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BPMA: COMMERCIAL STEEL PIPE BURST PRESSURE TOOLS

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BUSINESS INFORMATION SYSTEM
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Dissertation submitted in partial of the requirement for the
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CERTIFICATION OF APPROVAL

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UNIVERSITI TEKNOLOGI PETRONAS
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CERTIFICATION OF ORIGINALITY

This is to certify that the author are responsible for the work submitted for this project, that the originality work is author's own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

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(NUR AIN BINTI ZAWAWI)

ABSTRACT

This report deliberated about the project work and the understanding of the chosen topic, which is BPMA (*Burst Pressure Mobile Application)* as Commercial Steel Pipe Burst Pressure Tools for Chemical Engineering Department, entitled *Burst Pressure Mobile Application*. A research conducted, mobile technology plays major role in recent education trend nowadays. For Generation Y and Generation Millennium, mobile technologies such as mobile phones, smart phones, tablets and laptop create a bridge over the educational gap that teachers, parents and adults left behind because younger generation nowadays have become more independent to learn things for the future. The difficulty of associating the technology and life has been one of the key factors for children to catch-up with current lifestyle. In addition, nowadays many mobile application was developed to make the way of learning easier and effective to the students. Besides, the mobile apps help student to learn fast and help them to solve their problem. In engineering fields, research has shown that the allowable pressure and burst pressure in pipe is very important for safety purposes and to avoid any failure occur. Besides that, the pressure could be considered countenance of the maximum pressure which something can sustain before it will break or burst. Pressure and burst pressure in pipe is very important in designing any system especially in Oil and Gas Industry. Hence, there is a need to develop *Burst Pressure Mobile Application*. This mobile application will help all the users – Lecturers, Engineering Students, even Engineers, Oil and Gas Services Company, Pipe's suppliers, Technologist and Researcher to determine allowable pressure and burst pressure in commercial steel pipe in easier way. Additionally, it has been acknowledged that there are no any mobile application to determine allowable pressure and burst pressure in commercial steel pipe that can be used in the Google Apps Store, while instantaneously providing motivation and courage by creating this mobile application it will provide a great solution for the concern arise. There are many mobile applications to determine pressure in pipe for the user, yet there is no any mobile application to determine allowable pressure and burst pressure specific in commercial steel pipe. The objective of this project is to provide a simple mobile application to calculate the allowable pressure and burst pressure in commercial steel pipe and the output of the calculation will determine whether

the pressure and burst pressure calculated is upper or lower the limit and whether it safe or not safe to be use. Furthermore, a prototype for the mobile application was developed using the Rapid Application Development and Agile Development methods. The mobile application was designed in such a way that it can be use at anytime and anywhere using Smartphone with internet connection and all the information needed at user's fingertips.

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CHAPTER 1

1.1 Background of study

Nowadays, technology plays a massive role for education purposes for an every single level of educations not only in Malaysia but all around the world. The usage of computers, laptops, desktop, projector, audio and visual materials have already been used in education and it is proven as a good platform to attract students' attention and give a good influence in today's education. However, mobile technology is moving forward rapidly, education can become so much easy and more interactive and dynamic to get. The awareness of getting up to date with the technology need to be cultured for the future young generation.

In engineering field, a pipeline system is very important because pipeline system is all part of the physical facility where liquids or gases such as oil, crude oil and natural gas are transported usually for a long distances between producing region and a local distribution system. Nowadays, with increasing of new oil and gas industry - pipelines are the most desired medium and an understanding of the pressure and burst pressure of pipelines become the most importance to oil and gas industry. Therefore the determination of pressure and burst pressure of pipelines has been studied over the years by many researchers. According to MacDonald et al. (2008), Hossam et al. (2010) and Liu et al. (2010), after period of time in services, the number of cases of pipe failure has been reported. In addition, the failure of the pipes is due to the failure pressure. Netto et al. (2005) stated that the defect on the pipes give significant effect on the failure pressure.

In this respect, this mobile application was introduced as a problem solving to determine the pressure and burst pressure in commercial steel pipe into the Engineering field and oil and gas industries. According to Cutlip et al. (1998) and Shacham and Cutlip (1999), Mathematical software packages are currently used for routine numerical problem solving in Engineering education and practice as they are easy to use and provide the most time efficient route for obtaining accurate solutions. The dominant position of the computers and laptops in the

personal computing field has been challenged lately by the mobile devices such as smartphones and tablets. Furthermore, according to Wingfield (2013), it is predicted that by 2017 the leading operating system for all computing devices will be Google's Android. Relying on these days trend, we decided to check the possibility of the use of Android-based smartphones, tablets and computers for general numerical problem solving. This mobile application will helps to determine the pressure and allowable pressure in commercial steel pipe based on the Nominal Pipe Size (Outer Diameter), Pipe Schedule (SCH), Strength of materials, Pipe Thickness and Safety Factor that user select from applications. As we can see in this new era of globalization, smartphones has become very popular and widely used in the educations, medical industries, oil and gas industries and many industries all over the world. The dominant position of PC and MAC in the personal computing field has been challenged lately by the mobile devices such as smartphones and tablets. A boundless achievement can be achieve in implementation of this mobile application especially in Malaysia. *Burst Pressure* Mobile Application will be great application that can carry out several tasks essential in engineering and oil and gas industries.

So far there is no mobile application that can determine allowable pressure and burst pressure specific for commercial steel pipe. Therefore the research aims to explore the use of mobile application in determining the allowable pressure and burst pressure in commercial steel pipe hence with the hope to make the process of determining the allowable pressure and burst pressure in commercial steel pipe become more efficient.

1.2 Problem Statement

In engineering fields, research has shown that the allowable pressure and burst pressure in pipeline system is very important for safety purposes to avoid any failure occur. Manual ways of calculating can still be used for the purpose of learning in the education system but an advance in technology help the engineer to improve their operational production. The major problem related to this project title is to help the students and lecturer to determine and calculate the allowable pressure and burst pressure in commercial steel pipe. Research has shown that the process to determining the pressure and burst pressure in commercial steel pipe must be done manually and all the data of the commercial steel pipe was manually recorded in Microsoft Excel by the most engineering student in Universiti Teknologi PETRONAS. Furthermore, human errors may be led during the process of transcribing data of non-digital format as handwriting in a notebook can get smudged, unrecognizable and unintentional mismatches among data can occur as well. Data storage and organization is another issue because all the data was manually recorded and there was no any special software or applications can be used to calculate the pressure and burst pressure in steel pipe.

1.3 Problem Identification

Steel pipe is designed for internal pressures and resistance to external loads utilizing based certain standards. Steel pipe's strength and versatility enables customized pressure class designs to meet the performance criteria specified that can operate the suitable pressures and suitable pipe’s bursting strength with design working pressure.

Bursting pressure of pipes can be determined by using the formula stated:

Pressure, P = 2 * S * T/ (OD) (SF)

Where P is pressure in kilograms per square inch, S is the strength of material, T is pipe thickness of wall in inches, OD is outside diameter in inches, and SF is safety factor of the pressure and bursting pressure will be select from the database of the application. The database as shown as in the figure below:

SIZE OD INCH OD MM	SCHEDULE (SCH)	W.T (INCH)	LBS/ FOOT	W.T (MM)	KG/ METER
1/4 0.540" 13.7mm	10S 40STD, 40S 80XS, 80S	.065 .088 .119	.3297 .4248 .5351	1.65 2.24 3.02	0.51 0.63 0.80
3/8 0.675" 17.1mm	10S 40STD, 40S 80XS, 80S	.065 .091 .126	.4235 .5676 .7388	1.65 2.31 3.20	0.64 0.84 1.10
1/2 0.840" 21.3mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .083 .109 .147 .188 .294	.5383 .6710 .8510 1.088 1.309 1.714	1.65 2.11 2.77 3.73 4.78 7.47	0.82 1.01 1.27 1.62 1.95 2.55
3/4 1.050" 26.7mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .083 .113 .154 .219 .308	.6838 .8572 1.131 1.474 1.944 2.441	1.65 2.11 2.87 3.91 5.56 7.82	1.04 1.31 1.69 2.20 2.90 3.64
1 1.315" 33.4mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .109 .133 .179 .250 .358	.8678 1.404 1.679 2.172 2.844 3.659	1.65 2.77 3.38 4.55 6.35 9.09	1.33 2.13 2.50 3.24 4.24 5.45
1 1/4 1.660" 42.2mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .109 .140 .191 .250 .382	1.107 1.806 2.273 2.997 3.765 5.214	1.65 2.77 3.56 4.85 6.35 9.70	1.68 2.76 3.39 4.47 5.61 7.77
1 1/2 1.900" 48.3mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .109 .145 .200 .281 .400	1.274 2.085 2.718 3.631 4.859 6.408	1.65 2.77 3.68 5.08 7.14 10.16	1.95 3.10 4.05 5.41 7.25 9.56
2 2.375" 60.3mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.065 .109 .154 .218 .344 .436	1.604 2.638 3.653 5.022 7.462 9.029	1.65 2.77 3.91 5.54 8.74 11.07	2.44 4.01 5.44 7.48 11.11 13.44
2 1/2 2.875" 73.0mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.083 .120 .203 .276 .375 .552	2.475 3.531 5.793 7.661 10.01 13.69	2.11 3.05 5.16 7.01 9.53 14.02	3.77 5.36 8.63 11.41 14.92 20.39
3 3.500" 88.9mm	5S 10S 40STD, 40S 80XS, 80S 160 XXS	.083 .120 .216 .300 .438 .600	3.029 4.332 7.576 10.25 14.32 18.58	2.11 3.05 5.49 7.62 11.13 15.24	4.60 6.59 11.29 15.27 21.35 27.68
4 4.500" 114.3mm	5S 10S 40STD, 40S 80XS, 80S 120 160 XXS	.083 .120 .237 .337 .438 .531 .674	3.915 5.613 10.79 14.98 19.00 22.51 27.54	2.11 3.05 6.02 8.56 11.13 13.49 17.12	5.96 8.52 16.07 22.32 28.32 33.54 41.03
5 5.563" 141.3mm	5S 10S 40STD, 40S 80XS, 80S 120 160 XXS	.109 .134 .258 .375 .500 .625 .750	6.349 7.770 14.62 20.78 27.04 32.96 38.55	2.77 3.40 6.55 9.53 12.70 15.88 19.05	9.67 11.82 21.77 30.97 40.28 49.11 57.43

SIZE OD INCH OD MM	SCHEDULE (SCH)	W.T (INCH)	LBS/ FOOT	W.T (MM)	KG/ METER
6 6.625" 168.3mm	5S 10S 40STD, 40S 80XS, 80S 120 160 XXS	.109 .134 .280 .432 .562 .719 .864	7.585 9.289 18.97 28.57 36.39 45.35 53.16	2.77 3.40 7.11 10.97 14.27 18.26 21.95	11.55 14.13 28.26 42.56 54.20 67.56 79.22
8 8.625" 219.1mm	5S 10S 20 30 40STD, 40S 60 80XS, 80S 100 120 140 XXS 160	.109 .148 .250 .277 .322 .406 .500 .594 .719 .812 .875 .906	9.914 13.40 22.36 24.70 28.55 35.64 43.39 50.95 60.71 67.76 72.42 74.69	2.77 3.76 6.35 7.04 8.18 10.31 12.70 15.09 18.26 20.62 22.23 23.01	15.09 20.37 33.31 36.81 42.55 53.08 64.64 75.92 90.44 100.92 107.92 111.27
10 10.750" 273.1mm	5S 10S 20 30 40STD, 40S 60XS, 80S 80 100 120 140, XXS 160	.134 .165 .250 .307 .365 .500 .594 .719 .844 1.000 1.125	15.19 18.70 28.04 34.24 40.48 54.74 64.43 77.03 89.29 104.13 115.64	3.40 4.19 6.35 7.80 9.27 12.70 15.09 18.26 21.44 25.40 28.58	23.08 28.34 41.77 51.03 60.31 81.55 96.01 114.75 133.06 155.15 172.33
12 12.750" 323.9mm	5S 10S 20 30 STD, 40S 40 XS, 80S 60 80 100 120, XXS 140 160	.156 .180 .250 .330 .375 .406 .500 .562 .688 .844 1.000 1.125 1.312	22.18 24.20 33.38 43.77 49.56 53.53 65.42 73.15 88.63 107.32 125.49 139.67 160.27	3.96 4.57 6.35 8.38 9.53 10.31 12.70 14.27 17.48 21.44 25.40 28.58 33.32	31.89 36.73 49.73 65.20 73.88 79.73 97.46 108.96 132.08 159.91 186.75 208.14 238.76
14 14.000" 355.6mm	10 20 30, STD 40 XS 60 80 100 120 140 160	.250 .312 .375 .438 .500 .594 .750 .938 1.094 1.250 1.406	36.71 45.61 54.57 63.44 72.09 85.05 106.13 130.85 150.90 170.21 189.10	6.35 7.92 9.53 11.13 12.70 15.09 19.05 23.83 27.79 31.75 35.71	54.69 67.90 81.33 94.35 107.39 126.71 158.10 194.96 224.65 253.56 281.70
16 16.000" 406.4mm	10 20 30, STD 40, XS 60 80 100 120 140 160	.250 .312 .375 .500 .656 .844 1.031 1.219 1.438 1.594	42.05 52.27 62.58 82.77 107.5 136.61 164.82 192.43 223.64 245.25	6.35 7.92 9.53 12.70 16.66 21.44 26.19 30.96 36.53 40.49	62.64 77.83 93.27 123.30 160.12 203.53 245.56 286.64 333.19 365.35
18 18.000" 457.2mm	10 20 STD 30 XS 40 60 80 100	.250 .312 .375 .438 .500 .562 .750 .938 1.156	47.39 58.94 70.59 82.15 93.45 104.67 138.17 170.92 207.96	6.35 7.92 9.53 11.13 12.70 14.27 19.05 23.83 29.36	70.57 87.71 105.16 122.38 139.15 155.80 205.74 254.55 309.62

