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CONCEPTUAL DESIGN MODEL FOR YOUTH PERSONAL DECISION AID

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Abstrak

Remaja cenderung untuk menghadapi pelbagai bidang membuat keputusan dengan mempunyai pelbagai pilihan. Walau bagaimanapun, alat membuat keputusan yang sedia ada terlalu kompleks dan tidak mudah difahami oleh golongan remaja. Selain itu, teknik-teknik matematik yang kompleks dan berstruktur tidak disukai oleh pengguna berbanding model reka bentuk secara terus dan mudah. Tambahan pula asas teori untuk membuat keputusan tidak banyak diamalkan dalam merekabentuk dan membangunkan teknologi bantuan keputusan. Oleh itu, terdapat keperluan dalam mempertimbangkan teknik kriteria pelbagai, model dan teori dalam pembangunan bantuan keputusan peribadi. Matlamat utama kajian ini adalah untuk membina satu model reka bentuk konsep untuk Bantuan Keputusan Peribadi Remaja (YouthPDA). Berikut adalah objektif yang telah digariskan untuk menyokong matlamat utama: i) untuk mengenal pasti teknik, kriteria, dan asas teori yang berkaitan membuat keputusan untuk YouthPDA, ii) membina model reka bentuk konsep untuk YouthPDA dengan menggunakan pembuatan keputusan yang dikenal pasti, kriteria, teknik, dan asas teori yang telah dikenal pasti, iii) mengukur model reka bentuk konsep YouthPDA melalui penilaian pakar dan, iv) mengesahkan hubungan antara dimensi dari segi kebergunaan model reka bentuk konsep menggunakan prototaip. Penyelidikan Rekabentuk telah dipilih sebagai pendekatan dan tiga fasa utama yang digunakan adalah Mengenalpasti Masalah, Merekabentuk Penyelesaian dan Penilaian. YouthPDA dibangunkan sebagai bantuan keputusan peribadi untuk remaja bagi membantu mereka memilih bidang pengajian dan laluan kerjaya mereka. Dengan menggabungkan data daripada pelbagai jenis personaliti dan kecerdasan, YouthPDA berfungsi sebagai sistem saranan yang menggunakan penaakulan berasaskan peraturan. Kebergunaan YouthPDA diukur dalam fasa penilaian. Hasil penilaian daripada 189 responden menunjukkan bahawa YouthPDA yang dicadangkan adalah berguna sebagai alat membuat keputusan untuk remaja. Ketepatan, Strategi Membuat Keputusan, Kepuasan, Pengetahuan Perolehan dan Kebergunaan Secara Keseluruhan adalah dimensi-dimensi yang diukur dan dikaitkan untuk mengemukakan kesimpulan. Teknik kriteria pelbagai, teknik dan teori yang telah dipilih terkandung bersama dalam model reka bentuk konsep yang disahkan dan prototaip YouthPDA sebagai sumbangan utama kajian ini.

Kata kunci: Model konsep reka bentuk, Bantuan keputusan peribadi, Kriteria membuat keputusan, Teknik membuat keputusan, Teori membuat keputusan.

Abstract

Youth tend to face many areas of decision making with multiple choices. However, existing decision making tools are too complex and are not easily understood by the youth. Besides, complex and structured mathematical techniques are not preferred by the users as compared to direct and straightforward design model. Additionally, theoretical foundation for decision making is not adequately considered in designing and developing decision aid technologies. Therefore, there is a need in considering and including relevant multi-criteria technique, model and theory in the development of personal decision aids. The main aim for this study is to construct a conceptual design model for Youth Personal Decision Aid (YouthPDA). The following objectives are outlined to support the major aim: i) to identify relevant decision making criteria, techniques, and theoretical foundations for YouthPDA, ii) to construct a conceptual design model for YouthPDA using the identified decision making techniques, criteria, and theoretical foundation, iii) to validate the conceptual design model of YouthPDA through expert review, and iv) to measure the correlation between usefulness dimensions of YouthPDA via prototyping. Design research is chosen as the approach and three main phases are adopted which are Problem Identification, Solution Design, and Evaluation. YouthPDA is developed as a personalised decision aid for youth to help them choose their study and career paths. By integrating data from the youth personality traits and multiple intelligences, YouthPDA functions as a recommender system that works on rule-based reasoning. The usefulness of YouthPDA is measured in the evaluation phase. Findings from 189 respondents show that the proposed YouthPDA is useful for youth as their decision making tool. Accuracy, Decision Strategy, Satisfaction, Knowledge Acquisition and Overall Usefulness are the dimensions being measured and correlated to put forward the conclusion. The selected multi-criteria, techniques and theories embedded into the validated conceptual design model are the main contributions of this study.

Keywords: Conceptual design model, Personal decision aid, Decision making criteria, Decision making technique, Decision making theory.

Acknowledgement

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List of Publications

The following are a few publications related to this study that have been published in journals and proceedings:

JOURNALS

1. **Norfiza, I.**, Siti Mahfuzah, S., & Norshuhada, S. (2016). Design Model of Computerized Personal Decision Aid for Youth: An Expert Review. European Proceedings of Social & Behavioural Sciences. International Journal of Interactive Digital Media (IJIDM). In press.

2. Siti Mahfuzah, S., **Norfiza, I.**, & Norshuhada, S. (2015). Measuring Helpfulness of Computerised Personal Decision Aid for Youth. Jurnal Teknologi. **(SCOPUS)**

3. **Norfiza, I.**, Norshuhada, S., & Siti Mahfuzah, S. (2015). PERSONAL DECISION SUPPORT: AN INTELLIGENT PERSONALITY DECISION AID. *International Journal of Conceptions on Management and Social Sciences.* Vol. 3, Issue. 2, April' 2015; ISSN: 2357 – 2787

4. **Norfiza, I.**, Norshuhada, S., & Siti Mahfuzah, S. (2015). INITIAL DESIGN MODEL OF HYBRID INTELLIGENT DECISION AID. *ARPN Journal of Engineering and Applied Sciences.* Vol. 10, No. 3, February 2015, ISSN 1819-6608 **(SCOPUS)**.

PROCEEDINGS

1. **Norfiza, I.,** Siti Mahfuzah, S., & Norshuhada, S. (2016). DESIGN MODEL OF COMPUTERIZED PERSONAL DECISION AID FOR YOUTH: AN EXPERT REVIEW. International Conference on Soft Science 2016 (ISSC'16). 11-13 April, Langkawi.

2. **Norfiza, I.,** Norshuhada, S., & Siti Mahfuzah, S. (2014). INITIAL DESIGN MODEL OF HYBRID INTELLIGENT DECISION AID. Advancement in Information Technology (2014 ADVCIT) 2014, 16-18 December, Bandung, Indonesia.

3. **Norfiza, I.,** Ahmad Affandi, S., Siti Mahfuzah, S., Norshuhada, S., Haslina, M., Azizi, A.Z., & Syamsul Bahrin, Z. (2014). INTEGRATING MULTIPLE INTELLIGENCES AND PERSONALITY TRAITS IN A DYNAMIC PERSONAL DECISION AID FOR YOUTH. Knowledge Management International Conference (KMICe) 2014, 12-15 August, Malaysia. ISBN: 978-983-2078-92-0, eISBN: 978-983-2078-93-7, pg: 769-801

4. **Norfiza, I.,** Norshuhada, S., Siti Mahfuzah, S., Syamsul Bahrin, Z., Azizi, A.Z., & Haslina, M. (2013). YOUTH PERSONAL DECISION AID (YOUTHPDA): THE PREFERRED YOUTH DECISION MAKING AREAS. International Conference on Computing and Informatics (ICOCI), Sarawak. ISSN: 2289-3784, ISBN: 978-983-2078-78-4, eISBN: 978-983-2078-79-1, pg: 215-221

Awards and Recognitions

The following are a few projects related to this study that have been awarded at both national and international levels:

GOLD

1. **GOLD** Medal, Malaysia Technology Expo (MTE2014), Malaysian Association of Research Scientist. (Youth Personal Decision Aid (Y-PDA): A Personalized Study & Career Decision Making Tool)
   PWTC,KL (20-22 February 2014)

SILVER

1. **SILVER** Medal, International Innovation Technology Exhibition (ITEX 2014), Malaysian Invention & Design Society. (Community Service for Youth: Integrating Multiple Intelligence & Personality Traits in a Computerized Personal Decision Aid for Youth)
   KLCC, KL (8-10 May 2014)

BRONZE

1. **BRONZE** Medal, International Conference and Exposition on Inventions by Institutions of Higher Learning (PECIPTA 2015), Ministry of Education. (YouthPDA: An Innovative Approach to Future Study and Career)
   KLCC, KL (4-6 December 2015)

2. **BRONZE** Medal, (iCompEx 2015), Politeknik Sultan Abdul Halim. (YouthPDA: A Community Service for Youths in Study and Career Decision Making)
   Politeknik Sultan Abdul Halim, Jitra (24 – 26 March 2015)

CHAPTER ONE
BACKGROUND OF STUDY

1.1 Introduction

Decisions play an essential part of human daily activities and making a definite choice out of any condition is certainly obligatory. Today, most of the business involves technology that includes decision making as many decision aid tools can be found to assist people making decision. Currently, more decision aid technology can be produced on the basis of assisting mankind to make decision as technologies are more user-oriented than before.

Computer and internet have played a very vital role in enlightening and simplifying the life of people. Information Technology specifically has made people's activities more easy, simple and flexible. These activities include dealing with assisting people in decision making. According to Zhang, Miao, and Luo (2011), the development of personalized recommendation technology is to recommend more valuable information to meet user's personalized demand.

Personal decision aid (PDA) is a system that might help users in assisting them to make decision in multiple areas of decision making by sorting out the available choices. Chen, Hu, Kuo, and Liang (2010) define a decision aid as online computer-based software which is able to identify appropriate option automatically from numerous product alternatives based on specific criteria. A personalized decision system considers individual's consumer preferences in order to support them in decision making.

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The idea of creating a PDA will be more successful when a person is willing to spend some time and effort in thinking about the decision to be made. Decision making is defined as the process and act of making a choice by agents such as individuals, groups as well as institutions among many possible courses of action, evaluation, thinking, and feeling in a given situation (Ule, 2009).

Decision aids come in many varieties. The aids may possibly vary in complexity from simple checklists, to statistical model, even to complicated expert systems. Ideally, decision aid is designed with its major aim to assist people in selecting the best choice as possible with their accessible understanding. Though, constructing great effective decision aids is not simply a matter of finding a method that produces the most accurate answer or the interface that best presents the result, but it is also of finding the most effective way to assimilate tools with human problem solving need (Hayes & Akhavi, 2008). In addition, obtaining recommendations from trusted sources is a critical component of the natural process of human decision making.

Decision aid is aimed at generating meaningful recommendations for users, in particular youths (Melville & Sindhwani, 2010). Living in youth era signifies the greatest challenge in determining what is best for the future. Having no proper or specific guidance to assist youth in making critical life decisions (e.g. college decision, course majoring decision, career decision etc.) could cause severe effects to their future and consequently to the development plan of a country (Abbas, Hoffmann, Howard, & Spetzler, 2007). Without an effective decision aid, people tend to make inaccurate decision. To ascertain whether youths have intention in

using such aid, a preliminary study was undertaken. This is explained in the next section and serves as motivation for the research.

1.2   Preliminary Study

The major aim of this preliminary study is to identify the area that is most applicable for youth to utilize the PDA. There were eight areas of decision making namely study, career, lifestyle, purchasing, friendship, politics, religion and marriage to be explored in the study. Besides, the preliminary study was intended to know the aid types in each of the mentioned area as well as trying to figure out their intention to use if the aid will provides to them.

1.2.1   Method for Preliminary Study

A survey was employed to collect data from 80 youths aged range from 15 to 24. The study was carried out for three weeks in November, 2012.

Youth are the main scope for the situation since the United Nations define youth as persons between the ages of 15 and 24 years old (UNESCO, 2012). Respondents were of different gender, races, academic backgrounds and employments status. An online instrument for the preliminary study was created and went through the validity process from the experts in this field.

Next, the instrument was distributed to the respondents via several of communication medium such as emails and social networking websites. Figure 1.1 shows the tasks done during the survey process.

Figure 1.1. Process in the youth survey

The instrument consists of a set of 22 questions with mixed format (please refer Appendix A). The instrument was divided into three different parts namely demographic, decision making styles and suggestions for the PDA guidance. Table 1.1 shows sample of the questions that have been carried out to the respondents.

Table 1.1

Sample of Questions for Instrument in the Preliminary Study

No.	Items
1	Have you made your own personal decision in any of the following? (study, career, lifestyle, purchasing, friendship, politics, religion, marriage)
2	How is normally you made decision?
3	Decision is a way in helping a person to make decision by sorting out the available choices. In your opinion, do you need an aid to help you to sort out decision?
4	Personal decision aid is a computerized system that assists a person by providing the best suggestion based on list of options provided by them. If the intended system is available, would you use the personal decision aid?

Table 1.1 continued.

5	Currently, there are plenty of Personal Decision Aid (PDA) published on the web especially in searching for partner, purchasing, as well as education namely MalaysianCupid.com, AsianDating.com, Hunch, Let Simon Decide, Choose It!, EduTools Education, Super Decision and many more. Are you aware of any of above mentioned PDAs?
6	Have you tried using any of the decision aid before?
7	In your opinion, would such aid be necessary?
8	Given here are the areas that might become your PDA. Briefly state how can the PDA aid you in study, career, lifestyle, purchasing, friendship, politic, religion and marriage?

1.2.2 Decision Making Styles among Youth

Table 1.2 shows that youth of aged 15-17 were excluded. This is due to the assumption that these age groups decision making activities in general are still influenced by their parents or guidance (HealthLinkBC, 2012).

Table 1.2

Frequencies of Respondents

Age	Respondents
18	2
19	28
20	7
21	18
22	17
23	8
24	3
Total	**80**

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The youth have experienced in dealing with their personal decisions; eight areas were identified in three categories (self-development, social and principle). These are study, career, lifestyle, purchasing, friendship, politics, religion and marriage. Youth are allowed to select more than one area and as a result, study, friendship, life style and purchasing are the most areas that the youth themselves experienced in decision making (Table 1.3).

The results indicated that youth made 74 responses study, followed by friendship (64 responses) and lifestyle (61 responses).

Table 1.3

Number of Responses toward the Youth Own Personal Decision Making

Category	Decision Area	No. of response
Self-development	Study	74
	Career	45
Social	Friendship	67
	Lifestyle (e.g. fashion, music, sport, etc.)	61
	Purchasing (e.g. gadget, car, etc.)	51
Principle	Religion	24
	Marriage	21
	Politics	14

Generally, based on the responses on decision styles among youth (youth are allowed to choose more than one decision style), they were typically have decided the decision on their own and also were get advised from parents and their family (68 responses). However, they were preferred not to get advice from professional advisors as shown in Table 1.4.

