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Google Apps Script-Based Automation for DPWH Project Document Preparation: A Developmental Design Science Case Study

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Abstract- ***This study documented the development and preliminary artifact-based evaluation of a Google Apps Script-based document generation engine for selected DPWH project document preparation. The problem addressed was the continued manual or semi-manual preparation of formal project documents despite the availability of structured digital data in spreadsheet-based sources. Using a developmental design science case study approach, the study examined a Google Workspace artifact that connects Google Sheets data with Google Docs templates through predefined placeholders. No external respondents were involved; instead, the evaluation used artifact-based evidence, including workflow comparison, step count, time trial records, repeated encoding count, output consistency testing, limitation logging, and researcher observation. Results showed that the artifact-supported workflow reduced counted workflow steps from 45 to 8, decreased listed repeated encoding points from 10 to 0, and shortened researcher-conducted preparation time for both a certification document and a Straight-Line Diagram vital dates document. The tested certification output passed 14 of 14 output consistency checks. However, the findings are limited to selected document tests and should not be interpreted as proof of office-wide productivity improvement or full deployment readiness. The study contributes a practical case of Google Workspace-based document automation and identifies future improvement needs, including placeholder standardization, missing-field testing, and support for complex document structures.***

Index Terms- ***Developmental Design Science, Document Generation, Google Apps Script, Google Docs Automation, Process Improvement.***

I. INTRODUCTION

Government engineering offices rely heavily on formal documents for project monitoring, reporting, contract administration, communication, and compliance. In DPWH-related project environments, documents such as certifications, Straight Line Diagrams, executive summaries, project engineer's reports, chronology of events, contractual data, and communication letters support administrative and technical decision-making. These documents require accurate data, proper formatting, updated signatories, formal headers and footers, and readiness for checking, routing, or printing.

Despite the availability of digital tools such as Google Sheets, AppSheet, and other spreadsheet-based systems, many formal project documents remain manually or semi-manually prepared. Project data may already exist in structured digital form, but personnel still manually transfer information into Microsoft Word or Google Docs templates. This creates a gap between structured data storage and formal document generation. The result may include repeated encoding, manual copy-paste, formatting inconsistencies, outdated template use, and additional checking work.

Google Apps Script provides a practical platform for addressing this workflow gap because it can automate and extend Google Workspace applications. In particular, it can work with Google Docs and Google Sheets, making it suitable for connecting structured data sources with formal document templates. This study therefore developed and preliminarily evaluated a Google Apps Script-based document generation engine that fetches project data from Google Sheets and inserts it into Google Docs templates through predefined placeholders.

The study was guided by the following main research question: How can a Google Apps Script-based

document generation engine support the preparation of selected DPWH project documents using structured data from Google Sheets and Google Docs templates?

Specifically, the study examined the manual workflow problem, artifact design, process differences, output consistency results, and improvement needs that emerged during artifact development and testing.

II. RESEARCH ELABORATIONS

A. Literature and Conceptual Basis

Digital transformation in government involves more than digitizing records. It also requires connecting data, platforms, and workflows so that public-sector operations can become more structured and responsive. OECD digital government literature emphasizes digital-by-design and data-driven public-sector practices, which are relevant to documentation-heavy government workflows [8], [9]. In DPWH-related documentation, formal standards are important because official documents are used for communication, reporting, compliance, and administrative action. The DPWH Policy Issuance and Correspondence Manual reinforces the importance of standardized document preparation and correspondence practices [3]. This context supports the need for automation tools that do not merely transfer data but also preserve formal document structure and readability.

Google Apps Script is a scripting platform that can automate and extend Google Workspace applications. Google Developers documentation states that Apps Script can be used to create and modify Google Docs programmatically [4]. The Apps Script Document service also allows interaction with document components such as body elements, paragraphs, lists, and tables [5]. These capabilities support the technical feasibility of a placeholder-based document generation engine.

Design science research is appropriate when the central research contribution is a designed artifact intended to solve a practical problem. Hevner et al. describe design science in information systems as research involving the creation and evaluation of useful artifacts [6]. This study follows that logic because the Google Apps Script engine is the main artifact. A case study approach also fits the study because the artifact was examined within a specific workflow context using multiple sources of evidence [10].

The study also used a process improvement lens. DMAIC supports structured improvement by defining, measuring, analyzing, improving, and controlling a process [1]. PDCA supports iterative change through planning, doing, checking, and acting [2]. These approaches are relevant because the study measured workflow steps, preparation time, repeated encoding points, output consistency, and remaining limitations.