SIZE OD INCH OD MM	SCHEDULE (SCH)	W.T (INCH)	LBS/ FOOT	W.T (MM)	KG/ METER
18 (Cont.)	120 140 160	1.375 1.562 1.781	244.14 274.22 308.50	34.93 39.67 45.24	363.56 408.26 459.37
20 20.000" 508mm	10 20, STD 30, XS 40 60 80 100 120 140 160	.250 .375 .500 .594 .812 1.031 1.281 1.500 1.750 1.969	52.73 78.60 104.13 123.11 166.40 208.87 256.10 296.37 341.09 379.17	6.35 9.53 12.70 15.09 20.62 26.19 32.54 38.10 44.45 50.01	78.55 117.15 155.12 183.42 247.83 311.17 381.53 441.49 508.11 564.81
22 22.000" 559mm	10 20, STD 30, XS 60 80 100 120 140 160	.250 .375 .500 .875 1.125 1.375 1.625 1.875 2.125	58.07 86.61 114.81 197.41 250.81 302.88 353.61 403.00 451.06	6.35 9.53 12.70 22.23 28.58 34.93 41.28 47.63 53.98	86.54 129.13 171.09 294.25 373.83 451.42 527.02 600.63 672.26
24 24.000" 609.6mm	10, 10S 20, STD XS 30 40 60 80 100 120 140 160	.250 .375 .500 .562 .688 .969 1.219 1.531 1.812 2.062 2.344	63.41 94.62 125.49 140.68 171.29 238.35 296.58 367.39 429.39 483.10 542.13	6.35 9.53 12.70 14.27 17.48 24.61 30.96 38.89 46.02 52.37 59.54	94.53 141.12 187.06 209.64 255.41 355.26 442.08 547.71 640.03 720.15 808.22
26 26.000" 660.4mm	10 STD 20, XS	.312 .375 .500	85.60 102.63 136.17	7.92 9.53 12.70	127.36 152.87 202.72
28 28.000" 711.2mm	10 STD 20, XS 30	.312 .375 .500 .625	92.26 110.64 146.85 182.73	7.92 9.53 12.70 15.88	137.32 164.85 218.69 271.21
30 30.000" 762mm	10S, 10 STD 20, XS 30	.312 .375 .500 .625	98.93 118.65 157.53 196.08	7.92 9.53 12.70 15.88	147.28 176.84 234.67 292.18
32 32.000" 813mm	10 STD 20, XS 30 40	.312 .375 .500 .625 .688	105.59 126.66 168.21 209.43 230.08	7.92 9.53 12.70 15.88 17.48	157.24 188.82 250.64 312.15 342.91
34 34.000" 864mm	10 STD 20, XS 30 40	.312 .375 .500 .625 .688	112.25 134.67 178.89 222.78 244.77	7.92 9.53 12.70 15.88 17.48	167.20 200.31 266.61 332.12 364.90
36 36.000" 914mm	10 STD 20, XS	.312 .375 .500	118.92 142.68 189.57	7.92 9.53 12.70	176.96 212.56 282.27
42 42.000" 1067mm	STD XS	.375 .500	166.71 221.61	9.53 12.70	248.52 330.19
48 48.000" 1219mm	STD XS	.375 .500	190.74 253.65	9.53 12.70	284.24 377.79

ABBREVIATIONS

XS : EXTRA STRONG
XXS : DOUBLE EXTRA STRONG
SMLS : SEAMLESS
ERW : ELECTRIC RESISTANCE WELDED
SAW : SUBMERGED ARC WELDED
EFW : ELECTRIC FUSION WELDED
SRL : SINGLE RANDOM LENGHT
DRL : DOUBLE RANDOM LENGHT

Figure 1: ASTM Database

1.3 Objectives

The proposed mobile application '*Steel Pipe Burst Pressure*' is developed with the following objectives:

i. To study the acceptance of the Engineering students on mobile apps as learning tools especially in Fluids Mechanics / Chemical Engineering.

ii. To develop Mobile Application that help the process of determining pressure and burst pressure in Commercial Steel Pipe.

1.4 Scope of study

The mobile application generally targeted to Engineering students and lecturer but this mobile application also can be used by Engineers, Oil and Gas Services Company, Pipe's suppliers, Technologist even a Researcher in related field. The users can determine the pressure and bursting pressure in commercial steel pipe easily without done it manually. Meanwhile, it will save time and decrease the possibilities of human errors that may well be led during the process of calculating, recording data, and unintentional mismatches among data. Nowadays, smartphone can thus take the place of an assortment of devices and provide the like functions infield information documentation even do a better calculation and this mobile applications was created to assist users to determine the pressure and bursting pressure with the collection of ASTM data provided. The outer diameter of the pipe, the wall thickness of the pipe, the strength of pipe and estimated safety factors will be variable that will be select by the user from the application and the information of the variable is retrieve from ASTM database. The pressure and bursting pressure in commercial steel pipe will be calculated and it will resulted whether it safe or not to be use. For this project, author has used the programming fundamental skills and mobile development skills that has been learned in the university in order to complete the project. All the guidance and references while developing the mobile application the author get from the previous notes and slides. This materials help the author to apply the theoretical knowledge as stated in the FYP guideline.

1.5 Relevancy of Project

With the improvement of technology presented to the world today, the awareness of utilizing the latest technology should also be nurtured from the beginning for our young generations. From the research, we have seen how the technology has been applied to educations including mathematics, science, chemical and much more. A study has shown that the number of IT well-educated people in Malaysia is increasing extremely giving new opportunity of improvement to IT industry in Malaysia.

In addition, with the great support from government, we can see that the Malaysia's government is moving the same page with the public by moving forward to utilize technological improvement of what we have nowadays. Refer to Bernama (2011), there are a lot of programs organized and supported by the government such as ICONapps and Developer Conference are all focusing on the same page which is mobile development for getting better community.

Besides, since the day technology was implemented in education, residents as well as the students, teachers and lecturers are accept the technological change with arms wide open. Now we can see almost every school and universities have their owns minimum number of computer lab at least one computer lab and most of the educational course outline are translated to digital medium and mobile learning medium to allowing students to learn in interactive and effective ways of learning and gain a better experience.

Growing battle of smart phones, tablets and hand-held laptops nowadays also underwrote as the relevancy of this project. This research project, which will be focusing on mobile applications that will contributes to the flexibility and freedom of movement of education in Malaysia.

1.6 Practicality of the Project within the Scope and Time Frame

The author has been given two semesters of his final year, which she needs to undertake in developing the mobile application. That is alike to almost seven to eight months of time frame.

The first half of the time frames the author will be focusing on the following activities of developing the apps, which are:

- Identifying the need and all the requirements for developing the application.
- Clarifying the problem statement and scope of the project.
- Understanding the latest trend and advancement of today's technology.
- Carry out research to understand the activities and processes in developing apps for education.
- Come out with the most user-friendly design and feasibility of the process flow for the system.
- Redefining scope and functionalities of the system.
- Getting software, hardware and relevant parts of the development of the mobile application.
- Drafting for the user interface for the mobile application.

The second half of the time frame, the author will emphasis on the following parts which are:

- Mobile application development.
- Getting the application available to the Google Playstore.

CHAPTER 2

LITERATURE REVIEW

2.1 Introduction

This chapter will briefly explain about the evolution of mobile learning, mobile learning in education, mobile application for chemistry, and existing apps for pipeline. The sources are taking from past research, journals, articles, and books. Besides, the information about the software that will be used also included in this chapter. Literature review is done to provide information about previous research and that can help to smoothly run this project. All this information is important before furthering to the analysis and study later.

2.2 The Evolution of Mobile Learning

The world is going mobile today with phones, computers and media devices that can fit in pockets, portable and it connects people with variety of information sources an relevant to learning (Naismith, Lonsdale, Vavoula & Sharples, 2004). Learning is a process of obtaining and retaining knowledge that is required to be implemented in daily life. Sturimski (1997) has stated that learning is not a passive process where it needs an ability to process new information, be able to recall, and apply it appropriately in the complex interaction between learner and the material being learned. Generation Y was born into technology and often know more about the digital world than their teachers and parents. Since that, the uses of the concept of mobile learning became common, laterally with the concept of e-learning and m-learning. It was new and different ways to learn effectively nowadays. According to Blanchard (2009), in each case it was argued that mobile learning platforms were an important part of learning, particularly with younger members of Generation Y, and even more so with Generation Z that known as the Internet Generation.

Besides, mobile learning refers to the use of mobile or wireless devices for the purpose of learning while on the move. According to Kukulska-Hulme & Traxler (2005), the typical examples of the devices used for mobile learning include cell phones, smartphones, tablet PCs, laptops, and personal media players can also fall within this scope. Peters (2007) advocated that the first generation of truly portable information has been assimilated with many functions in small and portable electronic devices. Besides that, the recent innovations in program applications and social software using Web 2.0 technologies - blogs, wikis, YouTube or social networking sites such as Myspace, Twitter and Facebook have made mobile devices more self-motivated, persistent and undertaking more educational potential. Nevertheless, Walker (2006) stated that it has been extensively acknowledged that mobile learning is not just about the use of portable devices but also about learning through circumstances.

Additionally, Peters (2007) observed mobile learning as a useful component of the flexible learning model. Based on Brown, he has summarized that several definitions and terms and identified mobile learning as "an extension of e-learning" (Brown, 2005, p. 299). According to Peters (2007), it was a subset of e-learning, a step toward making the educational process "just in time, just enough and just for me." (p.15). Lastly, Pea and Maldonado (2006) indicated that mobile learning incorporates "transformative innovations for learning futures" (p.437). Nevertheless, mobile learning is showing to be an ample ground for innovation, but there is a concern which is the success of mobile learning will depends on human factors in adapting and adopting with the use of the new mobile and wireless technologies. It is only now that the challenges of mobile learning on a greater scale, and with diverse populations of students, are beginning to be understood.

2.2 Mobile Application in Education

In unity with the technology-based developments, the idea of open learning is quickly changing its shape and meaning, it has become mentioning with the concept of distance education. Especially, the extensive of the unified teaching model, this trend has totally better. Additionally, the development and strengthening of internet infrastructure nowadays make the concept of internet-assisted education

or e-enabled education has been used commonly instead of the concept of traditional formal education. Yet, in recent years with the introduction of mobile devices in our daily life, the use of the concept of mobile learning has increased and e-learning has started to transform into m-learning. Nowadays, mobile devices are among the new technologies because of giving the user more freedom in time and space and their cost, mobile devices are very beneficial when compared with desktop computers (Oran and Karadeniz, 2007).

A few past years, the studies in the literature have presented that a significant percentage of the student population have smart phones and tablets, their gadgets also be able to run and use mobile applications. According to Sharpless et al. (2005) and Cochrane (2010), the mobile learning's most important difference separated from all other types of learning is that learners can be in constant motion. Besides that, Quinn (2000) has stated that mobile learning as the use of handheld devices for learning. It was the first definition that shown by Quinn (2000) has been discussed and it was agreed with some changes in quintessence. Furthermore, Çakır (2011) has been indicated that mobile learning contain the situations that an important part of learning takes place out of school and form people activities to make educational processes and results possible. By way of easy to approachability and convenience of mobile technology, learning activities such as drill and practice especially in the field of education can be carried out of the classroom (Saran, Seferoglu and Cagıltay, 2009). Corlett et al (2005) has stated that the palmtop computers (PDAs), mobile phones and the tablet computers, which have become increasingly widespread can be used for educational purposes and it is possible to take advantage in the teaching-learning process with the support of educational institutions. In addition, the mobile learning has many advantages such as engaging students with learning related activities in different physical environments, supporting group work in projects and improving communication and cooperative learning in the classroom (Gay et al, 2001).

