacatalog.worldbank.org/search/dataset/0038056/digital-governance-projects-database>

|  |  |  |  |
| --- | --- | --- | --- |
| Original Name | Project Name | Description | Values |
| Project ID | ProjectID | Project Identifier | Text |
| Region | Region | Mapping to the World Bank regions (abbreviation) | AFR / EAP / ECA / LCR / MNA / SAR |
| Country | Country | The name of the country where the project occurred | Text |
| ICROut | ICROutcome | Implementation Completion Report (ICR) Project Outcome rating – based on assessment completed within 6 months after closure of project by WBG project team | Standard ICR ratings : HS / S / MS / MU / U / HU |
| IEGOut | IEGOutcome | Independent Evaluation Group (IEG) Project Outcome rating = based on a review within 6 months after delivery by independent review board for validation. | Standard ICR ratings : HS / S / MS / MU / U / HU |

### Data Source: API\_NY.GDP.MKTP.CD\_DS2\_en\_csv\_v2\_4770391.csv (GDP)

<https://data.worldbank.org/indicator/NY.GDP.MKTP.CD>

|  |  |  |  |
| --- | --- | --- | --- |
| Original Name | Project Name | Description | Values |
| Country Name | Country | The name of the country | Text |
| Country Code | Code | Standard WBG Abbreviation for a country. | Text (3 characters) |
| 2021 | GDP2021 | The country’s Gross Domestic Product (GDP) for 2021 in US dollars. | Numeric |

### Summary Statistics

The following tables include summary statistics for some of the key variables I will be using in this project. I have separated categorical and non-numeric variables from numeric.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Variable | Count | Mean | Median | Std | Min | Max |
| GTMI | 198 | 0.552226 | 0.572181 | 0.261910 | 0.019134 | 0.991409 |
| CGSI | 198 | 0.574616 | 0.581023 | 0.237276 | 0.002509 | 0.990160 |
| PSDI | 198 | 0.649481 | 0.738621 | 0.284674 | 0.000000 | 1.000000 |
| DCEI | 198 | 0.448667 | 0.394079 | 0.314998 | 0.002499 | 0.997501 |
| GTEI | 198 | 0.536139 | 0.568245 | 0.276343 | 0.036503 | 0.983757 |
| GDP | 245 | $3,275,719M | $67,404M | $10,795,732M | $63M | $96,513,077 |

|  |  |  |  |
| --- | --- | --- | --- |
| Dataset | Variable | Count | Comment |
| GovTech | Code | 198 | 198 countries were included in the original GovTech assessment. |
| GovTech | DS\_Strategy\_Program | 0: 65  1: 67  2: 66 | 0 = No Strategy or Program  1 = Yes (Only strategy or program)  2 = Yes (Both strategy and program) |
| GovTech | FocusArea | 0: 69  1: 31  2: 32  3: 66 | 0 = Unknown focus for the strategy/program  1 = Basic digital skills  2 = Basic digital skills + Data literacy  3 = Advanced digital skills + Data literacy |
| GovTech | DSProgramType | 0: 100  1: 7  2: 76  3: 15 | 0 = None or unknown  1 = Academic program  2 = Public sector program  3 = CSO/Private program |
| Projects | ProjectID | 1024 | 1024 projects subsidized by WBG with at least one project outcome rating |
| Projects | ICROutcome | |  |  | | --- | --- | | HS: | 33 | | S: | 485 | | MS: | 316 | | MU: | 104 | | U: | 64 | | HU: | 5 | | |  |  | | --- | --- | | HS: | Highly Satisfactory | | S: | Satisfactory | | MS: | Moderately Satisfactory | | MU: | Moderately Unsatisfactory | | U: | Unsatisfactory | | HU: | Highly Unsatisfactory | |  |  | |
| Projects | IEGOutcome | |  |  | | --- | --- | | HS: | 25 | | S: | 295 | | MS: | 372 | | MU: | 158 | | U: | 80 | | HU: | 12 | | |  |  | | --- | --- | | HS: | Highly Satisfactory | | S: | Satisfactory | | MS: | Moderately Satisfactory | | MU: | Moderately Unsatisfactory | | U: | Unsatisfactory | | HU: | Highly Unsatisfactory | |  |  | |

## Analysis Methodology

This analysis will use both Linear (OLS) Regression and Logistic (Logit) Regression to analyze the influence of the inclusion of a Digital Skills strategy or program within each government, including the level of skills training provided, and the type. Additional independent variables are included to reduce omitted variable bias (OVB) including population and GDP.

Specifically, my dependent variables will be: GTMI, ICROutcome, and IEGOutcome. My primary independent variables will include:

|  |
| --- |
| GTEI |
| DS\_Strategy\_Program |
| FocusArea |
| DSProgram |
| DSProgramType |
| DSProgramMandatory |
| DSProgramExternal |
| DSProgramPublished |

I introduce three independent variables to reduce omitted variable bias (OVB) including population, income levels, and GDP. Although these variables can not eliminate OVB, my goal is to reduce bias to a level that can be used to assess the significance of the independent variables of interest.

Because the **ICROutcome** and **IEGOutcome** variables are categorical rather than continuous, these variables are converted into simple bivariate variables indicating Successful (1) or Unsuccessful (0) for a project. With this conversion, we can leverage Logit regression to understand the significance of Skills Training variables on project success.

# Analysis

# Discussion and Conclusion

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Additionally, I would like to evaluate regression outcomes across the groups identified by the WBG report. Based on the GTMI score, WBG identifies a grouping of the country in terms of its GovTech maturity. Theoretically, countries scoring higher in the GTMI would be more likely to 1) have implemented a Digital Skills program and 2) have a higher rate of success on projects.

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