Griffith School of Engineering

Griffith University

6007ENG – Industry Affiliates Program

Structural Health Monitoring of the Griffith Footbridge Using LoRaWAN Technology

Jessy Barber, s5138877

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Griffith University Internal Project

Yong Zhu

A report submitted in partial fulfilment of the degree of Bachelor of Engineering (Honours)

EXECUTIVE SUMMARY

These instructions have been prepared in the format that must be used for the final project report to be submitted as part of the assessment for the IAP Thesis. The instructions are designed to help you provide a report that will comply with the defined format. An executive summary (abstract) of one (1) page in length is mandatory for this report. The main text should be logically subdivided into sections, e.g. introduction, important issues and discussion, conclusions, and references. It should state the purpose of the project and its outcomes. For Masters courses, the report should be approximately 60 A4 pages ± 10% including text, figures, and tables. For 30CP undergraduate courses, the report should be approximately 45 A4 pages ± 10% including text, figures, and tables. For 20 CP undergraduate courses, the report should be approximately 30 A4 pages ± 10% including text, figures, and tables. In all cases, page limits *do not* include the executive summary, table of contents, or references. The electronic copy of the document should not exceed 5.0MB, or you may have difficulty submitting it. The page format is to have 2.5cm margins, with 12pt Times Roman typeface and 1.5 line spacing. Include a running heading at the top of each page, 1.25cm from the edge of the paper, with the course title and date right justified. Include a running footer at the bottom of each page, 1.25cm from the edge of the paper, with page numbers, your name and the report title. However, this footer title should not exceed 50 characters in length. You must also include a table of contents, which clearly identifies on which page to find each section and subsection. You may also wish to include appendices, where appropriate. However, the main body of the report must form a stand-alone document and must include all figures, tables or text required by the reader to understand the material being discussed. Although you may refer to figures, tables or text located in the appendices, these should be considered as supplementary to the discussion presented in the main body of the report. In general, material presented in the appendices will not be marked as part of your report.

ACKNOWLEDGEMENTS

On this one (1) page you must make clear all contributions to the project from other people and previous work upon which your project is built. The assistance of industry personnel, University staff, fellow students, and others should be acknowledged. Feel free to acknowledge the support of family and friends. Although the language of this section may be slightly less formal than the rest of the document, please keep it as professional as possible. Remember that your report may be read by many people (including prospective employers).

TABLE OF CONTENTS

1   INTRODUCTION

As part of your assessment in the Industry Affiliates Program you are required to prepare a report covering the outcomes of your research project. As this report forms a major part of your assessment, it is important that you are able to demonstrate your understanding of your topic. These instructions have been put together to aid you in the preparation of your report, and to ensure that your report is consistent with the defined format.

All reports must be submitted as an electronic copy only, on or before the due date. These instructions have been prepared in the format that must be used for the report and are designed to help you, the author, provide a report in a suitable format. It is recommended that you edit this document using the "styles" provided, rather than generating a new document.

2   STRUCTURE AND CONTENT OF THE REPORT

The report should be well structured: i.e. they must include:

(1)   **A Title Page:** including the report topic, your full name and student ID number plus the date of your submission. Do not include a header or footer on the Title Page.

(2)   **Executive Summary:** must be one (1) page in length and be self contained and explicit. The executive summary should briefly describe the aims of the work, the main issues identified, and the conclusions drawn. It may be in dot points.

(3)   **Acknowledgements:** should be one (1) page in length and must acknowledge the contributions of others. You may also wish to acknowledge any other support provided by others throughout your project.

(4)   **Table of Contents:** including the page numbers for each of the sections and sub sections. Using "styles" will allow MS Word to automatically generate the table of contents in the defined format. It is recommended that you edit this document using the "styles" provided, rather than generating a new document. You may also include a table of figures, list of acronyms, and other such tables if you desire, however these are not compulsory.

(5)   **Main text:** For clarity this should be subdivided into separate sections as set out below:

(i)   *Introduction* - describes the background of the work and its aims and objectives. You should also include a brief description of how the report is

structured. It should be clear from this section what exactly you have accomplished in your project. If you have worked as part of the team, or are continuing the work of somebody else, you should state clearly which parts of the work were done by you, and which parts were done by others. For research projects, you should state how your work has extended the body of knowledge in the field. For design projects, state the impact of your work on the company or field of design, and the potential benefits of the outcomes.