Kukulska-Hulme (2005) stated that the aims sustaining the use of mobile technology in education are to improving access, discovering the potential for changes in teaching and learning, and alliance with wider institutional or business aims. Where the emphasis is on changing teaching and learning processes, experts

and researchers are interested in two-way learning, students' obligation of their learning process and ways of helping students to see a subject differently than traditional ways of learning. Moreover, there is awareness that the new technologies may devour a major role in reducing cultural and communication barriers, and that they are adjusting attitudes and patterns of their study. Nevertheless, there are attempts to characterize these requirements, including in relation to interface design and usability of the mobile applications.

In the other hand, besides the benefits of mobile learning there are also many concerns to deliberate about mobile learning such as what should be design values in mobile learning environments, what needs to be done, the user friendly kind of mobile application, what kind of differences exist in instructional design for mobile environments, what kind of features required in a mobile learning management system, what the user requirements for the mobile applications and which platforms will be choose and used to develop the applications.

2.3 Mobile Application for Chemistry

Williams and Pence (2011) has stated that the advantage of mobile devices to learning was boomed in another recent publication and how smart phones had added a new dimension to the teaching of chemistry. Chemistry-related software, or chemistry "apps", on hand-held and portable touch-controlled computers such as smartphones and iPods are seeing dramatic growth with increasing adoption rates. (Libman and Huang, 2013). Besides, the capabilities that these apps can offer to the practicing chemist are approaching those of conventional desktop-based software, but apps tend to be focused on a relatively small range of tasks. Clark et, al. (2012) has indicated that to overcome this, chemistry apps must be able to seamlessly transfer data to other apps, and through the network to other devices, as well as to other platforms, such as desktops and servers, using documented file formats and protocols whenever possible. Yet, even the additional research in the area has focused on the use of existing apps, or the use of regular web services via mobile devices, rather than on the development of a new custom-made app. This area is still

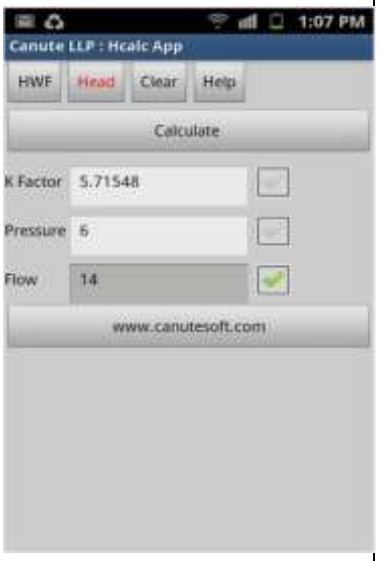
evolving and has little literature outside of computer science, where the focus is on learner created apps.

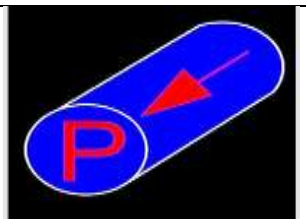
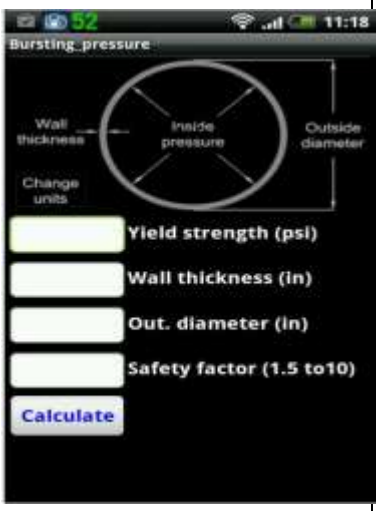
According to Weng et, al. (2012), the latest development of smartphones offers some immediate help to the problems given the large number of functions with which they are equipped. The specific purpose of the mobile applications is to allow students to easily see the temperature profile in the object as a function of time for heating or cooling, and the impact of the system parameters such as the thermal conductivity, heat capacity, density, length, and heat transfer coefficient on the resulting solution (Keith et al., 2013). It is an area of increasing importance in Chemistry and engineering courses, as they move from a technical focus to a more critical and conceptual focus (Gould, 2010). Chemistry is a subject that many students find challenging and the application was developed focusing on how to determine the pressure and burst pressure in pipeline.

Shacham et, al. (1996), in their research has shown that numerical problem solving was introduced into the Chemical Engineering education and practice in the early nineteen sixties. Cutlip et al. (1998), and Shacham and Cutlip (1999) stated that mathematical software packages are currently used for routine numerical problem solving in engineering education and practice is easy to use and provide the most time efficient route for obtaining accurate solutions. Furthermore, the foremost position of the PC and MAC in the personal computing field has been face up to lately by the mobile devices. Wingfield (2013) has predicted that by 2017 the dominant operating system for all computing devices will be Google's Android.

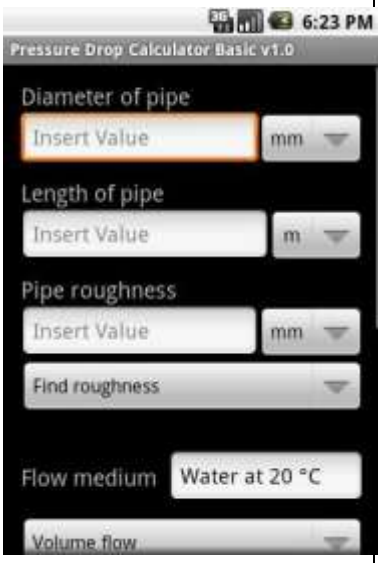
Relying on these trends and predictions, we decided to check the possibility of the use of Android-based smartphones, tablets and computers for general chemistry problem solving. For this aim, we have developed the *Steel Pipe Bursting Pressure Mobile Application* for Android-based devices. Apps are application software designed to run on smartphones and other mobile devices. The Apps provide new ways of interacting with information. Interaction happens anytime, anywhere, with anyone or anything. The challenge to teachers is how to take advantage of the Apps, in the context of the course, to help students learn chemistry.

2.4 Existing Mobile Application for Pipeline

Characteristics of the applications/Type of applications	Apps Interfaces	Apps Description & Features
HCalc Calculator	  	• Allow fire sprinkler engineers to check calculations or solving simple hydraulic calculation. • Allow to find the pressure loss in pipework using the Hazen Williams formula. • User can changed any of the 3 variables, flow, C-factor and the pipes internal diameter and the pressure loss will be calculated. • Can be used to solve the K-factor formula given the flow. • By using the slider controls to vary any of the variables (flow, K factor, pressure) user can see the effect they have instantly. • This version is in metric units only.

Pipe Hydraulic Calculator	 	• Pipe Hydraulics calculator is made to help user solve different characteristics for a pipe. • Can be used to calculate Bursting Pressure, Wall thickness, Pipe outside diameter and allowable stress. • User need to key in all the inputs the required data and the minimum the apps will calculate it. • Pipe Hydraulics uses the four Barlow equations to solve Allowable stress, Bursting pressure, Pipe outside diameter and Wall thickness for a pipe.

Hydraulic Calculator	   	• The Free Hydraulic Calculator includes many basic hydraulic calculations. • Cylinder calculations and pump calculations can be done by using this apps. • Hydraulic line calculations can also be done for fluid velocity, cross sectional area, Reynolds number and pressure drop. • **The free version is limited to 1" or 25mm line diameters.** • Calculations can be done in either metric or imperial units. • User need to enter hydraulic flow, cylinder velocity, or stroke time and calculate the other two or Hydraulic pressure, extend force or retract force and have the other two calculated. • Values include: displacement, oil flow, pressure, rotational speed, torque, and motor power. • Both mechanical and volumetric efficiency values are used.

Pressure Drop Calculator	 	• Can be used to calculate pressure drop of a fluid, in straight circular pipes due to friction. • Input parameters for this app is pipe diameter, length of pipe, pipe roughness, flow rate in several expressions, and physical. • Darcy friction factor, f is calculated depending upon the type of flow that exist in the pipe. • Reynolds number is less than 2000 (laminar flow), the f=64/Re formula is used to calculate the friction factor f. • If Reynolds number is more than 2000 of the transition/turbulent flow, an approximation of the Colebrook equation is used in order to calculate friction factor f. • Then Darcy-Weisbach equation is used finally to calculate the pressure loss.

Steel Pipe Bursting Pressure Mobile Application		• Can be used to calculate the pressure and burst pressure in commercial steel pipe based on ASTM database. • User no need to key in all the inputs and they just need to select any of the 3 variables, Size of pipe, pipe schedule and Safety factor and the allowable pressure, burst pressure of the pipe will be calculated by formula given. • By using the slider controls to vary any of the variables (Size of pipe, Safety factor, pipe schedule) user can see the effect they have instantly. • This version is in metric and imperials unit only. • This apps is made to help user solve different characteristics for a commercial steel pipe.

Table 1: The existing mobile applications

Based on author's perspective, there are still limitations in the existing mobile application for pipeline. The limitations including:

i. There are no mobile applications that focused on the commercial steel pipe. Most of the applications are used which have a very wide and general scope for piping.

ii. There were lack of applications to determine and calculate pressure and burst pressure in the market especially for commercial steel pipe.

iii. Most of the applications do not provide information on the formula has been used, the previous result of the calculation and whether the pressure and burst pressure in commercial steel pipe calculated was safe or dangerous to used.

iv. Most of the applications users need to key in manually all the variables and this can lead to human errors because sometimes during the process of write down data of non-digital format as handwriting in a notebook can get smudged, unrecognizable and can occurs the unintentional mismatches among data as well.

Since, the study of the crude oil and natural gas transmission steel pipelines applied in the pipeline industry has usually shown that the crucial reason for their failure is pressure and burst pressure in the pipe itself. Therefore, a mobile application to determine and calculate the pressure and burst pressure in commercial steel pipe is needed. In addition, the mobile application can reduced the human errors. The functionalities and elements that were determined for the development of *Burst Pressure Mobile Application* include:

i. The app will provide the ASTM database for commercial steel pipe in the app.

ii. The user no need to key in the input variables and the user only have to select an information that will retrieve from database provided in the app.

iii. The app will automatically calculate the pressure and burst pressure in commercial steel pipe and the app will determine whether the pressure and burst pressure is upper or lower limit and whether it safe or dangerous to be used by the user.

2.4 Mobile Apps for Android or iOs

Nowadays, mobile devices are multi-functional devices that have capable of introducing a broad range of applications for the businesses and as well as consumer use. Same with a computer operating system, mobile devices operating system is the software platform that controls the functions and features available on the mobile devices and the familiar and well-known Mobile operating systems are Google's Android and Apple's IOS. This is because we can see in the market, these two operating systems commonly seen and each user of these two operating system keep done some comparison between each other.

2.4.1 Android

Andy Rubin was a founder of Android, Inc. and in 2005, Google assimilated it and then Rubin's team was developed a mobile device platform powered by the Linux kernel. On the November 5, 2007 the Open Handset Alliance, a business alliance of numerous bigger companies including Google, HTC, Intel, LG and other 76 firms revealed itself. Besides, the Open Handset Alliance also has revealed their first product, Android, a mobile device platform which was built on the Linux kernel version 2.6 and the first commercially available phone to run the Android operating system was the HTC Dream, released on 22 October 2008.

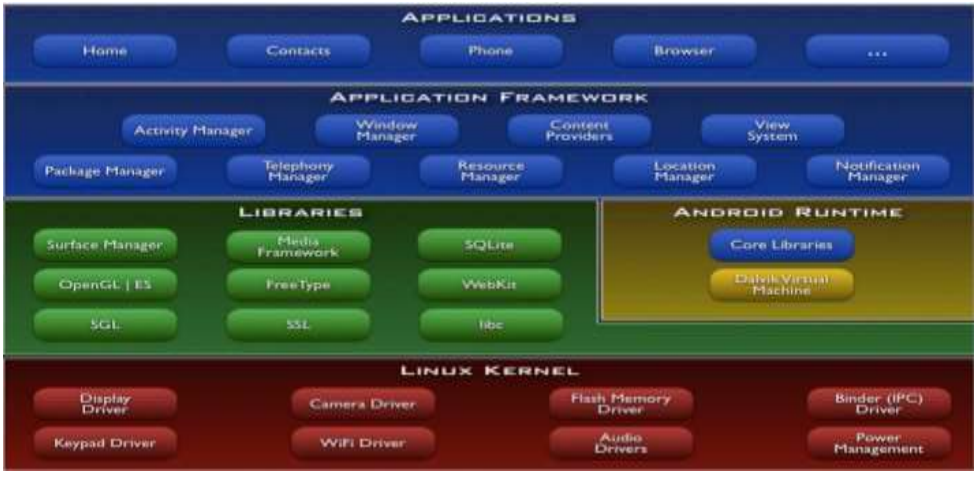


Figure 2: Android's Internal Architecture and Working

The Figure 2 shows that the components of the Android Operating System. The applications are commonly developed in the Java language using the Android Software Development Kit, but developer also can use other development tools that are available including a Native Development Kit for applications, open apps development platform such as apps inventor or android studio. In addition, by providing an open development platform, Android has offers potential developers the ability to build exceedingly rich, interactive and innovative applications.