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Table 1.4

Number of Responses for Decision Style by Youth

Decision Style	No. of response
Decide on your own	68
Get advice from parents/family	68
Get advice from friends	51
Get advice from Professional advisors (e.g. counsellor/ technology)	17

The respondents were informed that the decision aid is a way in helping them to make decision by sorting out the available choices. This computerized system will assist a person by providing the best suggestion based on the list of options provided by them. The result in Figure1.2 shows that the respondents positively need decision aid to sort out their decision. Consequently, 88% of them too have intention to use the decision aid (Figure 1.3) in helping them to make decision.
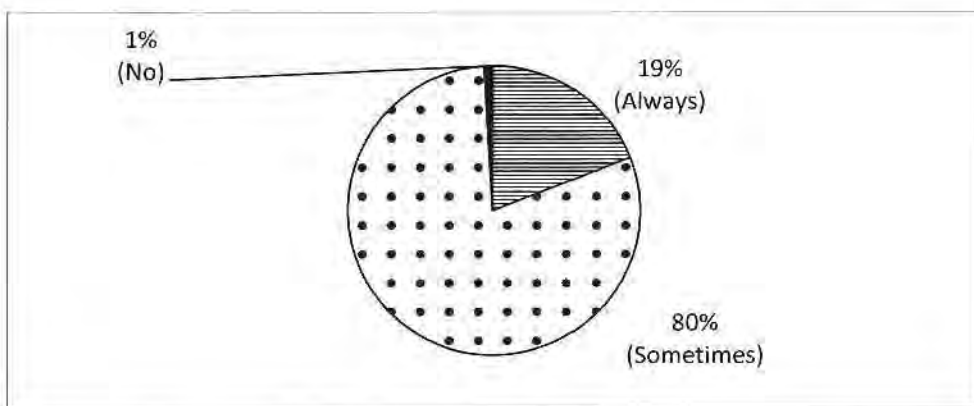
Figure 1.2. The need for decision aids to sort out the decision
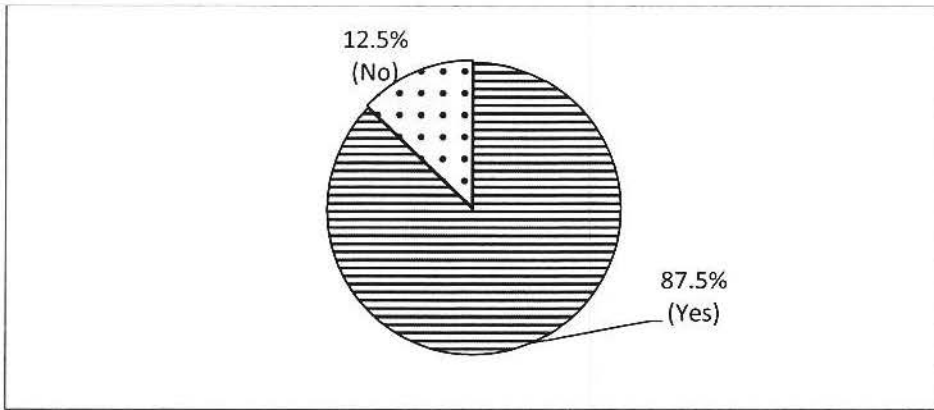
Figure 1.3. Intend to use the decision aids

As mentioned earlier, three categories of areas were identified to be selected by the respondents namely self-development (study and career), social (lifestyle, purchasing and friendship) as well as principle (politics, religion and marriage). Figure 1.4 is based on the areas of decision making that youth are fascinated most to use PDA with, and they are allowed to choose more than one area. Accordingly, it seems that study (53 responses), career (51 responses), purchasing (42 responses) and life style (36 responses) are the most preferable areas chosen by the youth.
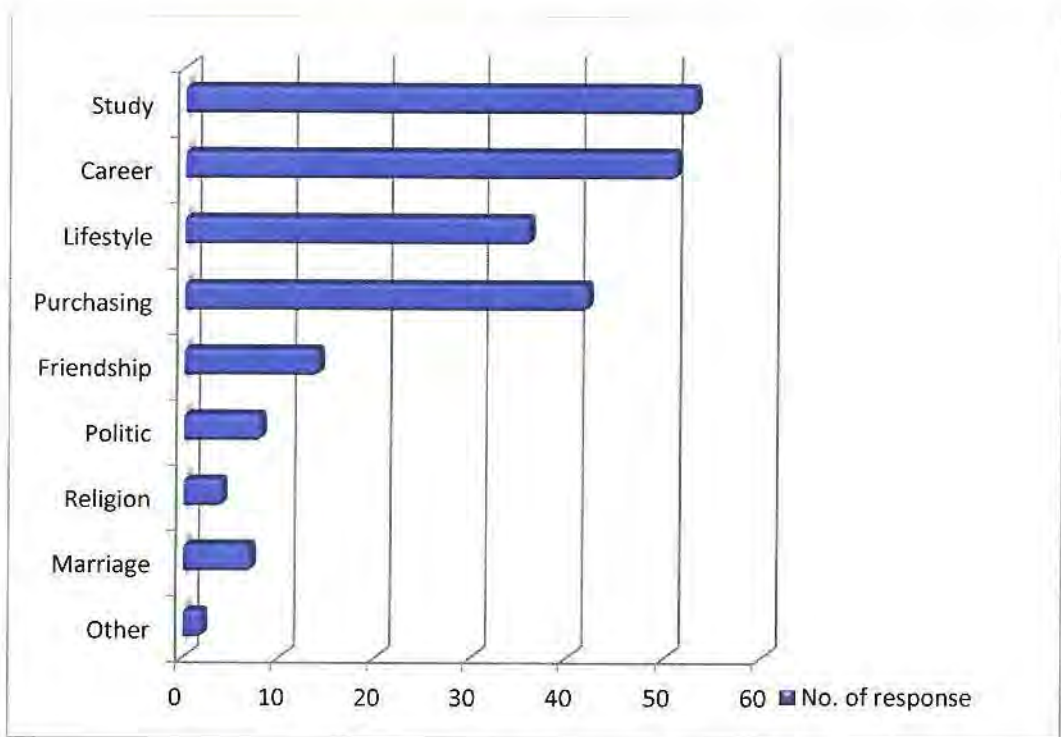
Figure 1.4. Most preferable areas chosen by youth

Results also indicate that although there are plenty PDA available on the web especially in searching for partner, purchasing, as well as education namely MalaysianCupid.com, AsianDating.com, Hunch, Let Simon Decide, Choose It!, EduTools Education, and Super Decision, 72.5% or 58 of the respondents are unaware of such technology (Figure 1.5).
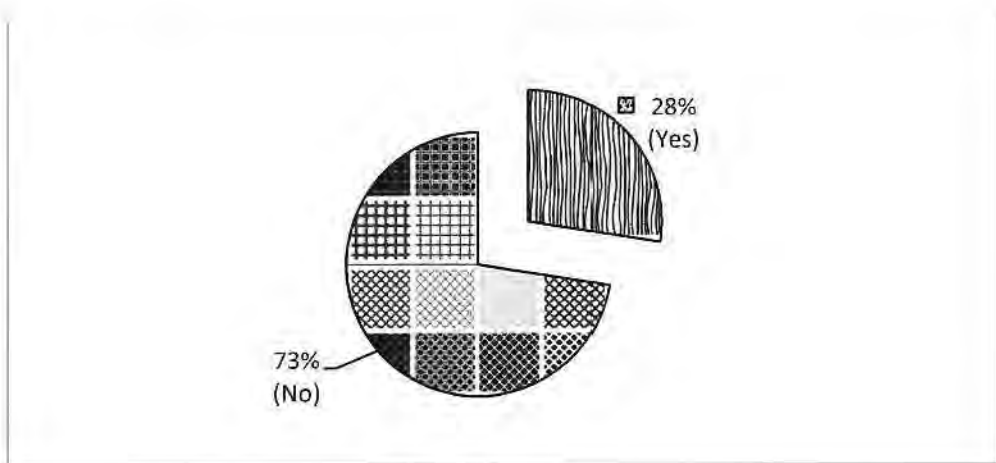
Figure 1.5. The youth awareness towards the current decision tools

Then, merely 10% had experienced using such technology for those who are aware of the technology. Although this is the case, 69% agreed that PDA is probably necessary as shown in Figure 1.6 and 88% will use PDA as a tool.
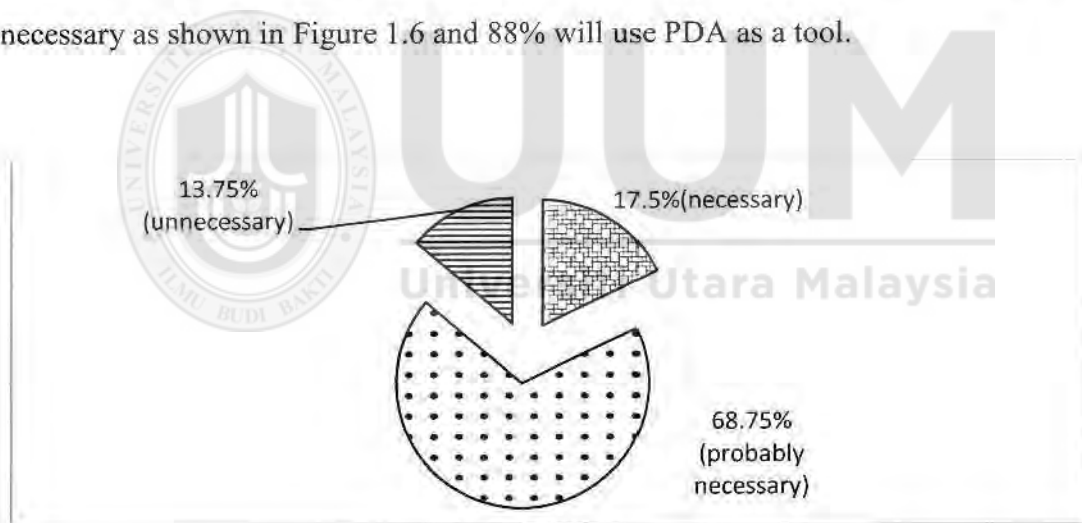
Figure 1.6. The needs for the decision tools

The implication of this study is the realism of a helpful PDA for youths in assisting them in decision making. This is due to the study that showed mostly 73% of the youths is currently unaware of available decision tools or PDA. However, potential respondents indicated that 88% of the oblivious youths have intention to use the PDA along with more than 80% might thinking that the PDA is a need.

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1.3   Research Motivation

Youth are not only the citizens of the future, but vital players upon which the continuity of development and national progress depends. Young people are encouraged to use their capabilities for their own empowerment. They have to become active and engaged participants in nation building and social development.

Basically, youth tend to face many areas of decision making with multiple choices in their hands. However, they face constraint in making desirable decisions. Besides that, existing decision making tools are too complex and not easily understood by the youth while making decision (Alidrisi, 1987; Arsham, 2004; McGuire, 2002; Yaniv, 2008). Without an effective decision aid, people may tend to make inaccurate decision (Payne & Bettman, 2002).

Personal decision aids should be explored as community services. Community services can be best defined as an activity that is performed by someone or a group of people for the benefit of the public or their institutions. Community services performed by youth are also referred to as youth service. Youth service is intended to strengthen young peoples' senses of civic engagement and community, and to help them achieve their educational, developmental and social goals. The way young people are growing up today is a threat to society and the future stability of communities. Along the process of growth, plenty of decisions have to be made, including those that will shape their future.

Thus, the Ministry of Education Malaysia (2015)'s overriding aspiration is to create a higher education system that ranks among the world's leading education systems and that enables Malaysia to compete in the global economy. The Malaysia Education Blueprint builds on the system's achievements to date and proposes major changes in the way the Ministry and system will operate in order to realise this goal. Specifically, the Ministry aspires to:

- Instil an entrepreneurial mind-set throughout Malaysia's higher education system and create a system that produces graduates with a drive to create jobs, rather than to only seek jobs;

- Construct a system that is less focused on traditional, academic pathways and that places an equal value on much-needed technical and vocational training;

- Focus on outcomes over inputs and to actively pursue technologies and innovations that address students' needs and enable greater personalisation of the learning experience;

- Harmonise how private and public institutions are regulated, and to transition from the current, highly-centralised governance system for HLIs to a model based on earned autonomy within the regulatory framework; and

- Ensure the financial sustainability of the higher education system by reducing HLIs reliance on government resources and asking all stakeholders that directly benefit from it to contribute as well.

In addition, there are some challenges in surviving higher learning education (i.e. tertiary education). There is lack of support in counselling programmes that deal with youth biological changes. Stress owing to biological changes affects youth's behaviour, personality, attitude and lifestyle. As a result, there are inactive

unemployed youth who does not look for work because he or she believes that no work is available or that he or she is not qualified for the offered job.

Apparently, the above mentioned issues could be due to many factors and one of them is lack of ability in making decisions among youth which will lead to being not knowing of what to do and regretting the present situations.

Subsequently in 2013, youth in Malaysia has been ranked as 52nd from out of 170 countries for their youth development index (Commonwealth Youth Program, 2013). It is higher compared to Vietnam, Cambodia and Thailand. Other than that, education, health and wellbeing, employment, political participation as well as civic participation have also been analysed through the program. Table 1.5 shows the comparison of youth development index among ASEAN countries.

Table 1.5

Youth Development Index among ASEAN Countries

Country	Rank	YDI	Edu*	Health*	Employ*	Politic*	Civic*
Singapore	22	0.745	0.799	0.876	0.844	0.278	0.263
Philippines	47	0.708	0.779	0.719	0.739	0.428	0.613
Malaysia	**52**	**0.699**	**0.856**	**0.811**	**0.685**	**0.188**	**0.368**
Vietnam	56	0.694	0.695	0.838	0.877	0.000	0.297
Cambodia	76	0.666	0.612	0.831	0.883	0.188	0.058
Thailand	77	0.662	0.719	0.810	0.775	0.042	0.223
Indonesia	97	0.591	0.677	0.733	0.644	0.025	0.226
Brunei	112	0.526	0.762	0.623	0.400	0.035	0.332
Myanmar	134	0.428	0.548	0.842	No data	0.000	0.504
Laos	137	0.417	0.565	0.825	No data	0.000	0.363

YDI – Youth Development Index

Edu*   = Education
H*   = Health and Wellbeing
Employ* = Employment
Politic* = Political Participation
Civic*   = Civic Participation

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Accordingly, the study shows that youth in Malaysia have a high index in education as well as health and wellbeing. It is a good achievement for the country that education becomes the highest index among ASEAN countries. The higher the index for a particular domain, the higher the available options the area will have. Education involves a study in higher level such as in university or college as tertiary education.

As Malaysia has a good index in this particular area, more choices for youth are provided in the university such as more option of programs offered, courses, co-curriculum activities, and student associations. As everyone is concern of this important area, there is a need for decision aid to assist the youth by providing the best recommendation out of numerous listed options for them to make an appropriate decision. The youth must be in their right path by selecting the right choice delivered based on their personality, intellectual and needs.

1.3.1 Youth as Country Asset

In this new era, youth is a valuable human capital development around the world. In Malaysia, there are a lot of initiatives provided by the government to support their activities. According to the World Bank, Malaysia spent 21.30% of its government expenditure and 5.13% of its GDP on education provision in 2010. Ministry of Youth and Sports is responsible for the following as outlined in the Malaysia Budget 2013:

- Subsidy of two per cent of interest rates business loans for young entrepreneurs for loans up to RM100, 000.

- RM200 rebate for smart phone purchase for those aged 21 to 30 years.

- Bantuan Rakyat 1Malaysia (BR1M) 2.0 for the unemployed graduates

On the other hand, Malaysian Youth Council (MYC) has been setup by the Non-Governmental Organization (NGO) on July 23, 1948 and has 40 affiliates with three million members. The goals are to introduce mind, body and spirit as a unified character in the Malaysian youths. Besides, to accomplish the goals of the National Youth Development Policy for Vision 2020 strategy, youths were urged to have their own responsibility, independence, volunteerism and patriotism. The MYC also emphases on the youths demands, issues and roles to be taken care of. Establishing incorporated and inter-sector youth growth is the main aim to construct a robust Malaysian youth identity by regulating national development and recuperate the youth movement. Therefore, it is indeed timely to focus a study on youth.