(ii) *Review of the Published Literature* - the Final Project Report is one way in which you can demonstrate a scholarly approach to undertaking your IAP research project. As part of this scholarly approach, it is important that your report includes a thorough review of published material that is relevant to your study. This *"literature review"* may take the form of a separate chapter in your report, or it may be incorporated throughout the document. Your Academic Supervisor is the best person to provide guidance to you on the most appropriate way of including this review in respect to your specific discipline.

(iii) *Design Process or Research Methodology* - outlines the work undertaken during the project. Projects which are research-based should outline the methodology used in the research, the supporting theory, the experimental methodology, and the supporting evidence verifying the significance and validity of the approach. For projects which are focused on a product, this part of the report will detail the design process and implementation, once again linking the work done to relevant theory and justifying the design decisions made. Testing and verification of the final product to ensure it fulfils the design criteria is another important area that should be covered.

For both types of projects, it is important to refer back to supporting literature where appropriate, and ensure that the work is both well justified and supported by sufficient evidence, either from the literature or through experimental validation. This part of the report may be broken into two or more sections as appropriate; your academic supervisor can guide you on the most appropriate structure for your discipline and project. The title of these sections should describe the contents, and not simply be "Design Process".

(6) **Experimental Results:** a detailed report on the results of any experiments conducted, as well as an appropriate analysis of these results using statistical or

other methods. For projects which lead to a final product, this section will usually be concerned with testing and validation of the product to ensure that it meets the stated objectives. Ensure that any adverse results or discrepancies are noted and explained where possible.

(7) **Conclusions:** a brief explanation of the significance and implications of the work reported. These conclusions should already have been discussed in more detail previously in the report. Do not introduce a conclusion that is not supported by arguments made in the rest of the report.

(8) **References:** these should be to accessible sources and must include an appropriate number and quality of non-web based references. Please ensure that all work cited in the text is included in the reference list, and that the dates and authors given in the text match those in the reference list. You must also ensure that all references in your Reference List have been cited in the main body of the report text. References must always be given in sufficient detail for the reader to locate the work cited (see below for formats).

(9) **Appendices:** items that may form appendices include maps, draft designs, data sheets, configuration diagrams, additional photos, data tables etc., additional test results, detailed experimental results, computer program listings, company feedback sheets on the project, full circuit diagrams and/or a user manual (up to five (5) pages). Data sheets do not need inclusion if they can be referenced elsewhere. In general, markers will *not* take the appendices into account when marking the report, so ensure that any important information is placed in the main body. Additional data, program code, more detailed results, etc, can be put in an Appendix.

The title of the individual headings may vary depending on the nature of the report, but it is important that a clear structure is preserved. For Masters courses, the report should be approximately 60 A4 pages ± 10% including text, figures, and tables. For 30CP undergraduate courses, the report should be approximately 45 A4 pages ± 10% including text, figures, and tables. For 20 CP undergraduate courses, the report should be approximately 30 A4 pages ± 10% including text, figures, and tables. The page length does not include the title page, executive summary, acknowledgements, table of contents, references, or any appendices. The electronic copy of the full submitted document must not exceed 5.0 MB. Files which exceed the size limit will not be marked until they are reduced in size to 5.0 MB. Delays resulting from reduction in the size of the final report will incur

standard penalties resulting from late submission of assessment items. If it is essential that your report contains a high number of high resolution images, and thus will exceed this size limit, please contact the course convenor.

3 DISCIPLINE SPECIFIC STRUCTURE AND CONTENT

3.1 Instructions for Students Enrolled in Software or Electronics Engineering

If you are undertaking a software project the Final Project Report will be essentially the same as for a hardware or hardware/software project with the emphasis on the design and testability of the software developed. Since the design of software requires a different methodology, the Final Project Report will have a slightly different structure than described above. The appendix to the report should include several pages of example code.

The main body of the Final Report should be used to:
- Justify and explain the design choices used in creating the program(s).
- Justify and explain the testing methodology.
- Demonstrate that the program met the objectives (testable outcomes).