2.4.2. IOS

IOS is Apple's mobile devices operating system and it was originally and officially developed for the Apple's devices only such as iPhone, iPod, itouch, iPad, and Apple TV. Even though it is derived from Mac OS X, the iOS has the technologies that are exclusively available only on itself, such as the accelerometer support and Multi-Touch interfaces. These devices make iPhone easier to use compared to Mac OS. Thus, the other great invention of iOS is its abundant applications. According to the previous research, iOS has more than 300,000 applications in Apple`s App Store and all the applications has been downloaded more than 10 billion times. Software Development Kit (SDK) was the iOS software development platform which consists of the various code, rich with information, and all the tools that help the developer to develop, check, run, fix, and tune applications for iOS. However, Buck (2010) has stated that loading an application onto the devices is only possible after paying an iPhone Development fee.

2.4.3 Technical Specification of Android and iOS

Attributes	**Android**	**iOS**
Developer	Google	Apple
Operating System	Linux	OS X, Linux
Programmed In	Java, C, C++	C, C++, objective-C
Available on	Phones and Tablets (Samsung, LG, HTC, Lenovo and Other)	iPhone, iPod Touch, iPad, Apple TV
Voice Command	Google Now	Siri
Source Model	Open Source	Closed with open source components
Latest Stable Release	Android 4.4 KitKat	iOS 8.0

Table 2: Technical Specification of Android and iOS

CHAPTER 3

METHODOLOGY

In this chapter which is methodology part, a few of main elements that plays a major role in developing the mobile application. Besides, methodology is a systematic process that involve proper guideline and theoretical analysis that applied to the specific components of development activities such as methods, phases, techniques, tasks and tools needed. The mobile application was developed based on the research method, development method, the correct tools used and requirements gathering techniques that use to collects all the information needed. All details for each of the elements will be elaborates in details in this chapter.

3.1 Research Methodology

Research methodologies signify techniques that can be used to conduct research earlier before developing applications or systems. The research methodologies includes the method to be use in data collection process, the type of data to be collected, the number of respondents and additional variables that can help the process of research and development of the applications. For this project, the qualitative and qualitative approach author will be use by the author to gather all the research information and results.

3.1.1 Methods of Data Collection

The data collection process were from two sources, which are primary data and secondary data. The primary data is refer to data that collected from existing sources and the secondary data is the data that collected from

physical research done in real situation. Basically, the secondary data can be collected through survey, interview or observation.

3.1.2 Project Development Methodology

Burst Pressure Mobile Application will be developed based on Rapid Application Development (RAD). RAD is use to ensure that the project activities are well planned to satisfy all the needs of this project by stimulating timely delivery and to make sure its within budget. Besides that, RAD will help the project to be developed in a short time frame and it can prevents long planning phase with high quality possible results and outputs. RAD methodology helps to support the development of the application and at the same time it helps to ensure the high quality of the product. Besides that, this methodology also helps to allows the prototype to be develop quickly and alongside in the build phase.

Burst Pressure Mobile Application will be developed accordingly using the 4 main phases in RAD. Figure 3 below shows the important phases for the project which are Planning Phase, Analysis Phase, Design Phase, Implementation Phase, System Prototype, Testing Phase, Implementation Phase, and Maintenance Phase. In addition, each phase of RAD which are the Analysis, Design, and Implementation phases will be perform simultaneously and resulting the system prototype that will be revised by the students and lecturers of engineering department of Universiti Teknologi PETRONAS in order to extent the efficiency of the prototype model. Based on the Figure 4, FYP I will be made of planning phase until design phase and the other phases which is implementation phase until maintenance phase will be continues in FYP II.

Development as illustrated below:

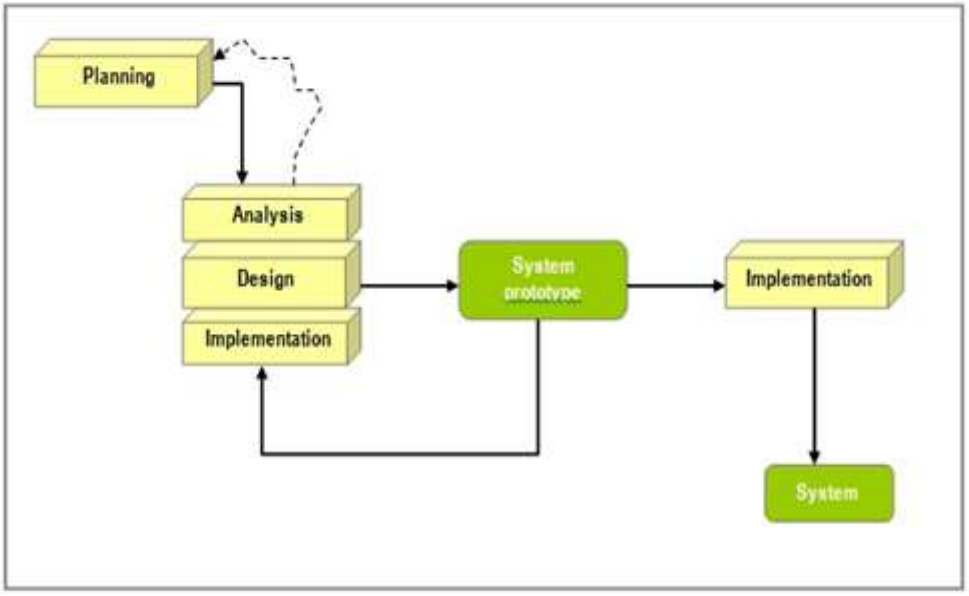


Figure 3: Rapid Application Development

3.2 Project Activities

The current project activity for development of Steel Pipe Bursting Pressure Mobile Application is now in the Design Phase as the progress of the project. Below are the progress activities that have been done:

3.2.1 Planning phase:

For this stage, the project initiation of apps development, a high level view of the project and all the project scope was initiated. The author has done some research and readings to get clearer and more focus ideas for the project's feasibility and achievability. Literature review has been used to identify the activities or the process on how to create suitable mobile application to enhance and help students to get better learning environment by using advancement in technology. During this phase, the aims, goals and objectives of the project has been determined. All of these goals and objectives will be used as a point of reference for all of the development activities to ensure that the project keeps on the track.

Moreover, in the planning and development phases the author needs to have an ample skills and knowledge to use Android Studio as application platform that be used to develop the applications. The time allocated for this Final Year Project (FYP) is 8 months and within that time frame, the author requires developing an android system mobile application that can be used for education purposes. The most important is the well planning has to be done in order to ensure the accomplishment of mobile application.
The author has used Key milestone and Gantt chart as a point of reference to ensure every task on particular time frame during the project will be done and completed.

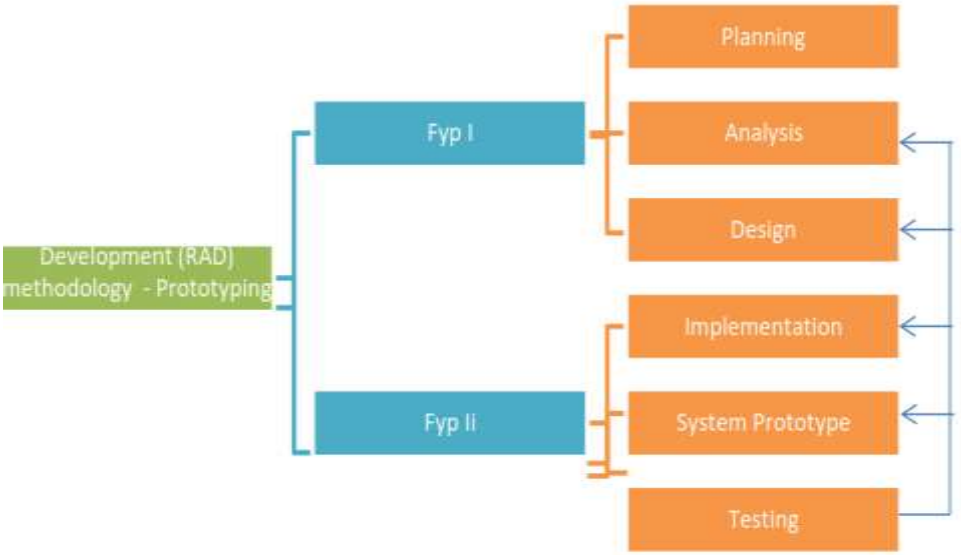


Figure 4: Implementation of SLDC in the development of the mobile application

Requirements Gathering

Requirement gathering is usually the first part of any software product. This stage starts when thinking about developing a mobile application. The main target group will be the Student in Engineering Department and expert's people in Engineering Field, to find out if there is a real need in the market for the mobile application that will be developed.

For this project, it has been decided to gather user requirements by using pre-survey questionnaires to:

- **Students**

  An online pre-survey questionnaire has been conducted to the engineering's students in University Teknologi PETRONAS with 60 respondents to know their knowledge about mobile learning, mobile application in education and their opinion about the need of the mobile application that will be developed. The targeting respondents will be every students in UTP but mainly focus for engineering

students because the application was build related to what they has studied before.

- **Experts People in Engineering Fields**

Pre-survey questionnaires will also be carried out with the experts in Engineering Department such as the employer from Oil and Gas Company, the Engineering Department Lecturers' especially Mr. Mohd Zamri Abdullah to have in depth understanding on the topic which is pressure and burst pressure in commercial steel pipe.

3.2.2 Analysis phase:

In this analysis phase, some of the objective, scope and research elements has been analyze to make sure the development process will be clear and easy to approach during the design phase so that the requirements can be meet. Critical analysis has been implemented for the following:

- **Literature reviews**

Literature reviews is one of the important elements in these research. The related activities which are collecting and analyzing significant and interrelated literatures that were found on the same topic as this project has been done to certify the presence of research topic in the proposed project. As well as to identify its feasibility within the time frame given and to ensure the relation between the concepts used. Besides, the literature review help the author to gain an impression about the important aspects of the related topic and help to identify data sources that other researchers has been used.

- **Data collected from Pre-survey questionnaire**

  Next, data collection was done by doing a pre-survey questionnaire. The questionnaires are ready before the mobile application is built to collect all the predictions of the characteristic of the mobile application. This activities is vital to help the author to understand all the user requirements. Besides, it is best approach to be use because it will comes out with set of ideas quickly and informally. Then the result will be analyze from the responses' and will be use as the source and guidelines for the development of Steel Pipe Bursting Pressure Mobile Application

3.2.3 Design phase:

Next the step of the development process is the design phase where the mobile application will be developed by using the selected tools and methods based on all the requirements needed for the apps. The key component that will be focus during this phase is to make sure the apps effective, efficient, user friendly and easier to handle to the target group that has mentioned in this report earlier.

In the design phase, prototype development will be conducted according to the finding and analyze data got from respondents of online survey. The author has decided to build the Prototype by using Android Studio. Basically, Android Studio is one of tools for building mobile apps on the Android platform. The developer can design their apps interface by using the available web based graphical user interface (GUI) builder and insert in the function of the application in the platform in easy ways. Besides that, the activity in designing the GUI of this application is easier and faster been done by using Android Studio compared to Android App compliers.