1.3.2 Practice in Decision Support System

Decision making plays a vital role in everyday life. Each person needs to decide for every action he/she intended to. Therefore, Decision Support System (DSS) is the appropriate computer-based information system able to interact with users in decision making.

There are several capabilities of DSS listed by Tripathi (2011):

1. Support for problem-solving stages taking account of the intelligence, strategy, alternative, execution and observing

2. Support for different decision frequencies that range from unique to repetitive

3. Support for different problem structures ranging from high structured and programmed to unstructured and non-programmed

4. Support for diverse decision-making

5.   Unique decisions are organised by an ad hoc DSS

6.   Repetitive choices are organised by institutional DSS

As decision making is not a simple process, DSS will provide users with support to analyse complex information and help to make decision either for organizational or personal level of use. However, findings by Brown (2008) shows that decision tools served the organizations better than individuals while Li and Busemeyer (2009) state that academic study in improving performance of decision system is still lacking.

However, the technology and concept of DSS are still evolving as the computer architecture and software engineering are able to be reconstructed (Power, 2007). So, it will be able to support especially individuals involved in decision making process by utilizing data or alternatives to identify, assess and solve the problems. The system will then facilitate the complex problems that are difficult to handle in order to obtain a better decision.

1.4   Problem Statement

Decision making is made on daily basis. In order to obtain a clear, concise and accurate decision, people rely on aids that can help them in making decision. The preliminary study has provided initial evidence on the necessity to explore the decision making assistance to youths. With the existence of a variety of decision aids mentioned in previous section, how these aids could help the youths should be studied. Nevertheless, the design issues and supporting models underneath such aids should be determined since the aids are subject to human decision behaviour.

Although there are guidelines and criteria being produced for the design and evaluations of PDA, the development process, content and evaluation are not apply any conceptual or theoretical framework relevant to decision-making (Durand, Stiel, Boivin, & Elwyn, 2008). This statement is supported by Bartel, Daniel, Christopher, Fiery, David, and Peter (2015) where existing decision-making applications are not fully integrated with the related theories. In addition, Durand et al. (2008) highlighted that the lack of theoretical framework for the design and development of decision aid technologies most likely reflects a poor implementation from the early development stage of technology.

Additionally, conventional conceptual models that are able to assist decision making structure seem to be static and allow selecting only among a few alternatives that are usually mutually exclusive (Manca & Grana, 2010). For instance, Siti Mahfuzah (2011) has created a pre fixed conceptual design model for Personal Decision Aid (PDA) in education and e-commerce. However, the developed static model is unable to help in handling multi value criteria required by the users.

There are numerous decision techniques available to decision makers. However, according to Hayes and Akhavi (2008), these decision aids essentially do not improve the decision making creation through sophisticated mathematical model. This mathematical model actually fails to fit human decision making approach. McGuire (2002) and Arsham (2004) also support the statement that the indecision regularly unable to be solved with mathematical model, moreover the structured mathematical strategies have inadequate time to be implemented by most of the decision makers. Personal decision making is the most vital to be concern of,

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therefore complex and structured mathematical methods are not favoured (Alidrisi, 1987; Yaniv, 2008). Furthermore, users favour to a direct and straightforward design model in decision making process.

1.4.1 Research Gaps

Several research gaps are extracted from the problems discussed previously. The gaps are as follows:

i)   Theoretical foundation for decision making is not practiced in designing and developing decision aid technologies.

ii)   Static conceptual design model is unable to handle multi-criteria decision making required by the users to eventually manage the changes of different criteria dynamically.

iii) Complex and structured mathematical techniques are not preferred by the users as compared to direct and straightforward design model.

iv)   There is a need for a further research on usefulness to consider both outcome and process oriented approaches of decision aid evaluation.

Therefore, based on the stated research gaps, there is a need in considering and including relevant multi-criteria technique, model and theory in the development of personal decision aid for youth.

1.4.2 Research Question

Computerized decision aids are powerful tools to assist in decision–making. Therefore, decision makers will need well-designed aids and clearly defined process in constructing the decision aid. Thus, it leads to the following research questions:

1. What are the relevant decision making criteria, techniques, and theoretical foundations for the youth PDA?

2. How to construct a conceptual design model for the youth PDA?

3. How useful is the conceptual design model of the youth PDA?

4. Is there any positive correlation between dimensions in usefulness of the youth PDA?

1.5   Research Objectives

One of the main target users for PDA is youth where Malaysian youth are the fourth-highest percentage of digital user populations in the world (Sipalan, 2013). The Youth Development Index for Malaysia shows a high index in education (Commonwealth Youth Program, 2013), which demonstrates more choices of educational programmes are offered in the country. Since education is one major concern, there is a need to focus on how youth handle their decision making since it will affect their career and future.

Based on the problems discussed, this study aims to propose a conceptual design model that intended designed for youth called Youth Personal Decision Aid (YouthPDA). The design model would include decision making techniques, criteria and conceptual design model. Therefore, the following are the specific objectives of the study:

1. To identify relevant decision making techniques, criteria, and theoretical foundations for YouthPDA.

2. To construct a conceptual design model for YouthPDA using the identified decision making criteria, techniques, and theoretical foundation.

3. To validate the conceptual design model of YouthPDA through experts review.

4. To measure correlation between dimensions in usefulness of YouthPDA via prototyping.

1.6   Scope

The following scopes are defined to clarify the focus of this study:

1. Youth community in this study is defined as young people whose age within the range of 15 to 24. The same definition is also used by the United Nations.

2. There are a few required areas that have been identified through the highest score in the preliminary study that was carried out namely study, and career from self-development category as well as purchasing and lifestyle from social category. As for the prototype development, the first two highest score in the preliminary study (i.e. study and career) are chosen to be tested by the respondents. Identified decision methods as well as the conceptual design model for YouthPDA will then be integrated in constructing a youth decision aid prototype.

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3. The prototype that has been developed in this study is aimed at helping youth in decision making process but not problem solving process; for instance, the prototype is able to suggest the best options for youth to choose excluding highlighting on process after the decision has been through.

1.7 Contribution of Study

This study is matched with current trends of online users where technologies are essential for most of all daily requirements. As highlighted earlier, the decision making technique component of the conceptual design model requires a thorough study involving a few groups of youth throughout this study. Other than that, the specific contributions of this study can be summarized in the following subsections.

1.8 Decision Making Criteria, Technique, and Theoretical Foundation of YouthPDA

Personal decision making is the main idea of this study, so the technique related to decision alternatives and recommendations were incorporated one of the decision making technique including the criteria, as well as theoretical basis of decision making.

1.8.1 Conceptual Design Model of YouthPDA

The conceptual design model is a systematic guidance of organized way for youth to perform their personal decision making. The model consists of personal decision making processes including the filtering for the youth personality and supported by the determined decision making criteria, techniques and theoretical foundation.

1.8.2 Prototype of YouthPDA

A prototype of YouthPDA that was guided by the proposed design model consists of two areas of decision making; study and career. The prototype would provide assistance in a way that helps the youth to choose from the provided recommendations. The evaluation process required YouthPDA to be validated to show the feedback towards the constructed design model. This process also assessed the ability of YouthPDA to accomplish decision tasks.

1.8.3 Instrument to Measure Usefulness

With the great development of decision making application (decision aid), developers can create and publish the decision aid through social electronic communities easily. However, it is difficult for developers to discover the best reviews of the decision aid due to the sheer volume of reviews available for every single of them. Therefore, usefulness is a parameter that was chosen to validate the decision aid. The quality of the decision making application that has been produced might able to be tested by this usefulness instrument.

Criteria in decision making including usefulness is necessary to be obtained to ensure the developed decision making application will provide some assistances to the intended users.

1.9 Theoretical and Research Framework

This study is based on theories and concepts related to decision information system. The multi-criteria concept is applied where this study has produced a decision making aid that is able to dynamically adapt and process the value of certain criteria.

Examples of criteria such as attributes of context including SPM's result, intelligence level, interest and type of personality of the youth have been measured by putting on the weightage of each criterion.

The theoretical framework consists of three main stages (as discussed in Chapter 3) which are problem identification, solution design and evaluation. Problem identification examines the theories and concepts of general decision analysis, personal decision making and decision support technology. The theories and concepts that are covered are Personality Traits, Multiple Intelligence, Descriptive, Normative and Prescriptive Theory, Behavioural Decision Theory, Cognitive Theory, Preferences, Dominance, Multiple Intelligence as well as Personality Traits Theory.

Besides, existing MCDM techniques such as The Weighted Sum, Lexicographic, TOPSIS, AHP and others are compared to find a relevant way to be included in this study. Furthermore, the justifications are made to the present Knowledge-based technique. The technique involved Case-based reasoning (CBR) and Rule-based system which another idea of how decision making process may ease the development of a decision making application. In addition, the information technologies (IT) that support decision making process such as Decision Support System (DSS) as well as Computerized Decision Support are intensely studied.

As for the design stage, the theories and concepts of existing computerized decision aids as well as the accepted technique that have been reviewed were used as the basis to determine the components of conceptual design model for YouthPDA.

In the evaluation stage, the conceptual design model of YouthPDA was evaluated through expert reviews. After refinement, the prototype was constructed and validated with the study and career areas that were defined by the youth in the preliminary study. The validity of the prototype started with pilot testing before it was carried out to measure the YouthPDA usefulness to youth in the experimental study. Finally, predictions made through the hypotheses were tested. Figure 1.7 displays the overall theoretical and research framework throughout this study.

| PROBLEM IDENTIFICATION | SOLUTION DESIGN | EVALUATION |

Literature Study and Content Analysis

Preliminary study: (Theories)
- Descriptive, Normative & Prescriptive
- Behavioural Decision Theory
- Cognitive Theory
- Preferences
- Dominance
- Multiple Intelligence
- Personality Traits

Comparing existing MCDM techniques:
- The Weighted Sum
- Lexicographic
- Simple Multi-Attribute Rating Technique (SMART)
- Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS)
- The Weighted Product Model (WPM)
- The Analytic Hierarchy Process (AHP)

Knowledge-based
- Rule-based Reasoning (RBR)
- Case-based Reasoning (CBR)

Information Technology in decision support:
- Decision Support System (DSS)
- Computerized Decision Aid (CDA)

Research Problem & Scope

Research Gap

Decision Areas

Develop Conceptual Design Model for YouthPDA

Objective 2

- Decision theories
- MCDM techniques & criteria
- conceptual design

Objective 1

Expert Review

Prototyping

Pilot Testing

Experimental studies

Measuring Usefulness

Objective 3

Objective 4

Finding Analysis

Report writing and research publication

Figure 1.7. Theoretical and research framework

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1.10 Definition of Terminologies

These are the definition of mostly used terminologies throughout this study that related to the topic discussed.

Computerized Decision Aid (CDA): Tools to assist in decision making where decision models are designed and incorporated to enable available data to be analysed in order to present a recommended solution to a problem.

Decision techniques: distinctive method to solve problems which follow the guidelines of particular decision strategy.

Decision Theories: theories that support the decision tools by considering all human being approach.

Decision Support System (DSS): an interactive computer-based information system with wide range of characteristics and advantage.

Design Model (DM): consists of decision making techniques, criteria and conceptual design model.

Conceptual Design Model (CDM): a description of the proposed system in terms of a set of integrated ideas and concepts about what it should do, behave, and look like, that will be understandable by the users in the manner intended.

Dynamic Conceptual Design Model: a mental model of operation with a wide variety of tasks as well as modifying the perspective, and considers the fluctuations of other item within the conceptual design activity.

Multi-criteria Decision Making (MCDM): an approach for problem solving with presence of multiple attributes.

Personal decision making: a system that might help users in assisting them to make decision in multiple areas of decision making by sorting out the available choices.

Youth Personal Decision Aid (YouthPDA): a personal decision making system designed specifically for youth to assist them in making decision.

1.11 Overview of the Thesis

This thesis is organized in seven chapters. An overview of each chapter is as follows:

Chapter 1: As an overview of the research topic of the thesis and briefly describe what the thesis attempts to achieve. It also contains the problem statement, research objectives, and scope of research as well as contribution of the study which clarify the goals.

Chapter 2: Includes the decision making model and theories in complying with the model that could be used in the realism of Youth Personal Decision Aid (YouthPDA). This chapter also includes reviews of personal decision making with their components, fundamental of decision theories and previous study on applicability of decision support technology.

Chapter 3: Discusses on the phases involved in the process of achieving outlined research objectives. The processes are based on design science approach in information system studies. Each phase in the methodology is detailed and the relationship between the outcomes of each phase and research objectives are also discussed.

Chapter 4: Comprises of the development of YouthPDA design model using comparative study, and content analysis for decision criteria, techniques, theories and

HCI components that have been used. The expert evaluation has been carried out for the experts to review the proposed design model. The refinement process was completed due to the recommendation trough expert review.

Chapter 5: Elaborates on the process of YouthPDA prototype construction based on developed and revised design model. The prototype was then tested through an experimental study by youth as respondents.

Chapter 6: Discusses on the analysis and finding from the conducted experimental study. The mean, correlation, and the strength and weakness factor in the instrument were also deliberated. The usefulness dimensions were validated and the constructed hypotheses were tested in order to measure YouthPDA capability.

Chapter 7: Summarised the achieved objectives of this study. The limitations and recommendations and conclusion outcome from this study were suggested for future research.

CHAPTER TWO
LITERATURE REVIEW

2.1 Introduction

The literature includes the study on the youth and their environment as the decision aid will be provided to them. Besides that, there are also reviews on design model including decision making techniques, criteria and conceptual design model that could be used in the realism of Youth Personal Decision Aid (YouthPDA). This chapter also includes comparative analysis of design model, reviews on personal decision making with their components, fundamental of decision theories and previous study on applicable decision support technology.

2.2 The Youth Lifestyle

Youth lifestyle is one of the most precious moments in each of human especially in dealing with their current interest on area of study, fashions, music, and social. There are some factors such as education, study, and purchasing may affect the youth lifestyles.

2.2.1 Education

The education for the youth normally affects their way of life. As for example youth with less education have different style of thinking and judgment towards certain situations. There are many type of education especially in schools for instance physical education and sport (PES).

The study shows the scientific proof of the PES (children and educational systems) by assembled on the contributions and profits. Research proof is obtained by the

physical, lifestyle, affective, social, and cognitive of children's development (Bailey, 2006). Significant and distinct contributions have been proposed as PES has the potential for development in each of these domains.

Based on the review, PES has been recommended for its potential to create distinct contributions to the children's fundamental movement skills progress and physical capabilities, which are necessary predecessors of participation in later lifestyle and sporting physical activities. The development of social skills and social behaviours, self-esteem and preschool attitudes as well as academic and cognitive development can be supported if the PES is appropriately presented.

Besides that, youth are also involved with other problems in their learning. There is a study related to stressors and resources among university applicants by Pluut (2014) that emphasised that stress is a predominant occurrence among university students. There are effects on well-being and academic performance where a research on academic consequences and outcomes of stress is carried out by exploring study–leisure conflict (interference between the study and social domains). Three factors on student well-being which are academic satisfaction, study-to-leisure conflict, and academic performance were investigated. The results indicate that study-related stressors rise study-to-leisure conflict and reduce academic performance, leisure-to-study conflict reduce both academic satisfaction and performance, and team social support able to rise academic satisfaction.

Lots of benefits will not essentially result from students/youth participation where there are also effects that likely to be mediated by the nature of the interactions

between students and their teachers/lecturers, as well as their parents. Contexts that highlight positive experiences, characterized by enjoyment, diversity, and the engagement of all are managed by committed and trained teachers and lecturers. The understanding and educated parents considerably effect the character of team social in these physical activities and raise the academic performance and will reduce the stress level.