The conceptual basis of the study follows an Input–Process–Output with Evaluation framework:
Existing Manual/Semi-Manual DPWH Document Workflow
→ Structured Google Sheets Data Source and Google Docs Template
→ Google Apps Script Document Generation Engine
→ Generated Google Docs Output
→ Artifact-Based Evaluation
→ Process Improvement Recommendations and Future Development Controls

B. Research Design

This study used a developmental design science case study approach. The design was appropriate because the study focused on designing, documenting, testing, and evaluating a Google Apps Script-based document generation artifact. A single-case process improvement lens supported the study by comparing the current manual or semi-manual workflow with the Google Apps Script-supported workflow.

The study did not use a survey, user acceptance test, or employee satisfaction instrument. It was not designed to measure perception or workplace adoption. Instead, it focused on artifact-based and process-based evidence.

C. Study Setting and Unit of Analysis

The study was situated in a government engineering office involved in DPWH-related project documentation, monitoring, and report preparation.

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The specific office name, project identifiers, contract numbers, staff names, document identifiers, file IDs, Drive links, official signatures, and internal records were excluded from the research output.

The unit of analysis was the Google Apps Script document generation engine and its supported Google Sheets–Google Docs document preparation workflow. This included the Google Sheets data source, Google Docs template, Apps Script engine, runner function, generated Google Docs output, Google Drive storage, and testing records.

D. Artifact Description

The artifact developed in the study was the DPWH Google Docs AutoFill Engine Prototype. Its main function was to fetch selected project data from Google Sheets and fill Google Docs templates using predefined placeholders. It supported selected DPWH project-related documents, especially Time Variance-related documents such as certification documents and Straight Line Diagram vital dates documents.

Table 1. Artifact Profile of the Google Apps Script Document Generation Engine

Item	Description
Artifact name	DPWH Google Docs AutoFill Engine Prototype
Artifact type	Google Apps Script-based document generation engine
Main function	Fetches selected project data from Google Sheets and fills Google Docs templates using predefined placeholders
Workflow supported	Preparation of selected DPWH project-related documents, especially Time Variance-related documents
Input data source	Google Sheets table containing anonymized project details
Output produced	Generated Google Docs document with project-specific data inserted into a formal template
Development stage	Working prototype / internal testing
Known limitation	Works best for text-based placeholders and still needs refinement for complex tables, images, and advanced formatting

The artifact used a modular Apps Script structure consisting of configuration, utility, core engine, runner, and document utility files. Examples of script modules included 01_CFG_BASE, 02_TEXT_UTILS, 03_DATE_UTILS, 04_NUMBER_UTILS, 00_ENGINE, 10_RUNNERS, and 90_DOCS_UTILS.

A sanitized runner function used in the artifact is shown below:

```
function RUN_AnnexB4() {
  return RUN_generateUniversalDoc_WITHCFG_({
    TEMPLATE_ID: "[Template File ID]",
    DEST_FOLDER_ID: "[Destination Folder ID]",
    OUTPUT_TITLE_SUFFIX: "Annex B-4 Certification",
    OUTPUT_NAME_APPEND_FROM_REPLACEMENTS: ["<<Type of Request>>"]
  });
}
```

This runner function shows that a specific document generation task can call a universal document generation function while supplying the template file, destination folder, output title suffix, and filename configuration.

E. Data Sources and Instruments

The study used artifact-based evidence sources and process documentation instruments. These included workflow mapping, artifact profile, component inventory, placeholder mapping table, screenshot documentation checklist, workflow step count sheet, time trial recording sheet, repeated encoding point count sheet, output consistency testing matrix, error and limitation log, development iteration log, and researcher field note.

F. Data Gathering Procedure

The researcher first documented the current workflow: gathering data through the Monitoring Section, using a Microsoft Word document, manually encoding data one by one, manually checking the document, and preparing it for printing. The proposed workflow was then documented: gathering data using the sheet file of the Monitoring Section, transferring or pasting data to Google Sheets, using the dedicated runner in the Apps Script file 10_RUNNERS, conducting quick checking, and preparing the document for printing.

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The artifact was then described through its profile, component inventory, Apps Script module structure, and placeholder mapping. The researcher recorded workflow step counts, time trials, repeated encoding counts, output consistency testing results, limitations, and researcher observations. The collected evidence was organized into workflow comparison tables, step count tables, time trial tables, encoding count tables, output consistency matrices, limitation summaries, and findings matrices.