3.2.4 Use Case Diagram

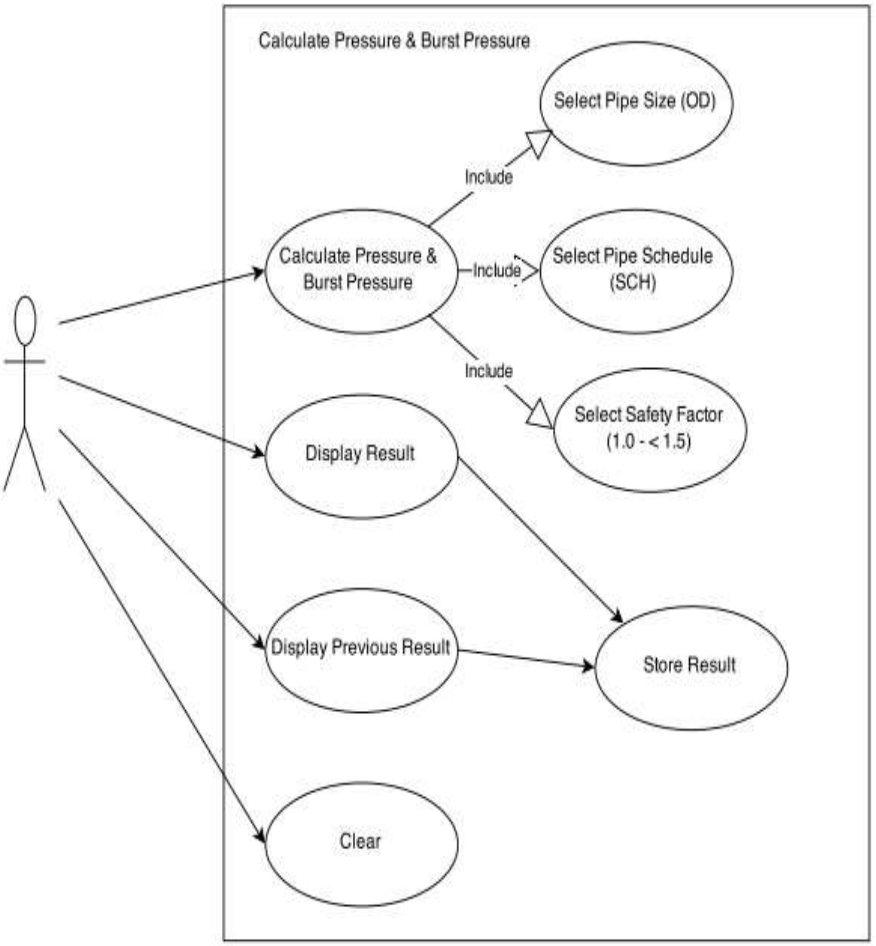


Figure 5: Use Case Diagram

3.2.5 System Requirements

As the part of activities in developing mobile application, the author has to identify some of the system requirements that needed for the mobile application to run efficiently and successfully. Fundamentally, the mobile applications requires all the features in order to run well on the users' devices. Though more or less mechanisms may require additional system resources.

Features	**Descriptions**
Operating system/ Platform	Device: • Android 4.4 Kit Kat

Memory	Device:- • RAM 3GB • Internal Memory: 16GB
Display	Target Device: • 1080 x 1920 pixels, 5.5 inches

Table 3: System Requirements

3.2.6 Implementation

After gaining recognition from the users, Steel Pipe Burst Pressure Mobile Application will be all set to use and go live to the market. Implementation is the phase where the mobile application has been finalized and the mobile application is ready to be distributed to its end users.

3.3 Key Milestone

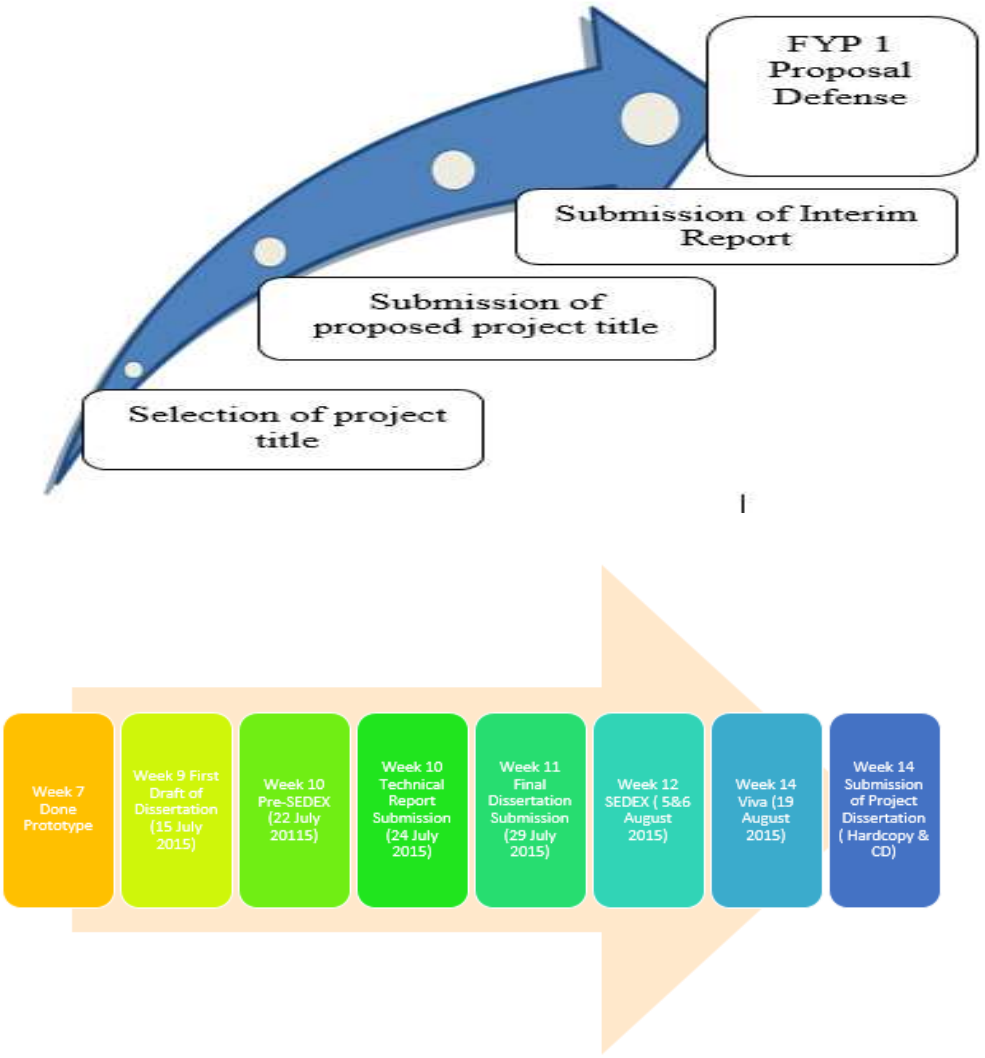


Figure 6: Key Milestones FYP1 & FYP2

3.4 Gantt Chart

The whole project's timeframe is constructed based on below Gantt Chart FYP1 & FYP2:

Detail Week	1	2	3	4	5	6	7	8	9	10	11	12	13
Selection of Project Title													
Submission of Proposal to Research Cluster													
Literature review													
Requirement planning													
Conduct the survey													
Development phase													
Submission of Interim Report													
Proposal Defense													

Table 4: Gantt chart FYP 1

Detail Week	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Working on Real Project Design and Requirements														
Working on Prototype Interfaces														
Working on Prototype Database														
Prototype Testing and Validation														
Conduct User Testing Survey														
User Testing Report														
Improvement Phase														
Pre-SEDEX														
Technical Report Submission														
Submission of Final Dissertation														
SEDEX														

Viva														
Submission of Project Dissertation														

Table 5: Gantt Chart FYP 2

3.5 Tools

3.5.1 Hardware

- Personal Laptop and Android Smartphone

3.5.2 Software

- Android Studio, Android Emulator

CHAPTER 4

RESULTS AND DISCUSSIONS

This chapter mainly focuses on the analysis and discussion of the results collected throughout the development of Burst Pressure Mobile Application. A survey and questionnaires has been done through Google Online Survey. 90 of the respondents from various background has answered the survey. The objective of the survey has been done is to know the rate of utilization of technology, importance of mobile learning and the acceptance of generation nowadays to the world of information technology. Furthermore, the critical analysis of the results and discussions has been done and will be used to conclude the achievements of Steel Pipe Bursting Pressure Mobile Application is relevance and on the track with the objectives of this research paper.

4.1 Pilot study

Pilot study is a minor scale initial study that was conducted to estimate all the important scope which is time, cost, feasibility and result size in order to expect proper sample size. Besides, pilot study has to be done at the initial stage before continuing with the development of mobile applications. The objective of the pilot study is to obtain inclusive information related to mobile learning and to know the rate of utilization of technology of present generation nowadays. In addition, the pilot study was done by an online pre-survey session with 90 respondents from various background including students and experts in engineering field. The questionnaire for the online pre-survey session was attached in Appendix.

4.2 Results

A series of questionnaires has been developed for this specific field. The questions are covering demographic of the respondents, the technology utilization, mobile applications, mobile learning and awareness of people in using technology. An online pre-survey has been conducted to 90 respondents, whereby the questionnaires was distributed thru various social networks especially Facebook, Google +, Twitter and spread thru email for data collections process. The goal of the pre-survey is to get data in user's demography, mobile learning, the utilization of mobile technology and opinion on the development of Steel Pipe Burst Pressure Mobile Application.

Figure 7: Occupations of the respondent

Figure 7 above shows the occupations of all the 90 respondents that answered the online questionnaire. Based on the results from the survey, 81.1% of the respondents were students and another 19.9% of the respondents were lecturer, architect or engineer, computer and mathematical occupations, installation, maintenance, repair and services occupations and other.

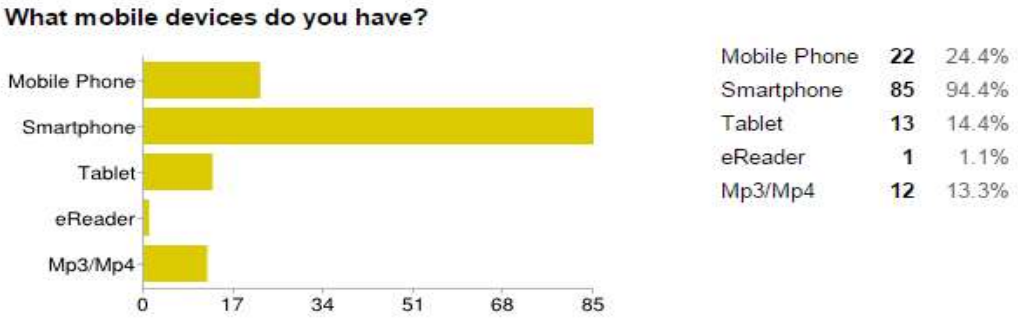


Figure 8: Mobile Devices that respondent has

Next, Figure 8 is the multiple choices question and the respondents could give more than one answer. Based on the result, the highest percentages were smartphone user which is 94.4% of the respondent, 24.4% of the respondent were mobile phone user, 14.4% of the respondents had tablets, 13.3% of them had mp3 or mp4 and the lowest is eReader which is 1.1% from the respondents.

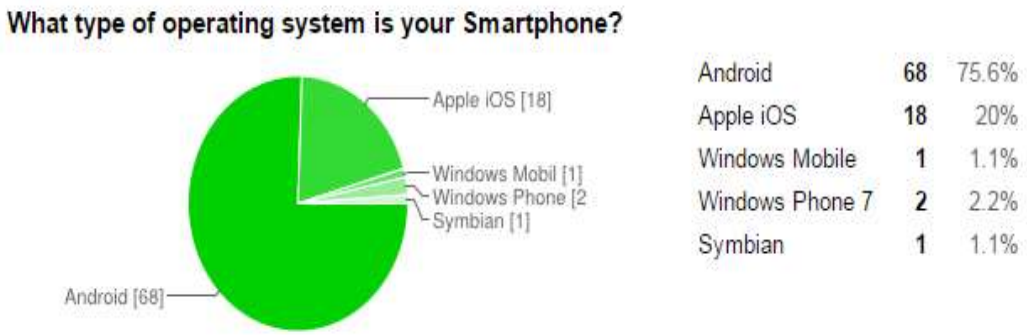


Figure 9: Operating System of the Respondents' Smartphone

Figure 9 shows that, out of 90 respondents, it was found that 68 of them is Android user, followed by Apple iOs user which is 18 of them, then windows phone 7, windows mobile and Symbian.

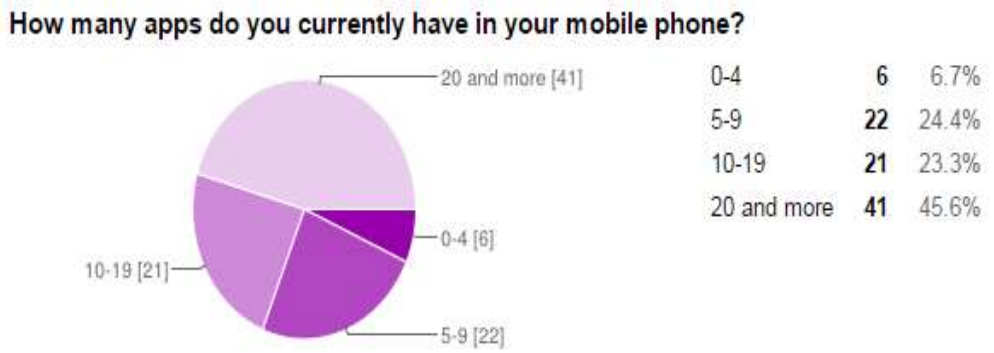


Figure 10: The number of apps installed in respondents mobile phone

Based on the survey, Figure 10 shows that out of 41 of the respondents had installed more than 20 apps in their phone and assuming that the mobile apps is important and provide a daily needs for the respondents.