2.2.2 Study in Higher Education

Youth in university life is much differs from their previous world. Programs, courses selection including co-curriculum activities are among the critical items that need youth's attention. Apart from that, there are some factors that influence youth to make an accurate decision.

Bye, Pushkar, and Conway (2007) have relates motivational components and the affective of academic life for traditional and non-traditional university students. The students who are 21 years old and younger that most likely have followed an unbroken linear path through the education system are defined as traditional students. Then, students who are 28 years old and older are defined as non-traditional students. The assessment were carried out to measures the intrinsic (essential) and extrinsic (not essential) motivation to learn, interest, and positive affect on 300 undergraduates, range from 18 to 60 years old.

The finding shows that non-traditional students stated higher levels of essential motivation for learning than traditional students. Non-traditional students are more intensely affected on intrinsic motivation that interrelated with positive affect

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compared to traditional students. The study shows that, both interest and intrinsic motivation significantly expected positive affect as interest and age for all students began as important predictors of intrinsic motivation to learn.

The effect of peers and friends on youth physical activity and motivation to be physically active has been studied where the objective is to test whether the presence of a peer increases the motivation to be physically active in overweight and non-overweight youth in a laboratory setting. The findings are the presence of a friend increased youth's motivation to be physically active (Salvy, Roemmich, & Bowker, 2009).

2.2.3 Purchasing

Purchasing power by youth will give a big impact to our society. Moreover, in the 2013 budget speech, Prime Minister and Minister of Finance Dato' Seri Haji Mohd Najib bin Tun Haji Abdul Razak has committed MYR 738 million ($USD 227 million) to youth and sports. This budget includes the BR1M for unemployed graduates, smartphones rebate as well as book voucher for IPT students. The youth should be guided wisely as more incentive from government as well as from their family for them to be freely involved with purchasing. According to study on youth's personal finance by Leong, Nur Azrina, Herizal, and Anthea (2012), 85% of youth own at least one bank account. Currently, the availability and affordability of gadgets, outfits, personal cares and food too are widespread including online sales in Malaysia. Therefore, the relation between these two factors is playing a vital role for decision maker to control their desire in purchasing by giving them a precise recommendation.

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Besides that, Kotler and Keller (2005) have emphasize that the purchase using decision making process includes the stages of need recognition, information search, evaluation of alternatives, purchase decision, purchase, and post-purchase evaluation. Post-purchase evaluation can be seen in most of the available online shopping website, a space for customer is provided for the customer to put the review on the products (Amazon.com, eBay and Lelong) as well as reviews on the company that supply the products (eBay and Lelong). The usefulness aspect is perceived when the next customer will be inquired either the published review is helpful or not by giving the 'yes' or 'no' answer (Amazon.com), or by giving ratings (eBay and Lelong).

Todd and Benbasat (1991), Todd and Benbasat (1992), and Todd and Benbasat (1994) reveal the importance of using decision and comparison aids to improve purchase decision process and focusing on validating usefulness which implicates both research and practice. Moreover, strongly positive ratings (Clemons, 2006) and excellence review (Chen, Dhanasobhon, & Smith, 2008) as measured by usefulness votes also definitely effects the sales.

2.2.4 Implications of Youth Lifestyles to the Study

Based on some situations discussed above, youth have a huge responsibility to their education and study as well as other social activities such as purchasing. Besides that, in approximately 10 years ahead, youth will have their own families where they will become the leader. Later, there is no doubt that they might become the future leaders for the country as well where their involvement is vital in determining the progress of nations.

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Conversely, if the behaviours of this human capital are not been taken care and carefully controlled, the country's hopes on them will be destroyed. The youth might involve with unethical lifestyles, incorrect ways of spending money, and have a wrong choice of education programs that might affect their careers.

So, by making use of the uniqueness of youth community as a focus group, a model that suits with the intended aim of study will be produced. Also, it is highly desirable that the potential users of YouthPDA are modelled based upon detailed qualitative data from extensive fieldworks. It is important that the youth community benefit from a decision aid that considers the relevant theoretical framework in its design and development. Perhaps with inclusion of more extensive group of potential users (i.e., among youth community) in the focus group might also lead to identification of more reliable decision making techniques.

2.3   Design Model

Design can be defined as "the conception and planning of the artificial" (Buchanan, 1990). Generally, the reality is excessively difficult to be duplicated, so a model should be simple and only capture the abstraction of reality. In fact, most of the complexity is inappropriate in problem solving (Turban & Aronson, 1998).

Design model in the context of computerized system is an element process that specifies the growth of design model as design tasks that consist of architecture, interface, component-level and deployment-level of elements. Table 2.1 depicts the details for each element.

Table 2.1

Design Model Elements (Pressman, 2010)

Elements	Descriptions
i. Architecture	• General outlook of the software product • The sources: system information related to software, connections between precise analysis model elements, & architectural patterns and styles accessibility • correlated systems resulting from analysis packages in model requirements

ii. Interface	• illustrate external actions of a class & give access to its public operations
	• Important elements
	  - User interface (UI)
	  - External interfaces to other systems
	• Internal interfaces among design components
	• show communication diagrams

iii. Component-level	• the internal detail of each software module
	• classify
	  - Data structures for all local data objects
	  - Algorithmic detail for all component processing functions
	  - Interface that allows access to all component operations
	• show component diagrams, activity diagrams, pseudo code (PDL), and flowcharts

iv. Deployment-level	• designated to assign software functionality and subsystems inside physical computing environment • Modelling: UML deployment diagrams • Descriptor form deployment diagrams show the computing environment but does not specify information of configuration • Developed instance form deployment diagrams classify specific named hardware configurations in the last stages of design

The existing elements are appropriate to be practised in the design model development as each of the four elements (architectural, interface design, component-level, and deployment level) described in the figure is able to create a complete view of design model. Firstly, the system structures, subsystems and their

components are developed using application domain and analysis model by architectural element. External and internal interfaces in the system are designed by interface design elements.

On the other hand, each of the components in the system is defined by component-level elements. Lastly, the physical configuration of architecture, components, and interfaces are distributed by deployment-level design elements. To further understand a design model, a comparative analysis of a number of models was conducted (Table 2.2).

Table 2.2

Comparative Analysis of Design Models

Title	Design Model	Description
Measuring Helpfulness of Personal Decision Aid Design Model (Siti Mahfuzah & Norshuhada, 2010)	Conceptual (refer Figure 2.1)	• Illustrates elements of PDA (decision making process) • Shows the interaction, behaviour and technique used for the proposed system
Designing Architectures from Problem Descriptions by Interactive Model Transformation (Alebrahim, Cote, Heisel, Choppy, & Hatebur, 2012)	Architectural (refer Figure 2.2)	• Models context diagram for Patient Care System • Describes relationships among major structural elements, derived from the class-based elements and flow oriented elements (data flow diagrams, control flow diagrams, processing narratives)
Ontology Models for Interaction Design: Case Study of Online Support (Butler, Hunt, Muehleisen, Zhang, & Huffer, 2010)	Working/ procedural (refer Figure 2.3)	• Shows procedures for modelling the user's problem space in Ontology Management Tools (OMT). • Shows user interface technology and integrated design effort with the user interface, information architecture, and implementation factors.
Designing Parameterized Signal Processing IPs for High Level Synthesis in a Model Based Design Environment (Butt & Lavagno, 2012)	Model-based (refer Figure 2.4)	• Describes the design of a parameterized bit-true Intellectual Property (IP) that using C code • An approach for establishing a common framework for communication throughout the design process and support development cycle
Real–Time Design Models to RTOS-Specific Models Refinement Verification (Mzid, Mraidha, Babau, & Abid, 2012)	Real-time (refer Figure 2.5)	• Depicts real-time response triggered by event • Integration between design and implementation phases • As instance of the verification-oriented meta-model

Conceptual design model is a plan to construct a computerised system. The design model structures are sufficient for the designers to create the physical system. In the conceptual design model environment, the designers are able to construct and integrate the whole components with all the process involved as depicted in Figure 2.1.
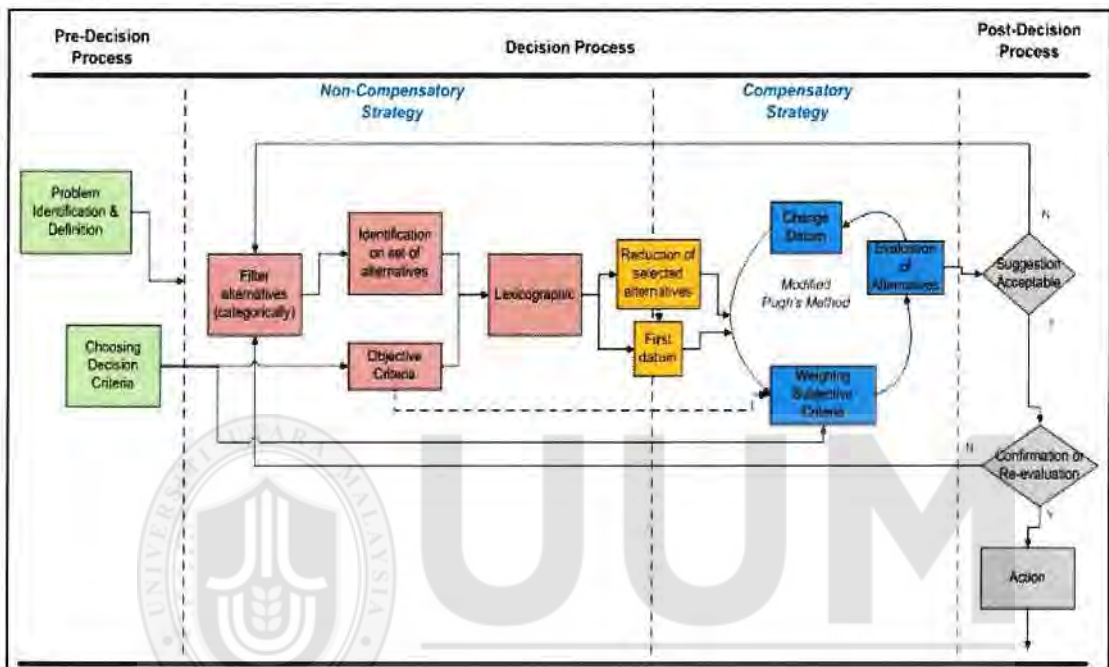
Figure 2.1. Conceptual design model (Siti Mahfuzah & Norshuhada, 2010)

An architectural design model represents precise set of trade-offs key in the system's structure and design. The design model is a high quality software development that consists of sufficient information and rigorous diagram to show the perspective in software architecture. Figure 2.2 illustrates the components comprises in one of the architectural design model.
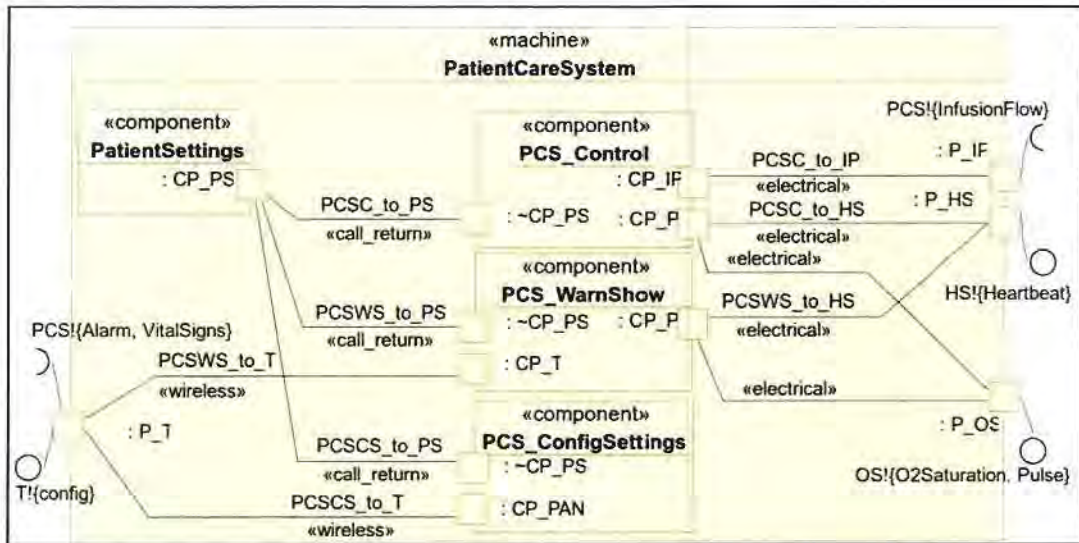
Figure 2.2. Architectural design model (Alebrahim, Cote, Heisel, Choppy, &

Hatebur, 2012)

Working design model is a conceptual design model tool that allows designers to create simulations that replace vague, time consuming, and simplified assumptions. The design model is best suited to produce and consider lots of real-mechanism systems such as online support for X-box as represented in Figure 2.3.
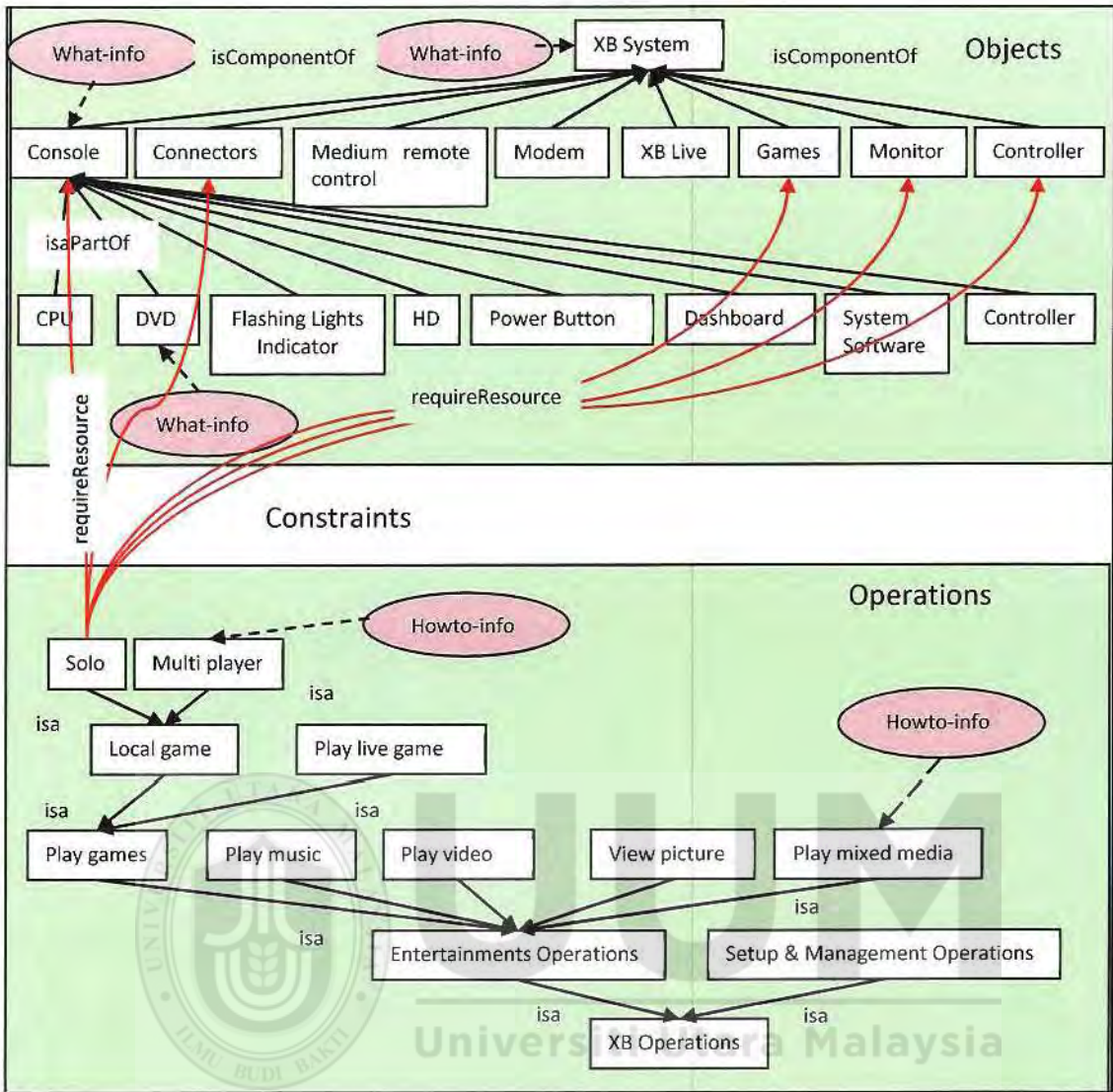
Figure 2.3. Working Design Model (Butler, Hunt, Muehleisen, Zhang, & Huffer, 2010)