Appendices:
- The documents generated by the QA method should be included in the appendices.
- The documents generated by the various phases of the software lifecycle should be included in the appendix.

3.2 Other Engineering Bachelor Degrees with Honours Students

For those students completing a Bachelor of Engineering with Honours, the Final Project Report must comply with honours thesis requirements in its composition and presentation style. It is therefore suggested that the Report follow the format of this template document. The Academic Supervisor is the best person to provide guidance on the most appropriate way to prepare this document in relation to the specific discipline in which the IAP research project is being undertaken. Students are encouraged to discuss with their Academic Supervisor the adoption of an alternative style for the Final Project Report where appropriate.

The level of Engineering Honours awarded will also be affected by the aggregate mark awarded for the IAP Thesis course, as a recognition of the research component within this project.

4   HEADINGS AND LAYOUT

Major headings like the one above are typed bold in 14pt upper case (capital letters), with two line spaces above and none below. The format of the major headings can be automatically set by selecting the *"Heading 1 Numbered"* style from the style list provided in the document.

4.1   Minor Headings

Minor headings are in 12pt bold type, not indented, with one line of space above and none below. The format of the minor headings can be automatically set by selecting the *"Heading 2 Numbered"* style from the style list provided in the document.

4.1.1   Sub-headings.

Sub-headings are typed in 12pt type, not indented, with one line of space above and none below. The format of the sub-headings can be automatically set by selecting the *"Heading 3"* style from the style list provided in the document.

4.2   Page Layout

All text should be word-processed using the A4 page size, with the following layout requirements:

- Reports must be formatted using 2.5 cm margins.
- Please use a 12pt Times New Roman typeface and 1.5 line spacing.
- Include a running heading at the top of each page, 1.25 cm from the paper edge, 12 pt Times New Roman typeface, with the following text right justified: "XXXXCOURSE CODE – Industry Affiliates Program, Semester 1, 2016".
- Include a running footer at the bottom of each page, 1.25 cm from the paper edge, 12 pt Times New Roman italic typeface. On odd pages, place your name at the left margin and the page number at the right margin. On even pages, place the page number at the left margin and the report title at the right margin. Use an abbreviated title if the full title is longer than 50 characters. Use Arabic numerals for page numbers. A line must be shown above the footer on each page.

- Normal paragraph text should be justified (extend to the right-hand margin) and be typed one and a half line-spaced to fill the full depth of the text area. Do not indent the text paragraphs.

- New paragraphs are not indented, but are preceded by a line of space. Also please avoid using footnotes or splitting tables over two (or more) pages.

- For bullet lists and numbered lists, refer to the examples shown in this report template.

- Important words in the text may be emphasized using **boldface** or <u>underlining</u>, but excessive use of these features is not recommended.

Table 1 contains the basic information related to page size and margin settings.

Table 1. This is an example of table layout. It shows the dimensions of the text area to be used for international (A4) paper size. The table caption should appear above the table.

	Text area	A4 paper	
	(mm)	(mm)	(in)
Depth	247	297	11.69
Top/bottom margin	-	25	1.0
With	160	210	8.27
Left/right margin	-	25	1.0

4.3   The Title Page

Special formatting requirements apply for the Title Page:

- The school and university names should appear left justified in 14pt **bold** typeface, as shown on the title page in this file. Allow one line space below the school and university names.

- The course code and name should appear left justified in 14pt **bold** typeface, as shown on the title page in this file.

- The main report title should appear left justified in 24pt **bold** typeface as shown on the title page in this file. You should limit the report title to no more than 15 words.

- Your full name and student ID number should appear left justified in 14pt **bold** typeface as shown on the title page in this file, with 24pt spacing both before and after the paragraph.

- The date of submission (including year and semester) should appear right justified in 14pt *italic* typeface as shown on the title page in this file, with 24pt spacing before the paragraph and 35pt spacing after the paragraph.

- The Industry Organisation name should appear left justified in 14pt **bold** typeface, as shown on the title page in this file. Allow one line space before the Organisation name.