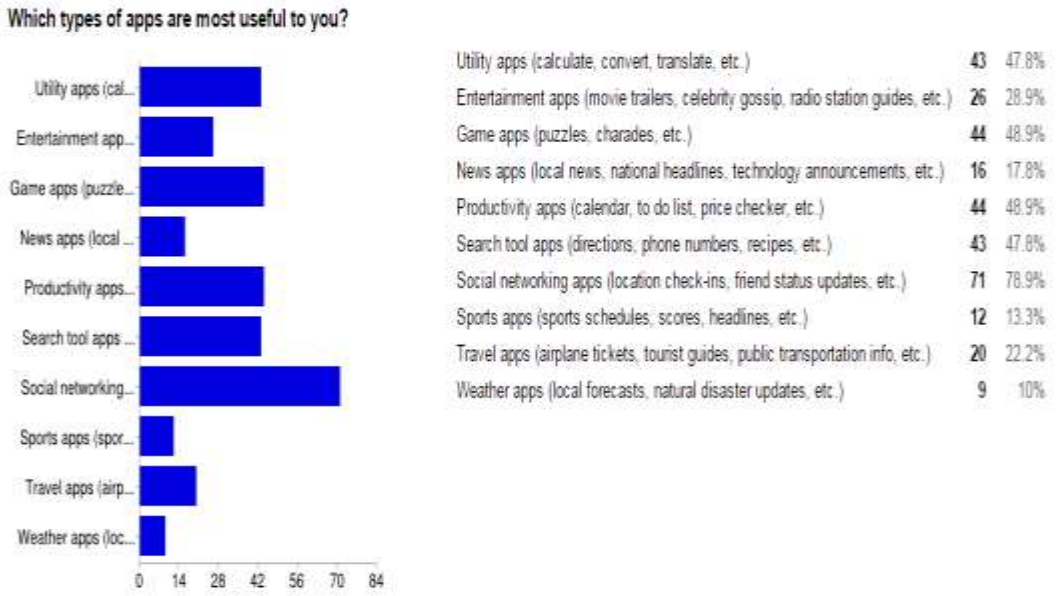


Figure 11: The types of apps are the most useful for respondents

Following, the most of respondents answered that social networking apps is the most apps that they frequently used in their daily, which is 78.9% from the respondents and from the result, we conclude that people nowadays tends to communicate more by using social network. For another 21.1% from the survey shows that the respondents had installed various apps in their mobile phone such as productivity apps, game apps, utility apps, entertainment apps and the rest.

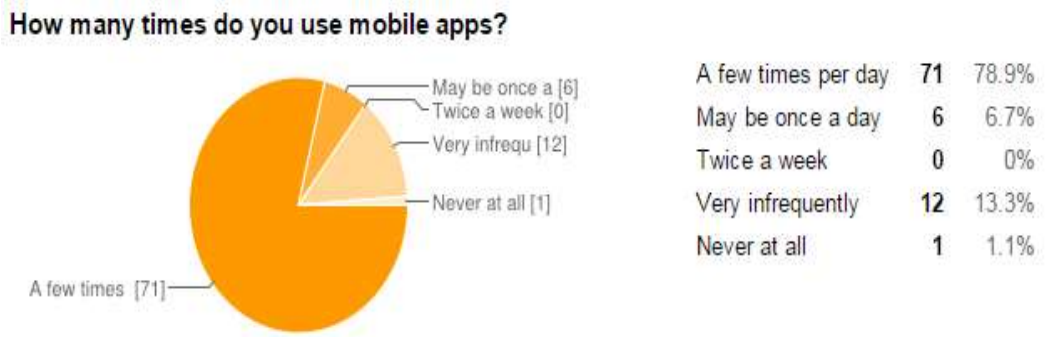


Figure 12: The frequently of the respondents use the mobile apps in daily

Based on the survey, most of the respondent used mobile apps a few times per day and only 1 of the respondents answered never used it at all. Assuming maybe the respondent did not having or using a smartphone, so that the respondents did not install all the apps in the phone.

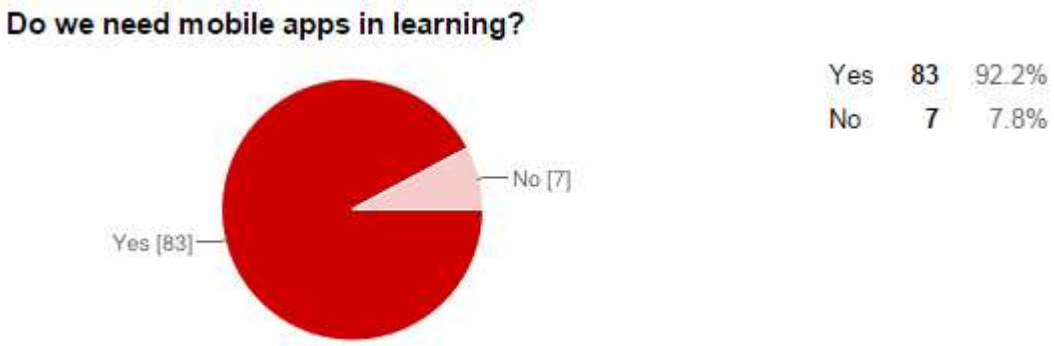


Figure 13: The needs of mobile apps in learning

From Figure 13, 83 of the respondents answered that we need mobile apps in learning. From the result we can conclude that there is a need to redesign the way of learning to adopt and adapt with current technologies nowadays. Mobile learning can be a major roles of mobility and communication of technology in the process of learning, and also to point out the significance of perspective in creating meaning, and the transformative effect of technology in supporting virtual societies that go beyond barriers of generation, age and culture.

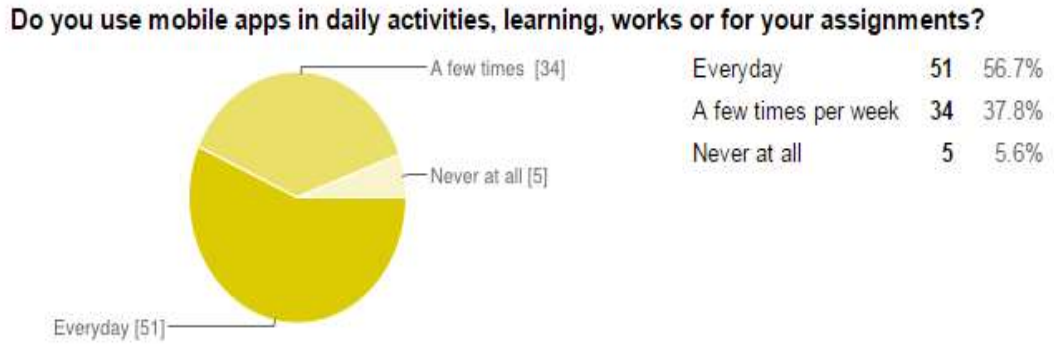


Figure 14: Uses of mobile apps in daily activities.

Based on the pie chart, more than half of the respondents which is 51 of them using mobile apps almost every day in their daily and 34 from them using mobile apps

only a few times per week in their daily to help them in solving their problem in their daily activities, learning, works and assignments.

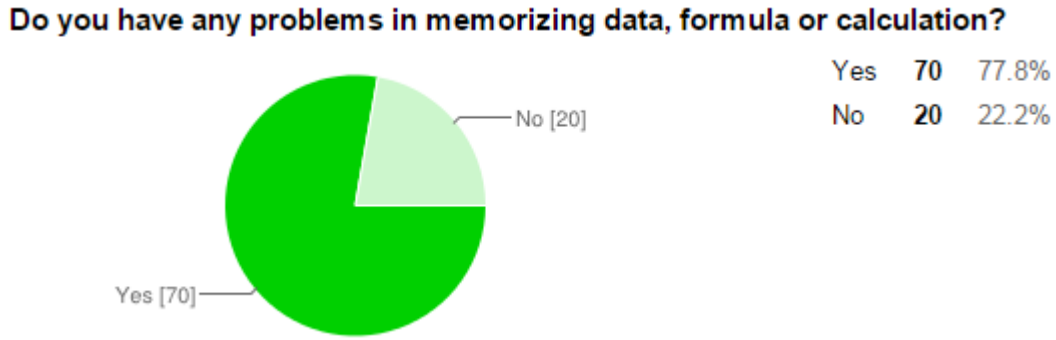


Figure 15: Problems in memorizing data, formula or calculation

Next, the question is to determine the problems of the respondents in memorizing data, formula or calculation and 77.8% of the respondents answered that they were having the problems.

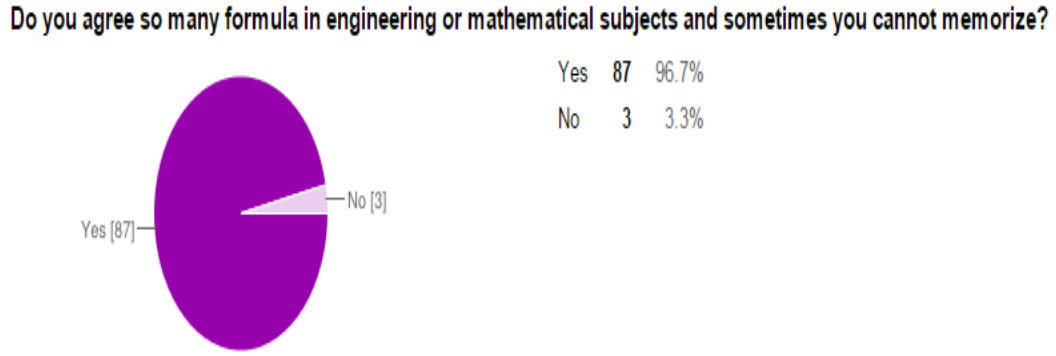


Figure 16: Formula in Engineering and Mathematical Subject

From Figure 16, 96.7% of the respondents agree that there is many formula especially in engineering, mathematical, physics or chemistry subjects that they need to memorize and they were facing the problems to memorize all the formulas to do the calculation.

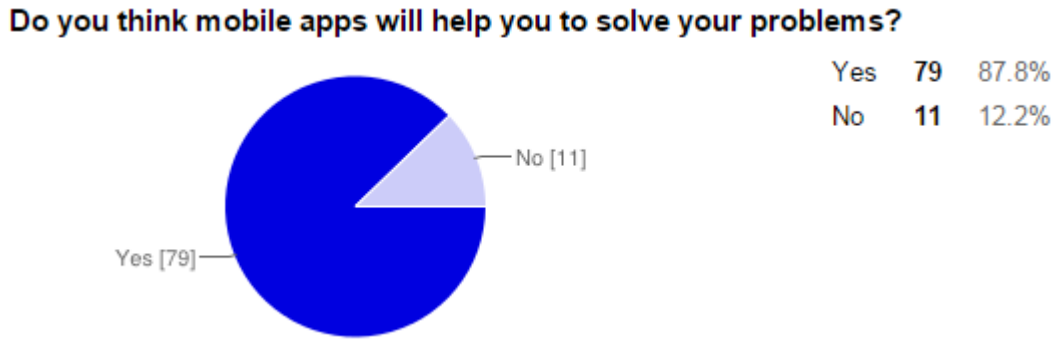


Figure 17: Mobile Apps help to solve the problems

Figure 17 shows the most of the respondents agree that mobile apps will help them to solve their problems. They believe mobile apps will make the complicated calculation become easier and plus they did not have to memorize all the formulas and the calculations if they had something that will help them in that.

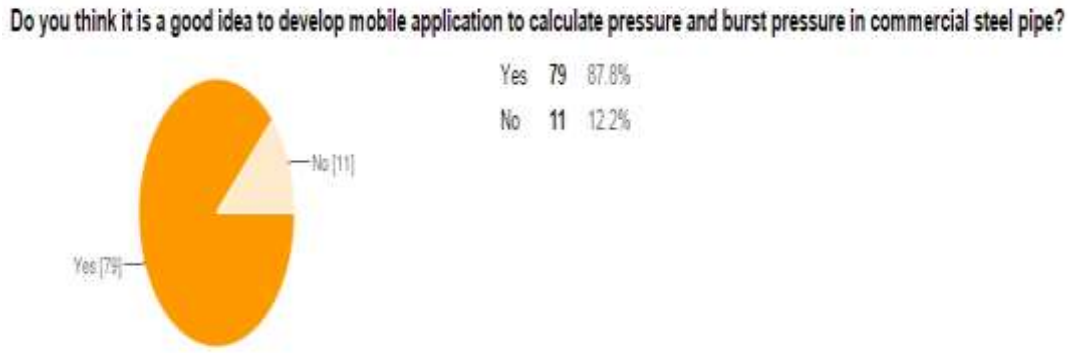


Figure 18: Mobile Apps to calculate pressure and burst pressure in commercial steel pipe

Figure 18 shows that 87.9% of the respondent agree that by developing mobile apps to calculate the pressure and burst pressure in commercial steel pipe, it will help them to solve their problems because there is no available apps to calculate pressure and pressure specifically for commercial steel pipe.