Model-based design model is generally used for designing complex control, signal processing and communication system in mathematical and visual method of addressing problems. The design model as shown in Figure 2.4 is allowed to be used in designing, simulating, implementing, and testing a variety of time-varying systems.
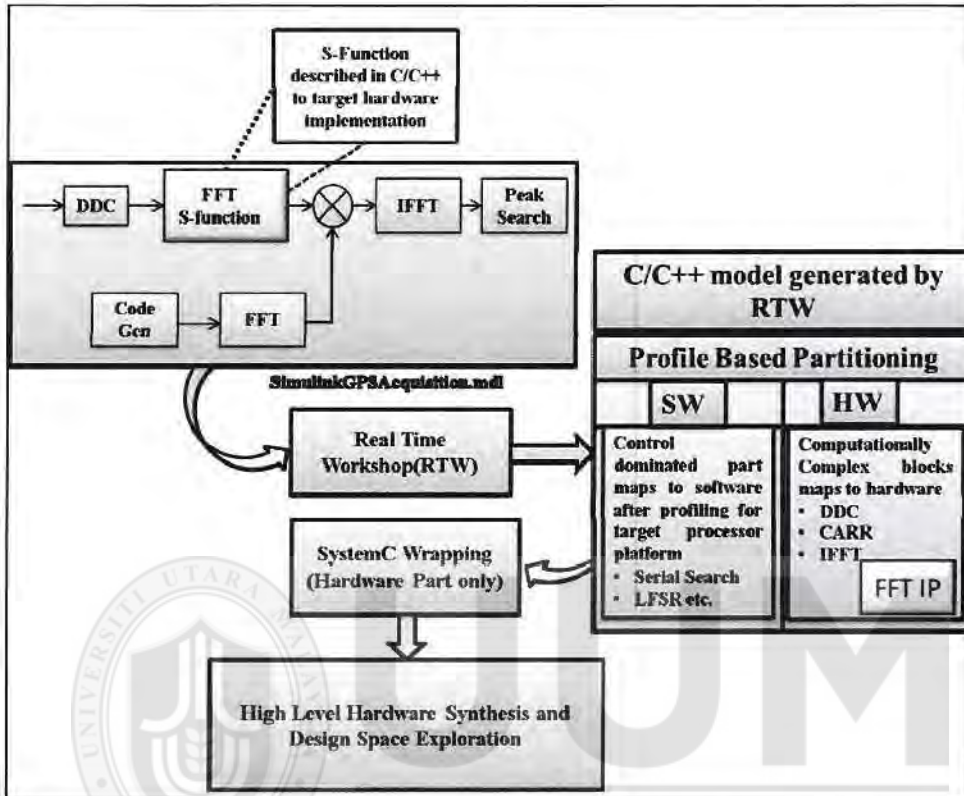
Figure 2.4. Model-based design model (Butt & Lavagno, 2012)

Real time design model has a few system elements such as sensor control processes, data processor, and actuator control processes. System design process involves design algorithms to process response for each class within given time. However the design model has a complex structure even for a simple system. Figure 2.5 shows the sample of real time design model which the data acquirement systems are usually prepared conferring to a producer consumer model.

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┌─────────────────────────────────────────────────────────────────────────┐
│  ┌──────────────────────────────┐                                        │
│  │ ElectronicBreakControl design-model                                   │
│  │                                                                        │
│  │  ┌──────────────────────────┐         ┌──────────────────────────┐    │
│  │  │ task1: PeriodicOptimumTask│        │ task2: PeriodicOptimumTask│    │
│  │  │                          │          │                          │    │
│  │  │ priorityValue: 20        │  ┌─────────────┐  priorityValue: 10 │    │
│  │  │ period: 60               │  │AntiLock_Shared  period: 100      │    │
│  │  │ deadline: 60             │  │  Resource   │  deadline: 100     │    │
│  │  │ timebudget:25            │  └─────────────┘  timebudget:25     │    │
│  │  │ jitter: 0                │                   jitter: 0         │    │
│  │  │ blockingTime: 15         │                   blockingTime: 0   │    │
│  │  │ responseTime: 40         │                   responseTime: 50  │    │
│  │  │ resources: Antilock      │                   resources: Antilock│   │
│  │  └──────────────────────────┘         └──────────────────────────┘    │
│  │                                                                        │
│  │        ┌───────────────────────────────────────────────────┐          │
│  │        │ <<swMutualExclusionResource>>                      │          │
│  │        │ Mechanism: MutualExclusionResourceKind = BooleanSemaphore     │
│  │        │ waitingQueuePolicy: QueuePolicyKind = Priority     │          │
│  │        │ concurrentAccessProtocol: ConcurrentAccessProtocolKind = PCP  │
│  │        └───────────────────────────────────────────────────┘          │
│  └────────────────────────────────────────────────────────────────────── │
└─────────────────────────────────────────────────────────────────────────┘
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Figure 2.5. Real–Time design models (Mzid, Mraidha, Babau, & Abid, 2012)

From Tables 2.1 and 2.2, it can be deduced that design model has elements and is used for different purposes. Nevertheless, conceptual design model will be the major concern in this study. Therefore, details description of the model is elaborated in this sub-section.

2.3.1 Conceptual Design Model

A conceptual model is an advanced description of how a system is prepared and functions. The model requires and defines the main design descriptions and similarities engaged in the design. It also consists of the system that exposes concepts to users which comprising the task-domain data objects for users to create and manipulate, their attributes, relationships between these concepts and the operations that can be performed on them.

Conceptual design model can be described as mental models of the way an object operates. There are three perspectives that are able to facilitate in developing conceptual models:

    i.   an interaction paradigm point of view

    ii.   an interaction mode point of view

    iii.   a metaphor point of view

In addition, Johnson and Henderson (2002) have listed six basic requirements along the development of conceptual design model as follows:

    i.   **Lexicon**: as metadata which is term to be used in the documentation

    ii.   **Task scenarios**: use-case or description of the relation between individual and the application (task-domain objects and actions)

    iii.   **User-interface**: the look and feel of the objects (user-actions)

    iv.   **Implementation**: object/action analysis

    v.   **Documentation**: description of task and interface actions

    vi.   **Design process:** design activities how it relates to the conceptual design model

Briefly, conceptual design model can be categorised into two models; static and dynamic conceptual design model.

2.3.1.1 Static Conceptual Design Model

Conceptual design model can function to be as guidance in completing any of application system generally or PDA specifically, is considered as static conceptual design model because of the predetermined attributes and criteria. This model is widely used as it is easier to define the constant value of required criteria such as demographic values, areas of decision making and list of options.

There are a few studies based on static conceptual design model. One of the examples is computerized personal decision aid (ComPDA) for m^d-Matrix application by Siti Mahfuzah (2011). The m^d-Matrix is a computerized decision aid that was designed to choose between provided technologies to develop a mobile phone application. Step 1 and Step 2 which are the categories and the possible alternatives have been pre-determined in the program. The computerized decision aid started with conceptual design model (Figure 2.6), and followed by the m^d-Matrix application (Figure 2.7).
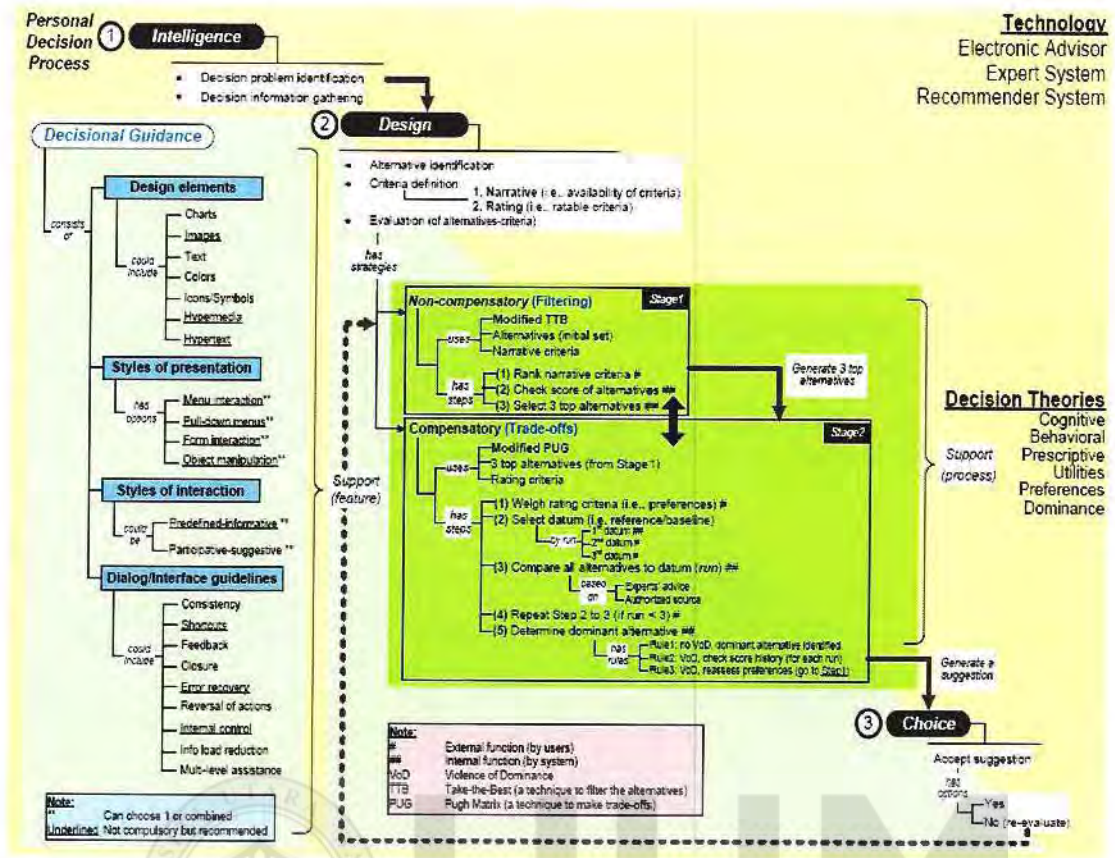
Figure 2.6. Conceptual design model for ComPDA (Siti Mahfuzah, 2011)

Figure 2.7. m^d-Matrix decision aid (Siti Mahfuzah, 2011)

Many good designs provide appropriate feedback to confirm the user's mental model of operation. The intended conceptual model should anticipate users' expectations rather than reflect designers' knowledge and mental models as Norman (1990) stated that, a user's conceptual model may not always match that of the designers.

2.3.1.2 Dynamic Conceptual Design Model

Conversely, Meghdari (1996) states that dynamic conceptual design model has the ability in managing multi-criteria requirements. Dynamic conceptual design model is a mental model of operation with a wide variety of tasks as well as modifying the perspective, and considers the fluctuations of variables within the conceptual design activity (Manca & Grana, 2010). Therefore by the stated justification, dynamic conceptual design should be capable in controlling the various kinds of facts such as changes in individual personality, trends and oscillate in interest.

Thus, the dynamic conceptual design will include both continuous variables such as age, education level and employment status where the constructed PDA is not pre-programmed and pre-determined. As for this study, the focus will be more on the dynamic conceptual design model since the requirements for youth is highly demanding (previous preliminary).

"Let Simon Decide" application is one of the examples of dynamic decision making where the decision making categories and list of alternatives are determined by the user. So, the user has the ability to put all possible alternatives for him to choose as shown in Figure 2.8.

Figure 2.8. Let Simon Decide decision aid (Ayax System Inc., 2014)

The criteria for youth will be the input as early as the filtering in personality test and followed by the choice of decision making areas before they will permit to proceed with decision making processes. The characters, trends, and interests of youth might change in period of time, therefore predetermined criteria or variable are unsuitable to be practised. So, it is a concrete requirement for realisation of the dynamic conceptual design model especially in managing youth behaviour in their decision making.

2.3.2 Implications of Design Model to the Study

The abstract object model that describes the comprehension description of relation between individual and the application is considered as design model. A design model can be used to imitate the process in reality into simplified object drawing to be easily understood and managed by developers. This model is able to cover in wide areas such as information system, engineering, architecture and business.

One of the types in design model is conceptual design model. A good conceptual design model is able to help the user to anticipate and understand the consequences of their actions. An erroneous in conceptual model probably happen if something goes wrong in the application and the user is unable to understand why. The choice of using dynamic conceptual design model optimistic to successfully satisfy the multi-criteria issues as it is the necessary requirements by the users.

2.4 Decision Aids Theoretical Ground

Decision aids theory is created to explain how human makes decision. Hence, this study will discuss a number of related theories that contribute to understanding of decision making particularly in the MDCM.

2.4.1 Descriptive, Normative and Prescriptive Decision Theory

Descriptive, normative and prescriptive decision theory would be used to construct a supportive decision making. However, decision makers have to choose which modes of analysis based on the emphasis argument.

Descriptive focuses on how people make decision and why they act the way they do. This mode concerns on what people actually do or have done which is more on psychological side of decision making (Bell, Raiffa, & Tversky, 1988; Goldberg, 1993). This mode of analysis is also known as behavioural decision making because of closely referring to how human behaves in making decision.

Meanwhile, normative decision theory highlights on how idealized people should make decisions and act upon it (Bell et al., 1988). They also emphasize on the concept of transitivity which is the common axiom in normative decision process. The main concern is on what people should do based on theory.

Prescriptive research more on people who willing to spend some time and effort to make a better decision. In general, this mode focuses on what people should and can do in making decision. Prescriptive models are based on both the strong theoretical foundation of normative theory in combination with the observations of descriptive theory (Dillon, 1998). Generally, the users can make better choice in prescriptive decision because this study focuses on the approach that unthreatened the users' perceptive abilities.

2.4.2 Behavioural Decision Theory

Behavioural decision theory offers an organized method for relating exactly how the values for individual decision makers and opinions are integrated into their choices and prescribing courses of action. Explicit in the theoretical mode is the interpretation that decision makers are able to express preferences given alternatives.

Subjective expected utilities will be considered where such preferences are capable to be assessed thoroughly.

Role of psychology in decision making is conveyed by behavioural decision study. Behavioural decision theory helps to emphasize the importance of attention, memory, cognitive representation, conflict, learning and feedback (Yin, 1994). Then, the decision studies should investigate on the mentioned psychological topics along with technical issues (Todd & Benbasat, 1994; Yin, 1994) for better understanding of the decision process.

Behavioural decision theory provides on the vibrant role of values and opinions in the findings and decision making of venders and customers. Advertising efforts intended at indulgent, elucidation, and foreseeing deliberately significant decisions that should deliberate analytical approaches based in behavioural decision theory (Bhasin, 2010). Most of researchers have constructed the behavioural decision-based models to deliver ways to assess and clarify vital consumer judgments in addition to successful marketing decisions.