- The Industry Supervisor name (where appropriate) should appear left justified in 14pt **bold** typeface, as shown on the title page in this file. Allow one line space before the Supervisor name.

- The Academic Supervisor name should appear left justified in 14pt **bold** typeface, as shown on the title page in this file, with 50pt spacing after the paragraph.

- The statement "A report submitted in partial fulfilment of the degree of Your degree program goes here", as shown on the title page in this file, should be left justified in 12pt font *italic* typeface with 50pt spacing after the paragraph.

- The statement "The copyright on this report is held by the author and/or the IAP Industry Partner. Permission has been granted to Griffith University to keep a reference copy of this report", as shown on the title page in this file, should be left justified in 8pt font typeface.

- The University logo must appear at the bottom right hand corner of the first page.

- The title page page must **not** include a header or footer.

- If your project is in confidence you should note this in large font on the title page e.g. 'IN CONFIDENCE'.

4.4   The First Section of the Report

Special formatting requirements apply for the first section of the report, which includes the Executive Summary and Table of Contents:

- The Executive Summary must appear on the first page.

- Acknowledgements must appear on the second page.

- The Table of Contents must appear on the third page.

- Each heading shown in the table of contents must show the page of the report where the section heading appears. The page number is shown with a right justified tab stop located at 15 cm, with a dot point leader

- Heading 1 section headings must be shown using all upper case lettering in 12pt **bold** typeface.

- Heading 2 sub-section headings must be shown in 12pt typeface, with a 1 cm indent.

- Heading 3 sub-section headings must be shown in 12pt italic typeface, with a 2 cm indent.

- Page numbers must be shown centred using 12pt typeface using Roman numerals, within the footer in the first section.

4.5 Figures and Tables

Figures and tables should be numbered consecutively as they are presented (Figure 1, Figure 2, etc. and Table 1, Table 2, etc.). Do not include the section number as part of the figure or table number. A descriptive caption, including the figure or table number in boldface followed by a full stop, should be placed directly above tables and below figures. References to each figure and table should appear in the text, and each figure and table should be positioned close to where they are first cited, as shown in Figure 1 and Table 1. Position the figures and tables as close as possible to where they are referenced in the text, so that you avoid the creation of large blank spaces in your document adjacent. As shown in Figure 1 and Table 1, text **must not** be wrapped around the figure/table. Allow two line spaces above/below tables/figures and make sure they fit inside the text area. Make sure that you cite the source for any figures or tables that you copy from a reference, and include this document in your reference list. You should also include a reference to the source of information presented when you prepare your own figure or table using information provided in another document.

Keep figures as simple as possible for clarity: avoid unnecessary complexity, colouring and excessive details. Beware of figures with extensive amounts of detail which are unreadable when reduced to fit on the A4 page. You should also be careful when copying figures found on web pages, which often are of poor quality when reproduced in a paper based report. Illustrations should be clear and any text provided in the illustrations should not be written with less than 10pt font size. Avoid using shading or greyscale as background in your illustrations as shading seldom reproduces well. Figures should be a good enough resolution to allow printing of the paper in black and white on a normal laser printer. Please take care