G. Data Analysis

The study used descriptive, comparative, and artifact-based analysis. The following formulas were applied:

Percent Step Reduction = (Reduced Steps / Current Workflow Steps) × 100

Percent Time Reduction = (Time Difference / Manual Process Time) × 100

Percent Encoding Reduction = (Reduced Encoding Points / Manual Encoding Points Before) × 100

Output Consistency Rate = (Number of Passed Test Items / Total Test Items) × 100

No inferential statistical testing was used because the study did not involve a sample of respondents or large-scale numerical observations. The results were interpreted as preliminary artifact-based findings from a selected workflow case.

III. RESULTS AND FINDINGS

A. Workflow Comparison

The current workflow involved gathering data through the Monitoring Section, using a Microsoft Word document, manually encoding data one by one, manually checking the document, and preparing it for printing. The proposed workflow used Google Sheets as a structured source and a dedicated Apps Script runner to generate the document, followed by quick checking.

Table 2. Manual and Google Apps Script-Supported Workflow Comparison

Workflow Stage	Current Manual/Semi-Manual Workflow	Google Apps Script-Supported Workflow	Observed Change
Data gathering	Gather data through the Monitoring Section	Gather data using the sheet file of the Monitoring Section and transfer/paste data to Google Sheets	Data source becomes more structured
Document tool	Use Microsoft Word document	Use Google Docs template connected to Apps Script	Template becomes automation-ready
Data entry	Manually encode data one by one	Use dedicated runner in Apps Script file 10_RUNNERS	Manual encoding is reduced or removed
Data insertion	Copy and paste data into the document	Script replaces placeholders with Google Sheet values	Placeholder-based insertion replaces manual transfer
Checking	Manual checking	Quick checking	Checking remains, but predictable edits are reduced
Output readiness	Ready to print after manual checking	Ready to print after generated output and quick checking	Output generation becomes more controlled

B. Workflow Step Count

Table 3. Workflow Step Count Comparison

Process Segment	Current Workflow Steps	Supported Workflow	Reduced Steps	Percent Reduction
Data gathering	2	2	0	0.00%
Data lookup	2	1	1	50.00%

Manual encoding / copy-paste	17	0	17	100.00%
Template preparation	1	1	0	0.00%
Placeholder/data insertion	17	1	16	94.12%
Formatting check	3	1	2	66.67%
Output generation	1	1	0	0.00%
Record storage	1	1	0	0.00%
Revision handling	1	0	1	100.00%
Total	45	8	37	82.22%

The artifact-supported workflow reduced the total counted workflow steps from 45 to 8, equivalent to an 82.22% reduction in the tested workflow case. The largest reductions were in manual encoding/copy-paste and placeholder/data insertion.

C. Time Trial Results

Table 4. Time Trial Results for Selected Document Preparation Tasks

Task Tested	Manual/Semi-Manual Time	Apps Script-Supported Time	Time Difference	Percent Time Reduction
Certification document	3 min 28 sec	1 min 21 sec	2 min 7 sec	61.06 %
SLD vital dates document	32 min 18 sec	3 min 7 sec	29 min 11 sec	90.35 %

The researcher-conducted time trials showed shorter preparation times for both tested tasks. The larger reduction occurred in the Straight Line Diagram vital dates document, likely because the manual version involved more date-related entries.

D. Repeated Encoding Reduction

Table 5. Repeated Encoding Point Reduction

Data Field / Information Type	Manual Encoding Points Before	Encoding Points After Artifact Support	Reduced Encoding Points
Project name	1	0	1
Contract ID / project identifier	1	0	1
Project location	1	0	1
Contractor / responsible party	1	0	1
Start date / effectivity date	1	0	1
Expiry date / completion date	1	0	1
Signatory name / designation	1	0	1
Document date	1	0	1
Standard paragraph text	1	0	1
Output file name	1	0	1
Total	10	0	10

The repeated encoding count showed that 10 listed encoding points were reduced to 0 in the tested artifact-supported process.

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E. Output Consistency Testing

Table 6. Output Test Status Summary

Output Test Status	Frequency	Percentage
Passed	14	100.00%
Passed with minor issue	0	0.00%
Failed	0	0.00%
Needs revision	0	0.00%
Not tested	0	0.00%
Total	14	100.00%

The tested certification output passed all 14 output consistency checks. These checks included placeholder replacement, project information insertion, date formatting, signatory field appearance, header/footer formatting, paragraph formatting, output file creation, output file naming, folder location, script execution, and document readability. This result applies only to the tested certification output and should not be generalized to all DPWH document templates.