2.4.3 Cognitive Psychology Theory

Cognitive psychology is the branch of psychology that learns mental processes as well as how people believe, observe, remember and discover. This branch of psychology is interrelated to other fields including neuroscience, philosophy, and linguistics.

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According to Douginator (2007) cognitive psychology is a school of psychology that focuses on areas of human memory, thought and perception. Cognition refer to a mental processes engaged in acquiring and understanding information that lies behind behaviour. It highlights the way a person understands and solves problems.

Cognitive psychology focuses on the way human process information. The function too involved on observing of how people treat the information obtained by them. This process is called stimuli by behaviourists, where Mcleod (2007) mentioned that cognitive psychology focuses on how this treatment leads to responses or stimuli.

The theory of cognitive psychology indicates that human mind is perceived to handle information in designed system. Most cognitive theories approve that information processes are the information selected up by the minds that is investigated, stored, recorded, and successively used in numerous ways (Neisser, 2009). Cognitive psychology depends on a bit of awareness and not to be represented in consciousness.

The core focus of cognitive psychology is on how people acquire, process and store information. There are numerous practical applications for cognitive research, such as ways to improve memory, how to increase decision-making accuracy, and how to structure educational curricula to enhance learning.

Unlike behaviourism, which focuses only on observable behaviours, cognitive psychology is concerned with internal mental states. On the other hand, psychoanalysis which relies heavily on subjective perceptions, cognitive

psychology uses scientific research methods to study mental processes. Since cognitive psychology relates to several other disciplines, diverse people in different fields often study this branch of psychology.

2.4.4 Utility Theory

Utilities are normally represented as numerically values are easy to be practice in decision-making (Hansson, 1994). There are two basic decision-rules that can be followed in utilities which are:

1. Select the option with the utmost utility.

2. Select the option with the utmost utility. Pick one of them if more than one option has the utmost utility.

Nowadays, most of monetary theory built on the indication that individuals make the most of their holdings based on the maximize rule by Hansson. Utilitarian moral theory suggests that individuals ought to maximize the utility causing from their actions even there are still a critic by the utilitarianism on the excessively demand. As a result, many decision problems still consent the levels of utility lower than maximal utility.

Besides, Scott (2002) state that utility theory is a theory in economic that suggests the behavior of individuals is based on the basis that the users can consistently relying on their preferences to rank order. In connection with user preferences, Table 2.3 shows the assumptions derived from the utility theory.

Table 2.3

Assumptions in Utility Theory (Scott, 2002)

No	Assumption	Description
1.	Completeness	Individuals can rank order all possible bundles which imply the theory assumes that, no matter how many combinations of consumption bundles are placed in front of the individual, each individual can always rank them in some order based on preferences. This means that individuals can somehow compare any bundle with any other bundle and rank them in order of the satisfaction each bundle provides. Mathematically, this property wherein an individual's preferences enable him or her to compare any given bundle with any other bundle is called the completeness property of preferences.
2.	More-is-better	Assume an individual prefers consumption of bundle A of goods to bundle B. Then he is offered another bundle, which contains more of everything in bundle A, that is, the new bundle is represented by αA where $\alpha = 1$. The more-is-better assumption says that individuals prefer αA to A, which in turn is preferred to B, but also A itself. For our example, if one week of food is preferred to one week of clothing, then two weeks of food is a preferred package to one week of food. Mathematically, the more-is-better assumption is called the monotonicity assumption on preferences where a hidden property allows costless disposal of excess quantities of any bundle.
3.	Mix-is-better	Suppose an individual is indifferent to the choice between one week of clothing alone and one week of food. Thus, either choice by itself is not preferred over the other. The "mix-is-better" assumption about preferences says that a mix of the two, say half-week of food mixed with half-week of clothing, will be preferred to both stand-alone choices. Thus, a glass of milk mixed with Milo, will be preferred to milk or Milo alone. The mix-is-better assumption is called the "convexity" assumption on preferences, that is, preferences are convex.
4.	Rationality	This is the most important assumption that underlies all of utility theory. Individuals' preferences avoid any kind of circularity; that is, if bundle A is preferred to B and bundle B is preferred to C, and then A is also preferred to C. Under no circumstances will the individual prefer C to A. Assumes: the innate preferences (rank orderings of bundles of goods) are fixed, regardless of the context and time.

Accordingly, in suggesting the preferences of an individual, the four assumptions in utility functions could be used as valuable tools in decision making.

2.4.5 Preference

In decision-making, Hansson (1994) states that preference relations are used to find the best alternative. The rules are divided into two cases as follows:

1. An alternative is (uniquely) *best* if and only if it is better than all other alternatives. If there is a uniquely best alternative, choose it.

There are cases in which no alternative is uniquely best, since the highest position is shared by two or more alternatives.

2. An alternative is (among the) best if and only if it is at least as good as all other alternatives. If there are alternatives that are best, pick one of them.

However, Hansson (1994) disputes that there are cases in which not even this modified rule can be used to guide decision-making. There are stages when preferences that violate rationality criteria such as transitivity sometimes unbeneficial to guide the decisions (Bell et al., 1988; Hansson, 1994).

2.4.6 Dominance

The decision making process will be perceived as a search for dominance structure where one alternative is seen to be dominant over the others. Montgomery (1989) describes the model of decision making as presented in such way to portray the decision process as a search for good arguments and not only as governed by a number of decision rules.

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There are two forms of dominance principles which are:

1. Weak dominance: One act is more rational than another if

    i) all its possible outcomes are at least as good as those of the other, and if

    ii) there is at least one possible outcome that is better than that of the other act.

2. Strong dominance: One act is more rational than another if all of their possible outcomes are better than that of the other act.

Probabilities are assigned to all the outcomes thus the dominance principle is also able to be practiced on decisions under uncertainty. It is still rational to choose one act over another act if all its outcomes are at least as good as the outcomes of the other act (if the probabilities are assigning to outcomes). On top of this, not all decision problems include an act that dominates all the others. Consequently additional principles are often required to reach a decision.

2.4.7 Implications of Decision Theories to the Study

Decision theories are the most vital foundation to be focussed on in this study. Each theory has its own inference. Descriptive, normative and prescriptive theories contain mode of analysis in the decision study. The major concern of this study is prescriptive that will act as the guideline on how this study should be carried out. The attention will be on the actual decision makers, specifically youth.

Behavioural decision theory is one of the best principles that able to combine individuals' values and beliefs into decisions and courses of action. The list of alternatives and recommendations will be evaluated in the decision tools. As an

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addition, cognitive psychology is a great combination with behavioural decision theory where it shows the way a person understands and solves problems. These principles will help to reflect the type of design that should be integrated in the development of YouthPDA. The chosen of these principles is because of the ability to influence human in decision making. This process will be done through acquiring, processing and storing information by understanding information that lies behind the behaviour.

Meanwhile, Utilities, Preferences and Dominance theory in decision making will link directly to the process commenced in creating YouthPDA. Concisely, Utility theory proposes that the utility resulting from individual's actions and also based on the four assumptions should be maximized while Preference theory will assist in finding the best recommendation out of available alternatives in the decision aid. Then, Dominance principle will be able to be practiced on decisions under uncertainty where this is essential to this study. The strengths and weaknesses of each theory are summarised in Table 2.4 for better understanding.

Table 2.4

Strengths and Weaknesses of each Theory

THEORY	STRENGTH	WEAKNESS
Descriptive, Normative, Prescriptive	i. Focus on the approach to obtain the users' capabilities. ii. Act as the guideline on how this study should be carried out.	Should combine the three theories to get the best approach in problem solving

Table 2.4 continued

Behavioural Decision	i. Relates how the values for individual decision makers and opinions are integrated into their choices to prescribing courses of action. ii. Used to deliver ways to assess and clarify vital consumer judgments in addition to successful marketing decisions. iii. The best principle that is able to combine individuals' values and beliefs into decisions and courses of action. The list of alternatives and recommendations will be evaluated in the decision tools	Focus only on observable behaviours
Cognitive Psychology	i. The ability to influence human in decision making. Focus on how people acquire, process and store information. ii. Practical applications: to improve memory, how to increase decision-making accuracy, and how to structure educational curricula to enhance learning.	Must relate to several other disciplines in order to understand and solve problems
Utility	i. Suggests the behaviour of individuals is based on the basis that the users can consistently rely on their preferences to rank order. ii. Proposes that the utility resulting from individual's actions and also based on the four assumptions should be maximized	Many decision problems still consent the levels of utility lower than maximal utility
Preference	Assist in finding the best recommendation out of available alternatives in the decision aid.	There is cases where the modified rule unable to be used to guide decision-making.
Dominance	Able to be practiced on decisions under uncertainty where this is essential to this study.	Not all decision problems include an act that dominates all the others. So, additional principles are often required to reach a decision.

2.5 Additional Theories

Undeniable, all decision theories described earlier are useful to the development of

YouthPDA design model. However, the decision theories themselves are inadequate

to sustain with youth's personality and intelligent. Therefore, the youth must be filtered for their characteristic and intellectual background before they are allowed to go for decision making process. The theories involved with this filtering process are Personality Traits (PT) for individual's characteristic recognition, and Multiple Intelligence (MI) theory as the learning approach. Both of the theories seem to be more of interest to this study and have been applied to many areas of studies.

2.5.1 Personality Traits (PT) Theory

The trait approach to personality is one of the major theoretical areas in the study of personality. Personality of each individual has the uniqueness on the thoughts, feelings and behaviours which combines the attributes, motives, value, and behaviours. According to trait theory, individual characteristics are collected from wide range of personalities. Negnevitsky (2005) assumes that, trait is an established characteristic that effects the reaction of individual's behaviour.

The theory of personality traits started approximately half of a decade and keep expanding including Goldberg (1981) and McCrae and Costa (1987). One of the major founding the personality traits area is Big five categories which divides the personality in different types of individuals.

Previously, Goldberg (1981) has found that former trait theorist' proposed the following as possible traits:

    i.   Gordon Allport's: 4,000 personality traits (too complex)

    ii.   Raymond Cattell's: 16 personality factors

    iii.   Hans Eysenck's: 3 factor theory (too limited in scope)

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2.5.1.1 Big Five Model

There are literature support provided for the formation of big five categories in personality traits dimension, yet still unable to satisfy each researchers in this field. However, these five categories that portrayed in Table 2.5 have been confirmed by Digman (1990) and Goldberg (1993).

Table 2.5

Big Five Categories

Big 5 Category	Personality
Extraversion	This trait includes characteristics such as excitability, sociability, talkativeness, assertiveness and high amounts of emotional expressiveness.
Agreeableness	This personality dimension includes attributes such as trust, altruism, kindness, affection, and other pro-social behaviors.
Conscientiousness	Common features of this dimension include high levels of thoughtfulness, with good impulse control and goal-directed behaviors. Those high in conscientiousness tend to be organized and mindful of details.
Neuroticism	Individuals high in this trait tend to experience emotional instability, anxiety, moodiness, irritability, and sadness.
Openness	This trait features characteristics such as imagination and insight, and those high in this trait also tend to have a broad range of interests.

From the table, the five categories include Extraversion, Agreeableness, Conscientiousness, Neuroticism, and Openness. According to Bonsjak, Galesic and Tuten (2007), all the categories are mostly attentive on actual behaviour of an individual, and this statement is supported by Machin and Sankey (2008).

2.5.1.2 The Myers-Briggs Type Indicator (MBTI)

Besides that, MBTI also concentrates on individual's personality. This instrument was established by Katharine Cook Briggs and Isabel Briggs Myers (Coe, 1992). There are four preferences with opposite personality (Table 2.6) that differentiate one person to another which are:

i. E or I (Extraversion or Introversion)

ii. S or N (Sensing or iNtuition)

iii. T or F (Thinking or Feeling)

iv. J or P (Judgment or Perception)

Table 2.6

The Myer-Briggs Opposite Traits

MBTI Type	Opposite
Extraversion (expressive) tend to focus their attention on the outer world of people and things	**Introversion** (reserved) tend to focus their attention on the inner world of ideas and impressions
Sensing (observant) tend to take in information through the five senses and focus in the here and now	**Intuition** (introspective) tend to take in information from patterns and the big picture and focus on future possibilities
Thinking (tough minded) tend to make decisions based primarily on logic and on objective analysis of cause and effect	**Feeling** (friendly) tend to make decisions based primarily on values and on subjective evaluation of person-centred concerns
Judging (scheduling) tend to like a planned and organised approach to life and prefer to have things settled	**Perceiving** (probing) tend to like a flexible and spontaneous approach to life and prefer to keep their option open

Then, Langton and Robbins (2007) categorized individuals into 16 differences personality traits group (human differences) which is comprised by Isabel Briggs

Myers, Katharine Briggs, and Carl Jung (psychologist). MBTI is one of personality indicator that able to measure each individual is used as assessment of personality theories.

MBTI was started with 8 indicators namely Extroverted (E), Sensing (S), Thinking (T), Judging (J), Introverted (I), Intuitive (N), Feeling (F) and Perceiving (P). The merging personality into 16 types then produce four categories of person including i) NF: valuing (manifesting universal values and valuing people), ii) SF: relating (including and building trustworthiness), iii) NT: visioning (pulling people with ideas to an optimistic future), and iv) ST: directing (action from a strategic perspective). These characteristic published in Figure 2.9 are able to differentiate a person with the suitable professions in the YouthPDA's recommendations as shown in Figure 2.10.

PERSONALITY COMBINATIONS

ISTJ	ISFJ	INFJ	INTJ
Doing what should be done	A huge sense of duty	An inspiration to others	Everything has room for improvement
ISTP Ready to try anything once	**ISFP** Sees much but shares little	**INFP** Performing noble service to aid society	**INTP** A love of problem solving
ESTP The ultimate realist	**ESFP** You only go around once in life	**ENFP** Giving liofe an extra squeeze	**ENTP** One exciting challenge after another
ESTJ Life's administrators	**ESFJ** Hosts and hostesses of the world	**ENFJ** Smooth talking persuader	**ENTJ** Life's natural leaders

Figure 2.9. 16 types of MBTI with suitable professions
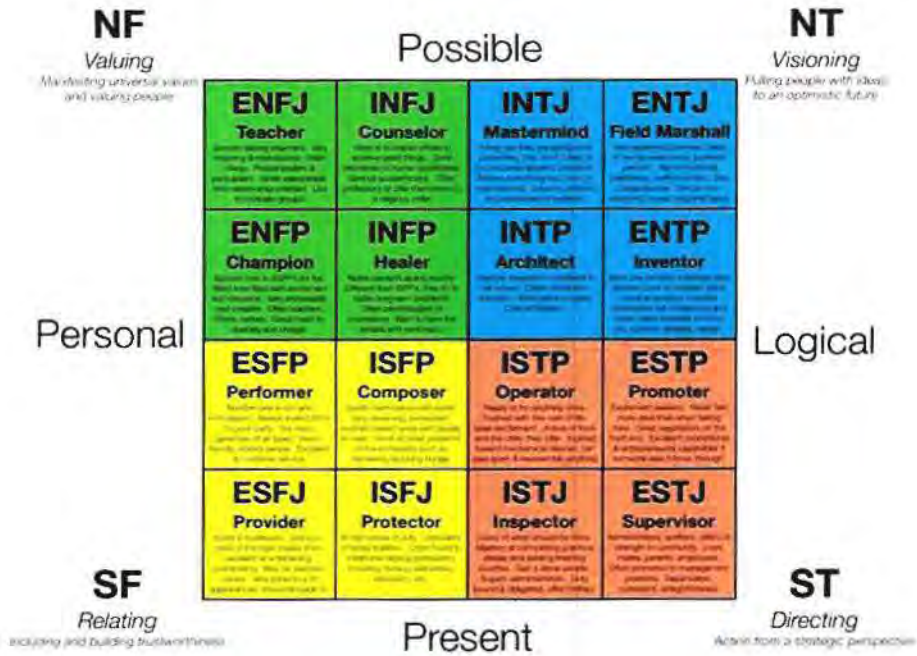
Figure 2.10. MBTI personality combination

2.5.2 Multiple Intelligence (MI) Theory

The theory of Multiple Intelligences (MI) was developed in 1983 by Dr. Howard Gardner, a psychologist and professor of neuroscience from Harvard University. MI essentially emphasizes on education and cognitive science field. According to Gardner (1983; 1993; 2011), people are born with a uniform cognitive capacity that can be easily measured by short-answer tests since MI reconsiders our educational practice of the last century and provides an alternative.