Figure 19: The tendency of pipe system failure can be reduce by having the mobile apps

For the chart in Figure 19, we can conclude that most of the respondent agreed that by having the mobile apps to determine and calculate the allowable pressure and burst pressure in commercial steel pipe can reduce the propensity of pipe system failure.

Figure 20: Willingness to use or buy the mobile apps

Lastly, Figure 20 shows that 80 over 90 of the respondents are willing to buy or use the mobile apps to help them to solve related problems. We can conclude that based on the result respondents has awareness on the needs of technology and mobile apps in problem solving.

4.3 Prototype Design

Figure 21: Prototype Main Page

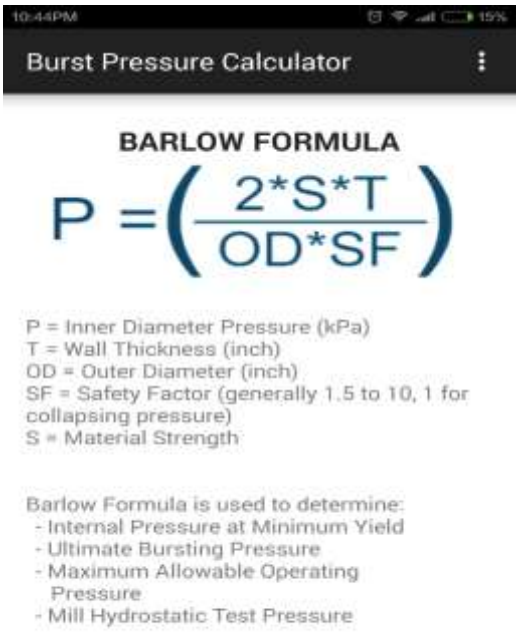


Figure 22: Prototype Introduction Page

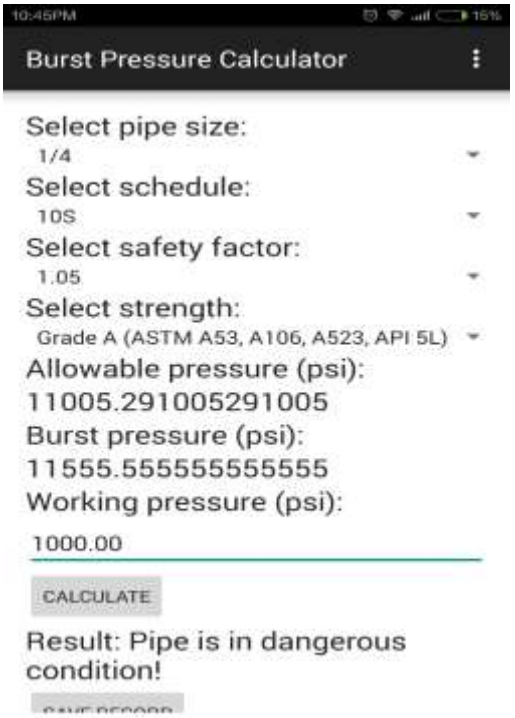


Figure 23: Prototype Calculation Page

The *Burst Pressure Mobile Application* consists of 3 main pages which are the main page, the introduction page and the calculator page. Figure 21, 22 and 23 shows that all the initial interfaces design for the apps.

Figure 21 shows that the startup screen or main page of the apps and when user click the start button the apps will move to the next page which is introduction page in Figure 22. Introduction pages is important to provide information about the formula and the used of formula for the calculation to determine the allowable pressure and burst pressure in commercial steel pipe.

Next, Figure 23 above shows the initial interface design for the calculator screen for *Burst Pressure Mobile Application*. Before the calculation to determine the allowable pressure and burst pressure will be done, user have to select 3 main input for the calculation which are Pipe Nominal Size (Outer Diameter), Pipe Schedule (SCH) and Safety Factor and all the inputs will be retrieve from the database, ASTM database for commercial steel pipe. Then, the calculation will be done by the apps and the output of the calculation are allowable pressure,

burst pressure, working pressure and the condition of the pressure whether it will be safe or danger to use the pipe.

4.4 Burst Pressure Mobile Application Development:

Below shows the part of calculation code of the mobile application designed for *Burst Pressure Mobile Application*:

```
public class CalculateActivity extends ActionBarActivity implements
AdapterView.OnItemSelectedListener {

    private Spinner spSize, spSchedule, spSafetyFactor, spStrength;
    private TextView txtAllowablePressure, txtBurstPressure, txtResult;

    private EditText txtWorkingPressure;

    private Button calculate, btnSaveRecord;

    private SQLiteHandler sqLiteHandler;

    int pipeSizePosition = 0;
    double wallThickness = 0.0;
    double outerDiameter = 0.0;
    double safetyFactor = 0.0;
    double strength = 0.0;
    double allowablePressure = 0.0;
    double burstPressure = 0.0;
    double workingPressure = 0.0;

    @Override
    protected void onCreate(Bundle savedInstanceState) {
        super.onCreate(savedInstanceState);
        setContentView(R.layout.activity_calculate);
```

```
        //spinners
        spSize = (Spinner)findViewById(R.id.spSize);
        spSchedule = (Spinner)findViewById(R.id.spSchedule);
        spSafetyFactor = (Spinner)findViewById(R.id.spSafetyFactor);
        spStrength = (Spinner)findViewById(R.id.spStrength);

        //text view
        txtAllowablePressure =
(TextView)findViewById(R.id.txtAllowablePressure);
        txtBurstPressure = (TextView)findViewById(R.id.txtBurstPressure);
        txtWorkingPressure = (EditText)findViewById(R.id.txtWorkingPressure);
        txtResult = (TextView)findViewById(R.id.txtResult);

        calculate = (Button)findViewById(R.id.calculate);
        btnSaveRecord = (Button)findViewById(R.id.btnSaveRecord);

        //database
        sqLiteHandler = new SQLiteHandler(this);

        //add data to spinner size
        List<String> arraySizes = new ArrayList<>();
        arraySizes.add("1/4");
        arraySizes.add("1/2");
        arraySizes.add("1");
        arraySizes.add("4");
        ArrayAdapter<String> sizesAdapter = new ArrayAdapter<String>(this,
android.R.layout.simple_spinner_item, arraySizes);

sizesAdapter.setDropDownViewResource(android.R.layout.simple_spinner_dropd
own_item);
        spSize.setAdapter(sizesAdapter);
        spSize.setOnItemSelectedListener(this);
```

```
        //add data for safety factor
        List<String> arraySafetyFactors = new ArrayList<>();
        arraySafetyFactors.add("1.05");
        arraySafetyFactors.add("1.10");
        arraySafetyFactors.add("1.15");
        arraySafetyFactors.add("1.20");
        ArrayAdapter<String> sfAdapter = new ArrayAdapter<String>(this,
android.R.layout.simple_spinner_item, arraySafetyFactors);

sfAdapter.setDropDownViewResource(android.R.layout.simple_spinner_dropdow
n_item);
        spSafetyFactor.setAdapter(sfAdapter);
        spSafetyFactor.setOnItemSelectedListener(this);

        //add data for strength
        List<String> arrayStrength = new ArrayList<>();
        arrayStrength.add("Grade A (ASTM A53, A106, A523, API 5L)");
        arrayStrength.add("Grade B (ASTM A53, A106, A523, API 5L)");
        ArrayAdapter<String> strengthAdapter = new ArrayAdapter<String>(this,
android.R.layout.simple_spinner_item, arrayStrength);

strengthAdapter.setDropDownViewResource(android.R.layout.simple_spinner_dr
opdown_item);
        spStrength.setAdapter(strengthAdapter);
        spStrength.setOnItemSelectedListener(this);

        spSchedule.setOnItemSelectedListener(this);

        calculate.setOnClickListener(new View.OnClickListener() {
            @Override
            public void onClick(View v) {
                //working pressure
                String textWorkingPressure = txtWorkingPressure.getText().toString();
```

```
            if(!textWorkingPressure.isEmpty()){
                workingPressure = Double.parseDouble(textWorkingPressure);
            }

            if(workingPressure >= allowablePressure && workingPressure <
burstPressure){
                txtResult.setBackgroundColor(Color.parseColor("#FFFFFF"));
                txtResult.setTextColor(Color.parseColor("#000000"));
                txtResult.setText("Result: Pipe is Safe to use!");
            }else{
                txtResult.setBackgroundColor(Color.parseColor("#D50000"));
                txtResult.setTextColor(Color.parseColor("#FFFFFF"));
                txtResult.setText("Result: Pipe is in dangerous condition!");
            }
        }
    });

    //save record button
    btnSaveRecord.setOnClickListener(new View.OnClickListener() {
        @Override
        public void onClick(View v) {
            String pipeSize = spSize.getSelectedItem().toString();
            String schedule = spSchedule.getSelectedItem().toString();
            String safetyFactor = spSafetyFactor.getSelectedItem().toString();
            String strength = spStrength.getSelectedItem().toString();
            String allowablePressure = txtAllowablePressure.getText().toString();
            String burstPressure = txtBurstPressure.getText().toString();
            String workingPressure = txtWorkingPressure.getText().toString();
            String result = txtResult.getText().toString();

            if(workingPressure.isEmpty()){
```

```
                Toast.makeText(getApplicationContext(), "Please fill in all details!",
Toast.LENGTH_LONG).show();
            }else {
                sqLiteHandler.addRecord(pipeSize, schedule, safetyFactor, strength,
allowablePressure, burstPressure, workingPressure, result);
                Log.d("record:", "pipsize: " + pipeSize + ", schedule: " + schedule + ",
sf: " + safetyFactor + ", strength: " + strength + ", allPre: " + allowablePressure +
", bPre: " + burstPressure + ", wPre: " + workingPressure + ", result: " + result);
                Toast.makeText(getApplicationContext(), "Record saved
successfully!", Toast.LENGTH_LONG).show();
            }
        }
    });
  }
```

4.5 Commercial Potential and Limitation of Steel Pipe Burst Pressure Mobile application

Commercial potential of Steel Pipe Burst Pressure Mobile Application

This application should be able to:

- To create awareness among Malaysian on the importance of mobile application in learning.
- To calculate and determine allowable pressure and burst pressure in commercial steel pipe.
- To reduce the tendency of pipe system failure.
- Chances to help people in learning easiest ways by using this application can be fully utilize.

Limitations of Steel Pipe Burst Pressure Mobile Application

- Lack of user knowledge on some data of the commercial steel pipe such as the schedule, the strength of materials or safety factor.

4.6 Burst Pressure Mobile Application Testing Results

After the final prototype was completed, a system performance testing was conducted on 20 respondents from Chemical Engineering students. The main objective is to execute system performance testing for each specification in Burst Pressure mobile application and to measure user's perception and acceptance level of Burst Pressure mobile application.

Prior to the usage of Burst Pressure mobile application, a short briefing was given to the respondents in order to ensure they understand the aim of the system testing as well as the respective functionalities in Burst Pressure mobile application. The respondents will subsequently rate their user' experiences in the designed questionnaires upon completion of the system performance testing. The result of the 20 user acceptance testing is shown in Figure 24.

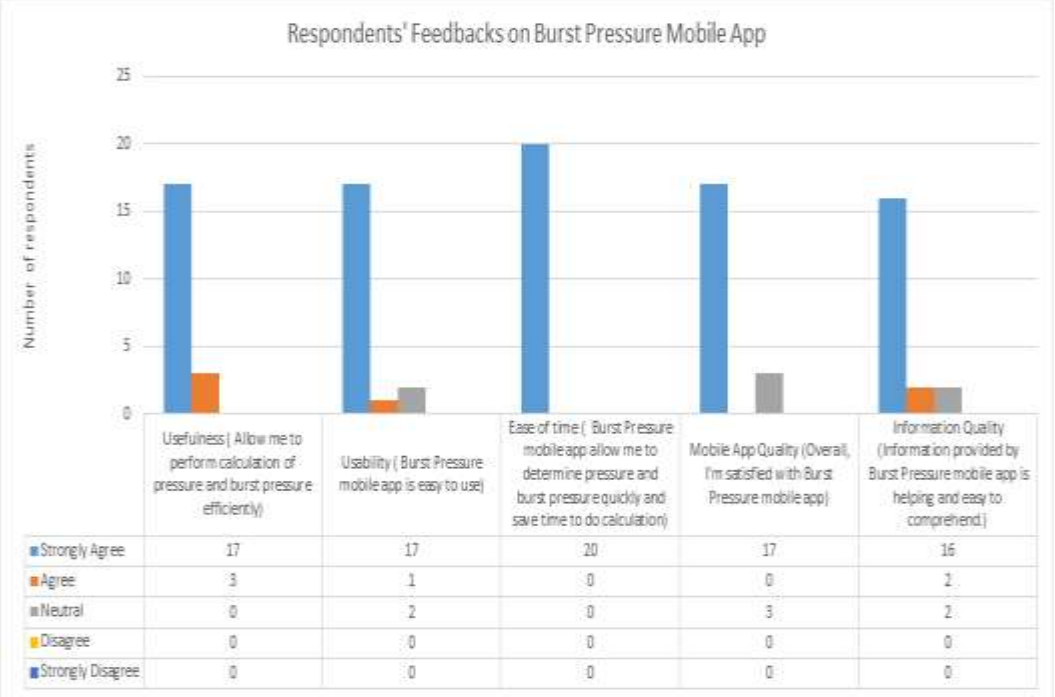


Figure 24: Respondents' Feedback on Burst Pressure Mobile Application System Testing

CHAPTER 5

CONCLUSION AND RECOMMENDATION

5.1 Conclusion

Burst Pressure Mobile Application was developed to help target users, Lecturers, Engineering Students even Engineers in related field to determine the allowable pressure and burst pressure in commercial steel pipe become convenient and easy. In addition, the users does not need to do the calculation manually. One of the main benefits of this mobile application the user can access the mobile application anywhere, anytime 24/7 without the need of internet access, as it is not inadequate to a certain time and use only.