that you do not include excessively large graphics files or embedded spreadsheet objects in your document.
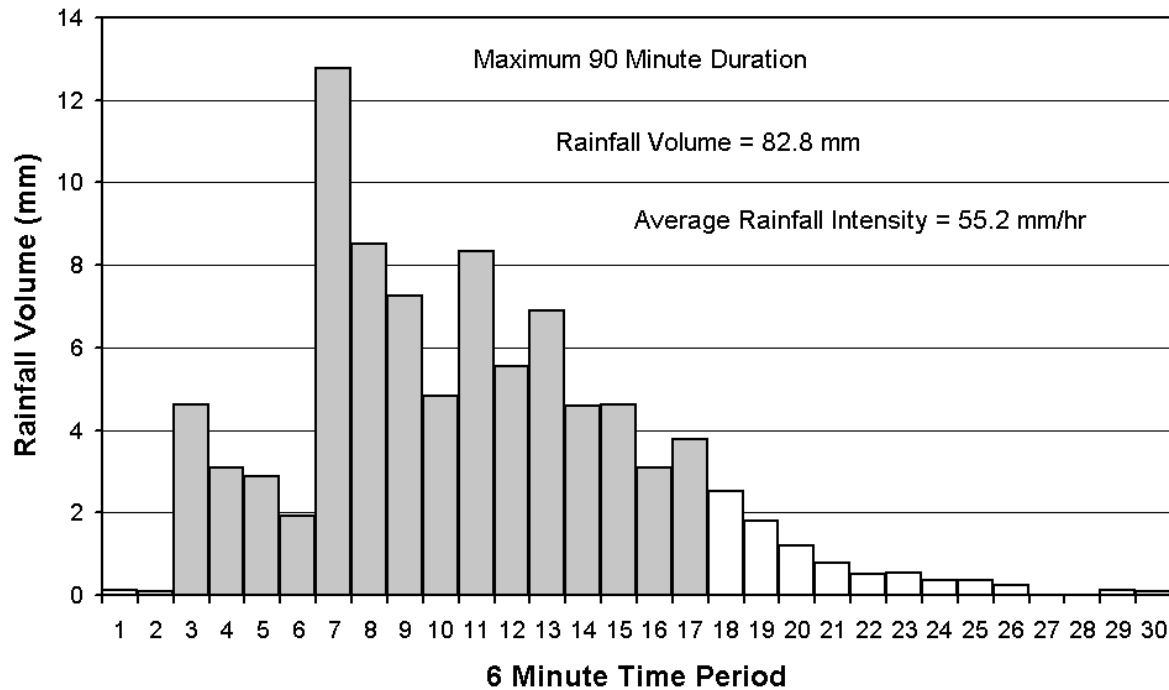
Figure 1. This is an example of a Figure layout. A GIF image was inserted, which generally results in a clearer figure for graphs, etc. A jpeg image is better for photographs.

4.6 Mathematics, Nomenclature and Units

All mathematics included in the text should be typed using an appropriate equation editor. Equations should be numbered, with the number shown in Arabic numerals within left and right hand brackets, as shown below. The equation number should be placed to the right of the equation, and right justified with the right hand margin. Use the "Equation" style to easily do this, using tab to get to the centre and right margin.

$$Q = \frac{1}{n} A R^{2/3} S_o^{1/2} \qquad (1)$$

Please take care that all terminology and notation used will be widely understood. Abbreviations and acronyms should be spelled out in full at their first occurrence in the text.

SI units are required in ALL cases. If non-SI units are necessary, SI equivalents must also be given bracketed beside the non SI unit. Units should have a single space between the number

and the unit. Thousands should be separated by commas (e.g. 1,000). The decimal separator is a full stop (e.g. g=9.80 m/s^2). Please ensure you use superscripts in units such as m^2 rather than m^2, which is not appropriate for a technical report.

4.7 Styles in the Report Template

This report template may be used directly when typing the manuscript. In that case you may use the pre-defined styles for Title, Headings, etc. Please also be sure to follow the guidelines in this paper template. Using the pre-defined styles allows you to automatically create and/or update the Table of Contents at the front of this report, by right clicking on the Table of Contents and selecting the **Update Field** menu item on the **pop-up menu**.

5 LANGUAGE

Reports should be in good, grammatically correct English. Have your typescript read by at least two other persons to avoid typing errors. The report should be written in the third person.

6 SUBMISSION OF REPORTS

Reports must be provided as an electronic copy only, on or before the due date, through the Learning@Griffith IAP course site. The electronic copy of the full submitted document must not exceed 5.0 MB. Files which exceed the size limit will not be marked until they are reduced in size to 5.0 MB. Delays resulting from reduction in the size of the final report will incur standard penalties resulting from late submission of assessment items.

7 CONCLUSIONS

It is a good idea to finish by bulleting out two or three "lessons learned" or findings that could include e.g. the main investigation findings or key findings of the work to pass along to your peers for practical applications. Concluding remarks should include a critical assessment of what has been accomplished, what should be made and an outline of any necessity for future work.