This theory highlights nine different kinds of intelligence (Figure 2.11) that reflect different ways of interacting with the world. Although human each has all nine intelligences, no two individuals have them in the same exact configuration but each person has a unique combination (profile). The intelligence is defined as:

- the ability to create an effective product or offer a service that is valued in a culture;

- a set of skills that make it possible for a person to solve problems in life;

- the potential for finding or creating solutions for problems, which involves gathering new knowledge (Digman, 1990; Gardner, 1983; 1993; 2011) .

1. Linguistic Intelligence

- the capacity to use language to express what's on your mind and to understand other people. Any kind of writer, orator, speaker, lawyer, or other person for whom language is an important stock in trade has great linguistic intelligence.

2. Logical/Mathematical Intelligence:

- the capacity to understand the underlying principles of some kind of causal system, the way a scientist or a logician does; or to manipulate numbers, quantities, and operations, the way a mathematician does.

3. Musical Rhythmic Intelligence:

- the capacity to think in music; to be able to hear patterns, recognize them, and perhaps manipulate them. People who have strong musical intelligence don't just remember music easily, they can't get it out of their minds, it's so omnipresent.

4. Bodily/Kinesthetic Intelligence:

- the capacity to use your whole body or parts of your body (your hands, your fingers, your arms) to solve a problem, make something, or put on some kind of production. The most evident examples are people in athletics or the performing arts, particularly dancing or acting.

5. Spatial Intelligence:

- the ability to represent the spatial world internally in your mind -- the way a sailor or airplane pilot navigates the large spatial world, or the way a chess player or sculptor represents a more circumscribed spatial world. Spatial intelligence can be used in the arts or in the sciences.

6. Naturalist Intelligence:

- the ability to discriminate among living things (plants, animals) and sensitivity to other features of the natural world (clouds, rock configurations). This ability was clearly of value in our evolutionary past as hunters, gatherers, and farmers; it continues to be central in such roles as botanist or chef.

7. Intrapersonal Intelligence:

- having an understanding of yourself; knowing who you are, what you can do, what you want to do, how you react to things, which things to avoid, and which things to gravitate toward. We are drawn to people who have a good understanding of themselves. They tend to know what they can and can't do, and to know where to go if they need help.

8. Interpersonal Intelligence:

- the ability to understand other people. It's an ability we all need, but is especially important for teachers, clinicians, salespersons, or politicians -- anybody who deals with other people.

9. Existential Intelligence:

- the ability and proclivity to pose (and ponder) questions about life, death, and ultimate realities.

Figure 2.11. Nine Multiple Intelligences (Gardner, 1983; 1993; 2011)

2.5.3 Implications of PT and MI to the Study

Decision theories are very significant foundation to this study. Selected theories will contribute to the realism of conceptual design model construction. The decision aid theories will help in developing the process of decision making. Yet, the PT and MI theories will be used as the filter of the decision aid as the users need to create their profiles as part of the aid system depending on the rule-based to provide with suggestions.

Generalizations in each individual's personality may be able to be made amongst the personality theorists that are concerned with identifying consistent individual differences between individual's behaviour and the causes and consequences of these differences. The MBTI is the proof of personality universal structure that could be a guide in the construction of filtering such as self-monitoring in developing YouthPDA.

On the other hand, each intelligence that is introduced in Multiple Intelligence has its own abilities and will clearly define the youth strengths. The personality traits of a youth too will be obviously clarified as it is the main formula to create the combination of PT and MI in designing the alternatives in the decision making application.

2.6 Decision Making

There are various definitions of decision making across the literature. Most of the definitions revolve around information gathering and structuring function of the process. Caroll and Johnson (1990) indicate that decision making is a process by

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which a person, group or organization identifies a choice or judgment to be made, gathers and evaluates information about the alternatives and selects from among the alternatives. Besides describing the relevant activities involved in the process, it also shows that judgment and choice as the outcomes of decision making process.

Decision making environment is determined by several components including the collected data, activities and the evaluation. Germeijs and De Boeck (2003) state that there are three theoretical sources of indecision process which are; i) lack of information (not having a view on the possible alternatives or/and not knowing the attributes of the alternatives or/and not having enough information about the alternatives and their outcomes), ii) valuation problems (value, vagueness, value conflict and evaluative evenness) and iii) uncertainty about the outcomes (unpredictable events and limitations to one's capability to bring an alternative to a good end).

2.6.1 Decision Making Process

Some decisions are more important than others either in the immediate or long term effect. Good decision making ought to be applied to every problem at all the time. Harris (2009) stated that it is often quite not nice when we make decision without planning even though it is fairly common.

The evolution of information is a means of signifying the importance of decision as cited from Ullman (2002) as shown in Figure 2.12. The discussion includes that the most valuable information is a choice that based on all the less valuable information.

Therefore, decision making requires management of data, models and knowledge, and judgment related to the decision.
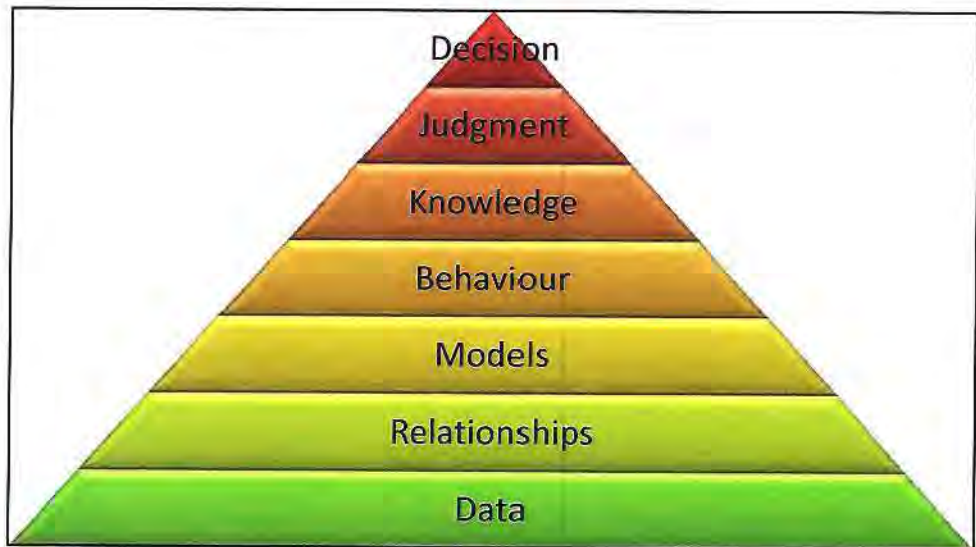
Figure 2.12. The decision pyramid

Decision is an outcome of a series of steps. Through these steps, the information will be derived and generated. In the literatures, various decision making processes are proposed to solve decision problems which varying from organizational level to individual level.

Girod, Elliot, Wright, and Burns (2000b) explained that the activities of decision making are clustered based on the type of information. Table 2.7 lists out the decision making activities accordingly and exhibits the process of decision making as information oriented.

Table 2.7

Decision Process Based on Decision Information

No.	Information	Decision Making Activities
1	Issues	Generating issues
		Organizing issues to be worked on
2	Criteria	Identifying criteria to ensure understanding
		Weighting criteria (establishing preference)
3	Alternatives	Identifying alternatives
		Clarifying the alternatives' working principles
		Clarifying alternatives environment
4	Evaluation	Establishing alternative performance relative to a particular criterion
		Gathering external information
		Generating analytical or experimental results
5	Decision	Choosing the best alternatives
		Deciding on what to do next
6	The Process	Controlling the decision making process

2.6.2 Decision Making Stages

In decision making development, there are four different stages involved namely intelligence, design, choice and implementation. The roles of each stages and their interaction with system supports that have been summarized are illustrates in Figure 2.13.

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System Support

Management Information System (MIS):
Routine reports and exception reporting

Decision Support System (DSS):
Using analytical models and spread sheets to flexibly analyse data and design possible solutions

Decision Support System (DSS):
Using analytical models and larger data sets to identify the optimal solution

Group Decision Support System (GDSS):
Using online meeting and collaboration tools to choose the most acceptable and supported solution

Management Information System (MIS):
Routine reports and exception reporting

Decision Support System (DSS):
Using analytical models and data to fine-tune the solution

Figure 2.13. Decision making stages

As for Simon (1965), he had clarified that three main processes which are intelligence, design and choice are the main components in decision making. Table 2.8 explains how Simon's Model corresponds to Scientific Method as well as System Development Life Cycle (SDLC).

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Table 2.8

Mapping between Simon's Model with Scientific Method and SDLC

SIMON'S Model	Scientific Approach	SDLC
Intelligence	Define Problem	System Investigation
Design	Develop Alternatives	System Analysis
Choice	Select Solution	System Design
Implementation	Implement Solution	Implementation
Review		Maintenance

Intelligence phase is categorised as System Investigation in the SDLC. The process of defining problem in certain situations is how 'intelligence' works in the problem identifying. Design phase is equivalents to System Analysis where the alternatives of options to the given problems will be developed. The Choice phase is the System Design where the Scientific Approach called it as Select Solution where the process of accepting or rejecting the developed alternatives will be carried out. Meanwhile, the Implementation and Review phases are the additional phases in decision making stages. The implementation is more on to implement the solution provided, and the Review phase is the Maintenance process in the decision making application.

2.6.3 Decision Support System

Tripathi (2011) defines a Decision Support System (DSS) as an interactive computer-based information system that helps the users in decision making. This system assists the users to make a decision based on the alternatives available in order to solve a problem. Decision Support System too can be described as a class of computerized

information system that support decision making activities as well as improving a person or group's ability to make decision Power (2007) by using data, knowledge and communications technology (Velmurugan & Narayanasamy, 2008).

On the other hand, Arnott and Pervan (2008) explain that DSS is a field of Information System (IS) discipline that focuses on supporting and enrich managerial decision making. Fundamentally, DSS is about developing and deploying IT based systems to enable decision making processes. Thus, DSS has been classified by Power (2002) into five models which are data-driven DSS, document-driven DSS, model-driven DSS, knowledge-driven DSS and communication-driven DSS.

Meanwhile, Power (2007) stated that data-driven DSS highlights access to manipulation of time series (internal and external) as well as real time company data. This model targets on the product or services supplier, staff and managers to query a database or data warehouse deployed via web, client-server link or main-frame system. As for model-driven DSS, it is used to assist decision makers in analysing a situation. It is deployed at stand-alone pc for the managers and staff.

Document-driven DSS aims to a broad base of user group to search web pages and finds documents via client or server system or the web. This model will access unstructured data in larger sources of and the systems will present appropriate documents in more practical formats.

Another model of DSS is knowledge-driven DSS where it is used to choose products or services or to provide management advices. The target group is manager and the

technologies deployed are web or client or server system. A communication-driven DSS which support more than one user working on a shared task is focused at the internal teams including partners by setting up web or client server.

2.6.3.1   Decision Characteristics

According to Keen and Scott (1978), there are three types of decision making that have been practiced which involve:

i.   **Unstructured:** all phases of decision making process are unstructured, not well defined input, output set and procedures.

ii.   **Semi-structured:** has some structured aspect, some of the inputs or outputs or procedures are not well defined.

iii.   **Structured:** routine and repetitive with standard solution, well defined decision making procedure, given a well-defined set of input, a well-defined set of output is defined.

The unstructured decision making has no structured phases, and often solved with human intuition. However, semi-structured decision making has some structured phases and is solved with standard solution procedures and human judgement. Having said that, structured decision making has all structured phases, where procedures for obtaining the best solution are known.

DSS also consists of four major components which are the user interface, the database, the model and analytical tools and DSS architecture. This component becomes a main building block for Decision Support System (Power, 2007).

DSS incorporate types of information systems including Executive Information Systems, Expert System, Information Reporting Systems, and Transaction Processing Systems. The relation of the decision types and information system environment has been portrayed in Figure 2.14.
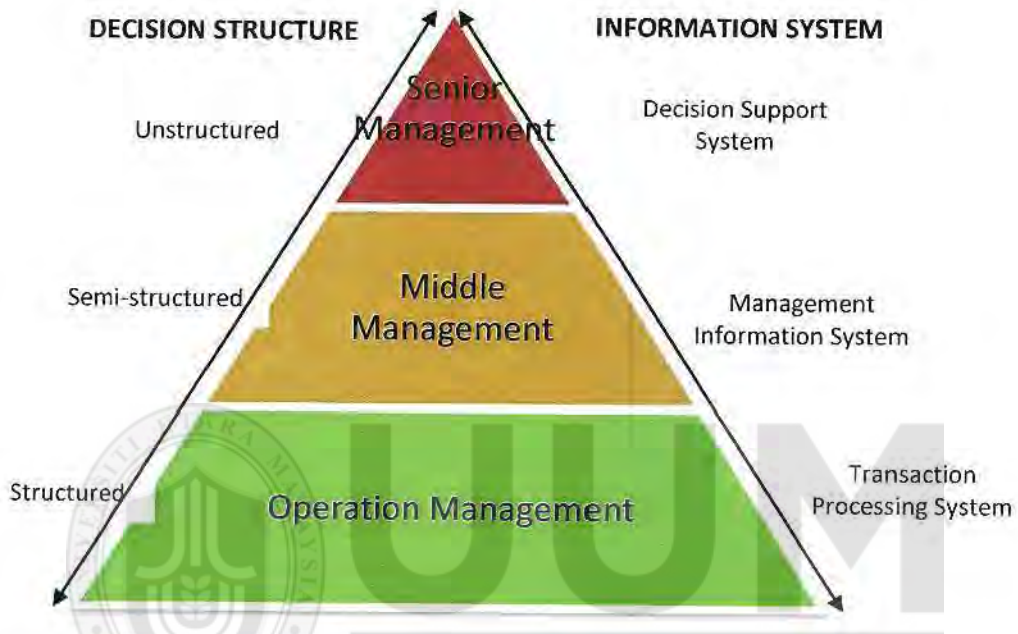
Figure 2.14. Decision making types in information systems environment

2.6.4 Computerized Decision Aid

In the Internet world, recommendation systems or decision aid become popular as it reduce decisions difficulties by providing the right solutions to the users. With the emergent dispersion of the Internet and e-commerce, personalized aids become progressively critical to reduce their information capacity and hunt for charges to classify suitable products or services for customers. Recommendations need to depend on user decision criteria and product attributes (Chen et al., 2010).

An aid is developed to assist people in choosing and determining the appropriate products or services that would fit them based on their preferences. This would reduce the complexity of decision making processes that are difficult to handle where the system will provide the users with the best alternatives based on specified criteria. In order to obtain customer loyalty and continued use, a worthy aid system ought to increase user accomplishment as stated by Taylor and Todd (1995) cited in Chen et al. (2010).