This project has met with its own objectives which are, it successfully being developed in order to help learning process become easier and more up-to-date by using the current technology. Moreover, it will increase awareness of Malaysian on the importance of mobile learning to have interactive and effective learning as the advancement of current technology.

Besides, this project has gone through the phase 1 of the pre-survey among the students and experts in the related fields and the feedback received from the respondents is noble. This proven that the relevancy of this research project to its aims and objectives. Additionally, the apps help to provide a solution to meet the problems and needs of the mobile apps in learning process nowadays. However, a few improvement still need to be done as it is to make sure the effectiveness of the mobile application. Since there is no any mobile application to determine allowable pressure and burst pressure focusing for Commercial Steel Pipe, it has become an inspiration and motivation for this project to be continued. Lastly, hopefully this apps can be implement to make the process of learning become easier, effective and interactive by using latest technology which is mobile learning.

5.2 Recommendations

At this time, there are limitations to the application that has been developed due to a few constraints such as time, capital or money and resources. But in order to achieve the objective of this project, there are suggestion of recommendations that can be taken to enhance the prototype.

- **Adding more supported platform**

  Without a doubt Android is the most operating system that has been used in smartphones and has many users compared to another operating systems. However, it will be better if it can be extended by other platform as well and by using the other platform such as iOS and Windows Phone, it would be huge impacts to mobile learning areas.

- **Updates for the mobile applications**

  When the new apps has been released, the major problems developer will figure out is when get feedback from the users. So, from the feedback the developer has to issue an update to fix all the problems. But when it comes to software versioning it must have major version number and followed by a point release for minor updates for bug fix or adding or removing and updating User Interface (UI).

    - **The Bug Fix**

      The most frequent types of app updates are bug fixes and it does not will change or affect the structure or feature set of an app. Instead, all the updates has to be done to make sure that the apps is working well. Besides, Bug fixes are the best way to make sure the integrity and structure of the app unbroken and it does not crash. Bug fixes also important to make sure the apps will run optimally.

- **Adding or Removing Features and Updating UI**

Adding or removing features from an app is a more noteworthy update than a bug fix. This is because adding and removing features is the most vital part of the apps development process. But if the developers want to add a new feature, the important things is to supervise the feedback from the users and just adding important features or remove the features in order to maintain the stability and functionality of the apps.

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APPENDIXES

i. Online Pre-Survey Questionnaire

Steel Pipe Bursting Pressure Mobile Apps Survey

In engineering fields, research has shown that the allowable pressure and burst pressure in pipe is very important for safety purposes and to avoid any failure occur. Pressure and burst pressure in pipe is very important in designing any system especially in Oil and Gas Industry. Hence, there is a need to develop Steel Pipe Burst Pressure Mobile Application. The objective of this project is to develop a mobile application to determine pressure and burst pressure in commercial steel pipe. Besides the applications will provide simple calculation based on user input and it will determine whether the pressure and burst pressure calculated is upper or lower the limit and whether it safe or not safe to be use.

*Required

What is your age?*

- 18-20
- 21-29
- 30-39
- 40-49
- 50-59
- 60 or older

What is your gender?*

- Male
- Female

Which of the following best describe your occupations?*

- Student
- Lecturer
- Architecture & Engineering Occupations
- Computer & Mathematical Occupations
- Installation,Maintenance, Repair & Services Occupations
- Other:

What mobile devices do you have?

- [ ] Mobile Phone
- [ ] Smartphone
- [ ] Tablet
- [ ] eReader
- [ ] Mp3/Mp4

What type of operating system is your Smartphone? *

- ( ) Android
- ( ) Apple iOS
- ( ) Windows Mobile
- ( ) Windows Phone 7
- ( ) Symbian

How many apps do you currently have in your mobile phone? *

- ( ) 0-4
- ( ) 5-9
- ( ) 10-19
- ( ) 20 and more

Which types of apps are most useful to you? *

- [ ] Utility apps (calculate, convert, translate, etc.)
- [ ] Entertainment apps (movie trailers, celebrity gossip, radio station guides, etc.)
- [ ] Game apps (puzzles, charades, etc.)
- [ ] News apps (local news, national headlines, technology announcements, etc.)
- [ ] Productivity apps (calendar, to do list, price checker, etc.)
- [ ] Search tool apps (directions, phone numbers, recipes, etc.)
- [ ] Social networking apps (location check-ins, friend status updates, etc.)
- [ ] Sports apps (sports schedules, scores, headlines, etc.)
- [ ] Travel apps (airplane tickets, tourist guides, public transportation info, etc.)
- [ ] Weather apps (local forecasts, natural disaster updates, etc.)

How many times do you use mobile apps? *

- ( ) A few times per day
- ( ) May be once a day
- ( ) Twice a week
- ( ) Very infrequently
- ( ) Never at all

Do we need mobile apps in learning? *

- Yes
- No

Do you use mobile apps in daily activities, learning, works or for your assignments? *

Google Translator, Calculator, Dictionaries

- Everyday
- A few times per week
- Never at all

Do you have any problems in memorizing data, formula or calculation? *

- Yes
- No

Do you agree so many formula in engineering or mathematical subjects and sometimes you cannot memorize? *

Chemical, Physics, Integration, Calculus

- Yes
- No

Do you think mobile apps will help you to solve your problems? *

Mathematical, Calculation, Translating, Memorizing

- Yes
- No

Do you think it is a good idea to develop mobile application to calculate pressure and burst pressure in commercial steel pipe? *

- Yes
- No

Do you think the failure of pipe system can be reduced by developing mobile apps to determine the allowable pressure in the pipe? *

- Yes
- No

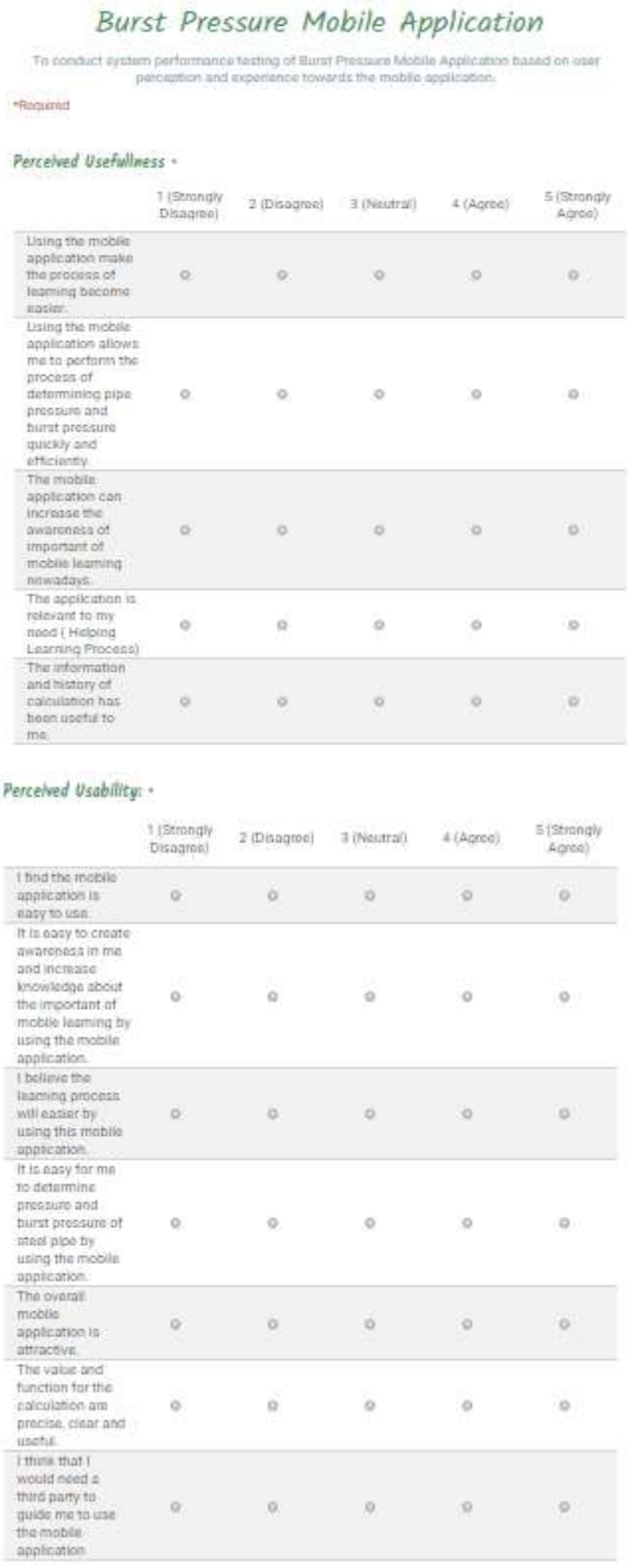
If you is an engineers, or engineering student, or Oil and Gas Services company's worker, or pipe's suppliers, or technologist even a researcher in related field, do you would like to use this mobile apps in your daily activities? *

- Yes
- No

Submit

Never submit passwords through Google Forms.

ii. Feedbacks Survey on Burst Pressure Mobile Applications Testing System



Burst Pressure Mobile Application

To conduct system performance testing of Burst Pressure Mobile Application based on user perception and experience towards the mobile application.

*Required

Perceived Usefullness *

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
Using the mobile application make the process of learning become easier.					
Using the mobile application allows me to perform the process of determining pipe pressure and burst pressure quickly and efficiently.					
The mobile application can increase the awareness of important of mobile learning nowadays.					
The application is relevant to my need (Helping Learning Process)					
The information and history of calculation has been useful to me.					

Perceived Usability: *

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
I find the mobile application is easy to use.					
It is easy to create awareness in me and increase knowledge about the important of mobile learning by using the mobile application.					
I believe the learning process will easier by using this mobile application.					
It is easy for me to determine pressure and burst pressure of steel pipe by using the mobile application.					
The overall mobile application is attractive.					
The value and function for the calculation are precise, clear and useful.					
I think that I would need a third party to guide me to use the mobile application.					

*Perceived Ease of Time **

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
Using the mobile application reduces delay in process of determining pressure and burst pressure in commercial steel pipe.					
I can perform the calculation on pressure and burst pressure in steel pipe in less time using the mobile application without depending on third party.					
I can look for the history of previous calculation in this mobile applications.					
The mobile application provide me an information about the formula that has been used to calculate the pressure and burst pressure					
The mobile application helps me to classify whether its danger or safe due to the pressure and burst pressure of the pipe.					

*Availability of Information: **

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
I receive the information about the formula that will use to determine pressure and burst pressure in steel pipe from the mobile application.					
I can get the history information of the previous calculation from the mobile application.					

Attitude *

Burst Pressure Mobile Apps Acceptances

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Disagree)
I think positively about using the mobile application as often as I need.					
The mobile application is a positive tool to determine pressure and burst pressure in steel pipe.					
Implementation of the mobile application with history information of previous calculation is a wise idea.					
Using mobile application has been a great experience and very helping in learning process.					

Behavioral Intention: *

Burst Pressure Mobile Apps Acceptances

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
I intend to use the mobile application as often as I need in learning process.					
I intend to use the mobile application to perform the task of determining pressure and burst pressure in steel pipe.					
I will strongly recommend other students to use the mobile application in learning process that related to pressure and burst pressure in steel pipe.					
I am more motivated to use the mobile application as one of learning tools.					

Information Quality: *

	1 (Strongly Disagree)	2 (Disagree)	3 (Neutral)	4 (Agree)	5 (Strongly Agree)
Information provided by the mobile application is relevant to my need (Related to field of study).					
Information on the previous history of the pressure and burst pressure calculation provided by the mobile application is very convenient.					
Information provided by the mobile application is easy to comprehend.					
Information provided by the mobile application is accurate.					
Information provided by the mobile application is complete.					

Submit

iii. System Testing