The main points from these instructions are:

- For Masters courses, the report should be no longer than 60 A4 pages ± 10% including text, figures, and tables. For 30CP undergraduate courses, the report should be no longer that 45 A4 pages ± 10% including text, figures, and tables. For 20 CP undergraduate courses, the report should be no longer than 30 A4 pages ± 10% including text, figures, and tables.   The page length does not include the title page, executive summary, acknowledgement, table of contents, references or any appendices.

- The electronic copy of the full submitted document must not exceed 5.0 MB. Files which exceed the size limit will not be marked until they are reduced in size to 5.0 MB. Delays resulting from reduction in the size of the final report will incur standard penalties resulting from late submission of assessment items.

- It is essential that all reports comply with the format requirements as explained in this report template.

- Allow the Industry Partner/Supervisor time to read a copy of the report prior to submission to the University.

- Print a copy of your final report and organise to leave it with the Industry Partner. You are not required to leave a copy with your Academic Supervisor.

- Please note that Final Reports will be put through Safe Assign or TurnitIn tools randomly. These are tools that help identify plagiarism.

- An example of a Final Project Report can be viewed on the Learning@Griffith IAP course site (under Schedule>Final Project Report) or at the IAP Office.

8   REFERENCES

It is essential that reports include a list of references at the end, showing that the author is aware of earlier work in the area both nationally and internationally.   The following information provides guidance on a referencing style that will be appropriate for most students.   However, students are encouraged to discuss referencing styles with their Academic Supervisor, who will be able to provide guidance on an appropriate style in the particular discipline. Electronic students are to comply with the IEEE referencing style, other disciplines should use the referencing style which is most appropriate. Students can find more information regarding referencing in the Resource section on the Learning@Griffith IAP course site.

It is ***highly*** recommended that students use a referencing tool such as EndNote (provided free of charge by Griffith) to manage and cite references. Such tools allow for easy importing of citations from Google Scholar or other databases, and will format both the in-text and bibliography section of your report in whatever style is appropriate.

APPENDIX A: AN EXAMPLE OF AN APPENDIX

Appendices are often included in reports as a way of including information which is supplementary to the material which forms the main body of the report. Often the appendices will include detailed analysis of data, or systems that you have used as part of your analysis. However, you should never include information in an appendix that the reader must understand in order to understand the content of the main body of the report.

You should also never assume that the reader will have access to the appendices when they are reading the main body of the report. This is because very large reports may have separate documents for the appendices. If you direct the reader to an appendix to see a vital piece of information, and they do not have access to this appendix, then the reader's understanding of the main body of the text will be severely limited. This is true for drawings and diagrams, as well as text. The general rule to follow is:

- If a piece of text or a diagram must be viewed to understand the text in the body of the report, then this text or diagram should appear in the body of the report, and not just in the appendix. As the appendix will be read as a stand alone document, the detailed information including this text or diagram should also be included in the appendix.

Include a running heading at the top of each page of the appendices, 1.25 cm from the paper edge, 12 pt Times New Roman typeface, with the following text right justified: "XXXXCOURSE CODE – Industry Affiliates Program, Semester 1, 2016".

Include a running footer at the bottom of each page, 1.25 cm from the paper edge, 12 pt Times New Roman italic typeface. Place the page number at the left margin and the thesis title at the right margin. Continue the page numbering from the previous part of the report. Use an abbreviated title if the full title is longer than 50 characters. Use Arabic numerals for page numbers. A line must be shown above the footer on each page.

The following additional items may also be included in appendices to the Final Project Report:

- Maps, draft designs, data sheets, configuration diagrams, additional photos, data tables etc.
- Additional test results

- Detailed experimental results

- Computer program listings

- Company feedback sheets on the project

- Full circuit diagrams

- User manual (for projects with a defined "product" outcome such as electronic products, or most IT projects).

- The User Manual should be self-contained and it should include a brief statement of function, a complete specification of the product/service, a labelled photograph/diagram of the item or screen shots, or block diagram of the installation instructions and include maintenance requirements.

- It should be written for the Industry Partner as opposed to an unknown final end-user.

- It is expected that this manual would be a maximum of five (5) pages, and should be clear and easy to read.

- It does not necessarily require fully formed sentences. Bullet points under headings would be appropriate.

- Data sheets do not need inclusion if they can be referenced and found elsewhere.