F. Limitations and Improvement Needs

Table 7. Error, Limitation, and Improvement Summary

Issue / Limitation	Evidence Basis	Effect on the Study	Recommended Action
Quick output checking remains necessary	Researcher observation	Automation supports drafting but does not remove formal review	Maintain output checking checklist
Placeholder naming must be standardized	Researcher observation and artifact design	Inconsistent names may cause unreplaced placeholders in future templates	Prepare a formal placeholder naming guide
Complex document structures need refinement	Researcher observation and known artifact limitation	Current prototype is strongest for text-based placeholders	Develop and test table, image, and advanced formatting modules
Missing-field handling was not fully stress-tested	Output test had no missing field	Blank source data behavior remains uncertain	Conduct deliberate blank-field test
Findings are case-specific	Evidence is based on selected document tests	Results cannot be generalized to all DPWH documents	Test additional document types and templates

IV. DISCUSSION

The findings suggest that the Google Apps Script-based document generation engine can support selected DPWH project document preparation by connecting structured data with formal document templates. The artifact reduced counted workflow steps, reduced listed encoding points, and shortened researcher-conducted preparation time in the tested cases. These findings align with the process improvement logic of reducing non-value-adding manual activities such as repeated encoding, copying, and checking.

From a design science perspective, the study demonstrates the development and preliminary evaluation of an information systems artifact. The artifact addressed a practical problem: the separation between structured project data and formal document output. The results show that the artifact performed its core function in the tested certification output by replacing placeholders, preserving formatting, generating a new document, and producing a readable output.

The findings also show the importance of control and refinement. The prototype passed all output consistency checks for the tested certification output, but quick checking remains necessary. This is expected in formal document workflows because generated documents still need to be reviewed before routing or printing. The study therefore does not claim that automation eliminates human review. Instead, it suggests that automation may reduce predictable manual data transfer while leaving formal verification intact.

The study also identified future development needs. Placeholder naming must be standardized across Google Sheets and Google Docs templates. Missing-field handling must be deliberately tested. Complex templates involving tables, images, and advanced formatting require further development. These limitations are important because they show that the artifact is a working prototype, not a finished universal system.

For public-sector digital transformation, the study contributes a practical example of small-scale workflow automation. It shows how Google Workspace tools can be combined to address a specific documentation bottleneck. However, the findings should remain case-specific. The time trial results were researcher-conducted, and output consistency testing was fully documented for the tested certification output. Further testing is needed before broader claims can be made.

V. CONCLUSION

This study documented the development and preliminary artifact-based evaluation of a Google Apps Script-based document generation engine for selected DPWH project document preparation. The artifact connected structured Google Sheets data with Google Docs templates through placeholder replacement and a dedicated Apps Script runner.

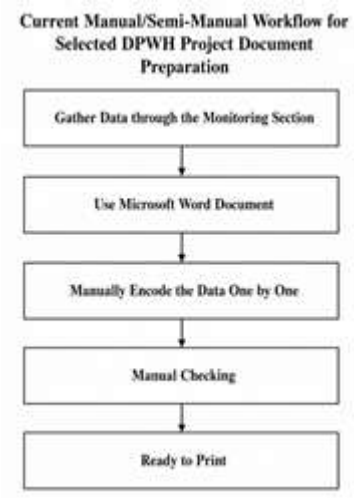
The findings showed that the artifact-supported workflow reduced counted workflow steps from 45 to 8, decreased listed encoding points from 10 to 0, shortened researcher-conducted preparation time for two tested document tasks, and generated a certification output that passed all 14 output consistency checks. These results suggest that the artifact has practical potential for supporting selected document preparation workflows.

However, the findings should be interpreted cautiously. The study did not include external respondents, did not measure user acceptance, and did not evaluate office-wide productivity. Output consistency testing was fully documented for the tested certification output, while the Straight Line Diagram vital dates document was included mainly in timing comparison. The artifact also still requires further refinement for missing-field handling, placeholder standardization, complex tables, images, and advanced formatting.

The study recommends the development of a formal placeholder naming guide, maintenance of an output checking checklist, missing-field and invalid-data stress testing, expansion of output consistency testing to additional document types, and further support for complex tables, images, and advanced document formatting. Overall, the study provides preliminary artifact-based evidence that Google Apps Script can support selected DPWH project document preparation by bridging structured data and formal Google Docs templates.

APPENDIX

Appendix A
Workflow Maps
Current workflow:



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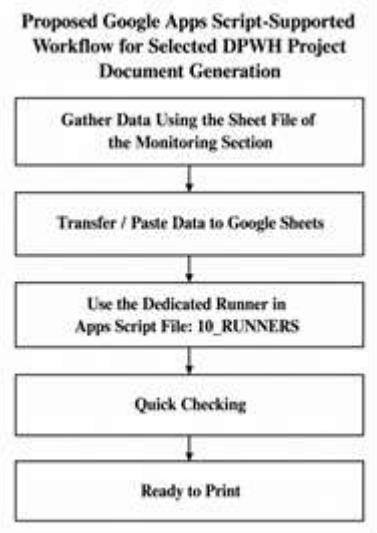
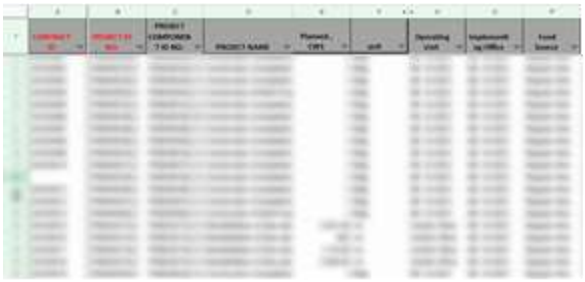
Proposed workflow:

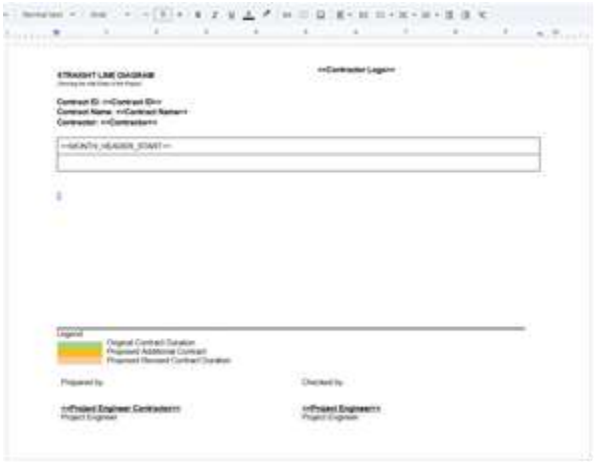


Appendix B



Google Docs Template with Placeholders (Certificate)

Google Docs Template with Placeholders (SLD Showing Vital Events)



Apps Script Runner Function

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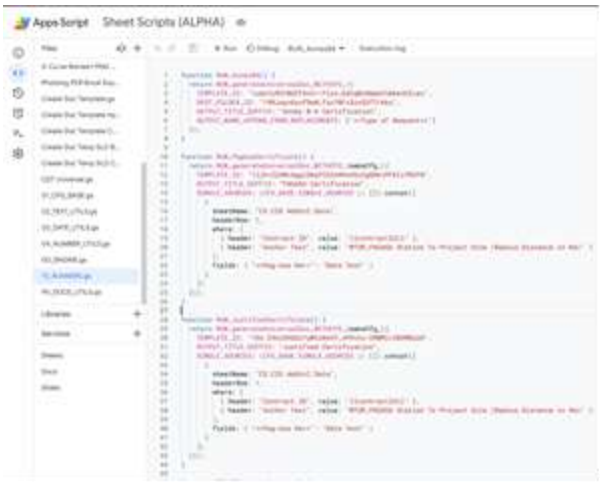
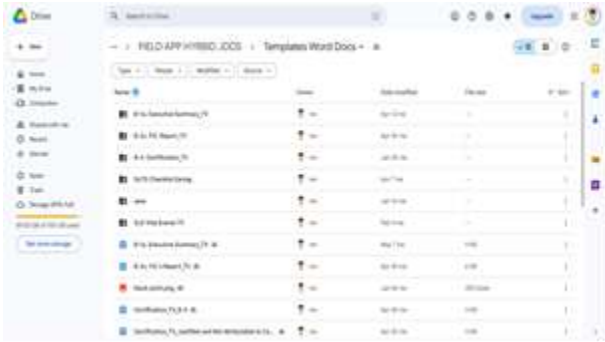


Apps Script Execution Log

Google Drive Output Folder

Generated Google Docs Output



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