Computerized decision aid refers to a various set of tools based on a varying techniques and complexity. Normally, decision aids are designed in order to assist human to decide the best decision possible with the knowledge they have available. The aids can be developed in form of website, spread sheet, web application and software (Siti Mahfuzah & Norshuhada, 2010).

Computerized decision aid can be narrowed down to personal decision aid (PDA). PDA or Personal Decision Support System (PDSS) is one of the DSS categories. PDAs are commonly used in real life and normally developed as small-scale systems. It is developed for single user or a small number of single users to enable decision task. PDA aid assists an individual in personal decision making such as the type of car they should buy based on their budget and other constraints.

2.6.5 Decision Aid Evaluation

Evaluation on the performance of Computerized Decision Aid (CDA) covers various aspects and attributes. But none of them really answers the question at which points computerized decision aids offer any help (Bronner & de Hoog, 1982). Jungermann

(1980) distinguishes two approaches to evaluation of decision aids; the outcome oriented approach and the process oriented approach.

There have been pros and cons between the two approaches. But, generally, the focus of either approach is on helping decision maker to make a decision. Bronner and de Hoog (1982) considered two key elements in proposing appropriate methods to measure usefulness of CDAs which is decision preferences order that reflects process and degree of satisfaction with the aid's solution that dependent on outcome. For some reason, their work proposing that "usefulness" could be one of the attributes that considers both evaluation approaches of a CDA. However, the literature studies show that more works on evaluating the effort (Todd & Benbasat, 1991, 1992, 1994) and accuracy (Chu & Spires, 2003; Gati, Gadassi, & Shemesh, 2006) of the decision aids were carried out as compared to works related to measuring usefulness of a decision aid.

2.6.6 Implications of Decision Making and Aids to the Study

The process involved in the decision making should be clearly determined as all the decision aids should concerned about. Characteristics available in DSS are examined to fulfil the requirements of decision aid that will be created. However, the issue may come out from the characteristic by Tripathi (2011) that used cutting-edge software packages by carrying out sophisticated analysis and complex assessments that that have been mentioned clearly in the previous chapter. This will be solved by enhancing the decision model as will be described in next sub-section.

2.7 Knowledge-based

A representation of expertise, wisdom or rules-of-thumb, often represented by rules containing "if-then-else" conditional statements or cases containing various fact patterns. Knowledge bases may also consist of representative objects (excited utterance) within a sub-class (rules against hearsay) and class (rules of evidence) of information. Knowledge bases typically focus on narrow issues, known as a domain, within a particular fact situation as depicted in Figure 2.15.
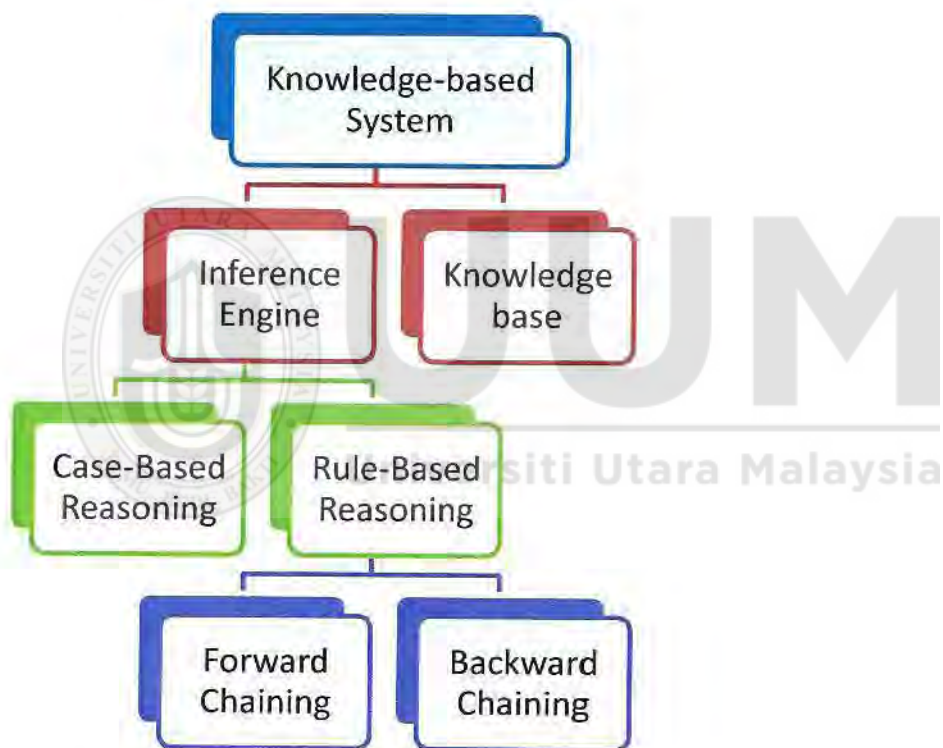
Figure 2.15. Knowledge-based methods classifications

Software code which processes the rules, cases, objects or other type of knowledge and expertise based on the facts of a given situation. Most artificial intelligence (AI) tools contain some form of deductive or inductive reasoning capability. There are many prominent AI techniques across literature, but Rule-based System (RBS) or Rule Base Reasoning (RBR) is mostly used towards data structure knowledge based

approaching to be analysed and come out with solutions (Chen et al., 2008). Two types of RBS are Forward Chaining and Backward Chaining.

2.7.1 Case-based Techniques

Case-based reasoning (CBR) practices humans solving analogy by comparing with former problems and amending the solutions to the new problem. Furthermore, CBR permits the important features in the past solved cases such as identical and adjusting, to the new matters as CBR provides better decision rationalisation and clarification using former cases (Nguyen, Prasad, Dang, & Drake, 2001). Numerous areas such as problem diagnosis, solution retrieval, help desk, assessment, decision support, design, and planning have been using CBR for years (Tung et al., 2010).

The evolution of CBR was started late in 1970s by development of Memory Organization Packets (MOPs) by Schank (Prentzas & Hatzilygeroudis, 2007). MOPs signified the used of knowledge repositories and cases organizers. MOPs was first executed in 1983 using CYRUS that known as forerunner of CBR system by Kolodner. Besides that, according to Pandey and Mishra (2009), MEDIC was the first CBR system in medical area that generated in 1988 for bacterial infection and pulmonology diagnosis.

There are four phases in CBR which are retrieve, reuse, revise and retain. The retrieval phase consuming indexing schemes and similarity metrics to regain related cases. Next, reuse phase provides a solution based on the regained cases. Then, the revise phase verifies the recommended solution. Finally, the retain phase stores the new suggested solution.

2.7.2 Rule-based Techniques

Decision making process required reasoning technique that produced results intelligently derived from available knowledge within a limited domain. Negnevitsky (2005) points out that decision making process is complex and difficult to be represented because human processed information internally based on their experiences and expertise. Besides, complexities also occurred when embedding human knowledge that significance in a specific domain (Goh, 2010).

However, the use of rule-based reasoning (RBR) facilitates decision making process by providing a technique in representing the process in the form of rules. RBR also provides approaches in represented and embedded knowledge easier. RBR used general knowledge of a specific domain and represent it in a form of rules.

RBR is a suggestion process used to analyse problem according to standard rules. RBR systems utilize expert knowledge by representing the knowledge in the form of rules which is used to resolve domain problems (Abdullah, Sawar, & Ahmed, 2009). Today, rule-based system is one of the oldest artificial intelligence technologies and being used in various fields such as military, medical and industrial (Goh, 2010).

Basic RBR system contains 3 parts; rule knowledge base, inference engine and working memory. Rules in RBR represent the knowledge of the domain or facts and will be stored in a knowledge base (Lee, 2008). A rule has a basic form as following:

IF   <conditions>,

THEN <conclusion>

The conditions are connecting the facts using logical connectives such as, AND, OR, NOT. A rule is fired when conditions of a rule are fulfilled, and the conclusion is derived. These rules are stored in the knowledge base. Rules in the knowledge base have the following features (Hatzilygeroudis & Prentzas, 2004):

• Naturalness in knowledge representation as referred to only specific domain knowledge that usually described in natural language such as guidelines, rules and regulations, and procedures.

• Modularity and uniform structure because every single rule, have its own meaning. Therefore, it is ensuring the flexibility of the knowledge base without intervening with the whole system.

• Ease of explanation in representing and reasoning with the domain knowledge because derived conclusions have been reasoned to ensure the conclusion is true.

Rule inference engine functioned as executor of the rules by matching the facts knowledge of domain by defines the corresponding rules using forward chaining or backward chaining inference methods. Besides that, inference engine also must perform the conflict resolution technique to ensure the integrity of the derived conclusion. Working memory is stored the facts for rules interaction and validation of rules conditions (Abdullah et al., 2009).

RBR is a particular type of reasoning which uses "if-then-else" rule statements. As mentioned above, rules are simply patterns and an inference engine searches for

patterns in the rules that match patterns in the data. The "if" means "when the condition is true," the "then" means "take action A" and the "else" means "when the condition is not true take action B." Here is an example with the rule PROBABLE CAUSE:

```
IF robbery is TRUE
AND
suspect witness identification is TRUE
AND
suspect physical evidence is TRUE
AND
suspect lacks alibi is TRUE
THEN
probable cause is TRUE
ELSE
round up usual suspects
```

2.7.2.1 Forward Chaining

Rules can be forward-chaining, also known as data-driven reasoning, because they start with data or facts and look for rules which apply to the facts until a goal is reached.

2.7.2.2 Backward Chaining

Rules can also be backward-chaining, also known as goal-driven reasoning, because they start with a goal and look for rules which apply to that goal until a conclusion is reached.

2.7.3 Knowledge-based Related Study

A research conducted by Abdullah et al. (2009) has implemented a Rule Based System at MTBC for applying billing compliance rules on medical claims. Structured Query Language (SQL) was used to develop the rule engine. The used of

SQL has provided two benefits in this research. Firstly, this researches regardless the use of working memory in their system because of real-time processing in Microsoft SQL Server database. Secondly due to SQL server, rule engine is using dynamic method of updating, editing and execution of rules. The strength of this research is when a rule is represented as a query stored in database using a well-known SQL language. This produced more efficient, flexible, and powerful technology in processing the system result. Efficiency gain is due to splitting of a single query into pieces and thus avoiding table joins. This type of rule engine is useful for domains involving frequent updating of knowledge.

Another research defines a rule-based approach in developing a web-based (Tammet, Haav, Kadarpik, & Kaaramees, 2006). A complex web-based application was constructed by separating the business logic with web interface. The constructed web consists of 3 main parts: the application server, rule solver and middleware server that connected the rule system with database. The rule system is used for defining and implementing business logic rules. The strength of this research lies in defining integration approach between a rule system with relational database systems and between user interfaces using the middleware server.

2.7.4 Implication of Knowledge-based to this Study

While it may be surprising and perhaps unbelievable to many sceptics, most practices could benefit from the use of expert systems to some extent, even litigation. However, transaction-based practices, where fixed fee billing is the standard or may become popular, are best suited for full knowledge-leveraging.

Obvious areas to consider include banking, bankruptcy, estate planning, family law, immigration and naturalization, landlord-tenant, mergers and acquisitions, probate, patents, real estate and trademark. Additionally, compliance-related practices may also be appropriate for automation, including environmental, labour and employment, securities and tax.

2.8   Multi-criteria Decision Making (MCDM)

People always involve in decision making in their daily life although decision making process is difficult to handle especially involving multiple criteria. They sometimes make inappropriate decision as they are unable to make the decision wisely.

Multi-criteria Decision Making (MCDM) is also known as Multi-criteria Decision Analysis (MCDA) is a study of decision making for problems which has multiple objectives, is one of a general class of Operations Research models (Pourjavad & Shirouyehzad, 2011). It is a set of methodologies which is used to compare, rank and select multiple alternatives having multiple attributes. MCDM is a famous decision making process using technique and procedures of multiple conflicting criteria (Habiba & Asghar, 2009).

According to Corner and Kirkwood (1991) as cited in Pourjavad and Shirouyehzad (2011), MCDM is one of the best techniques to solve problems considering various criteria for decision making. Generally, predetermined of options in different criteria are comprise in MCDM and occasionally might be clash with each other including benefit, gender and cost.

2.8.1 MCDM Methods

There are several methods in MCDM as for instance Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) and Multi-attribute Utility Theory (MAUT). Each method has its own aspect and characteristics in assisting decision makers to find the best solution in order to solve decision problems.

Sauian (2010) stated that MCDM is basically an approach of solving decision problems involving many criteria, factors or objectives. The basic characteristics of the aims are that they are regularly conflicting to one another. Essentially, MCDM have been categorised by Zionts (1990) into Multiple-Criteria Mathematical Programming (MCMP), Multi-Criteria Discrete Analysis (MCDA), Multiple-Criteria Utility Theory (MAUT) and Negotiation Theory (NT).

Figure 2.16 shows the classification of MCDM methods by Fulop (2005). The MCDM methods are categorised into four main families. The MCDM families include are Cost Benefit Analysis (CBA), Elementary Methods, MAUT and Outranking Methods.
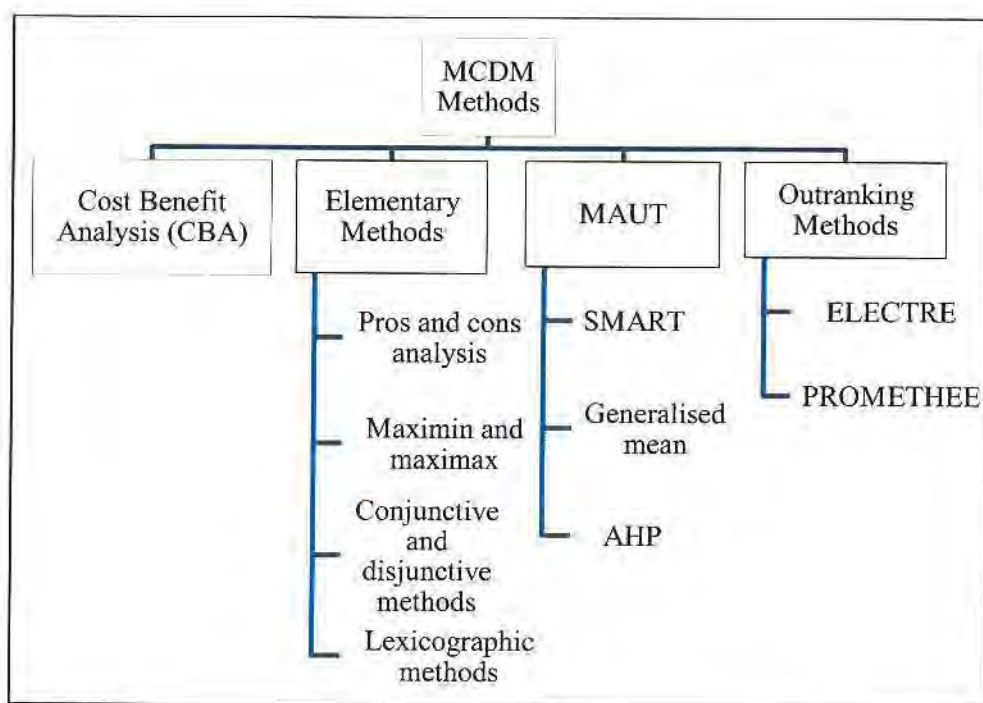
Figure 2.16. MCDM methods classifications

The common used method in decision making is CBA that estimates the costs and benefits of the options on financial base which widely used for guiding public policy (Fulop, 2005). Moreover, CBA has been used by Munda (1996) to integrate with environmental assessment and also used by US EPA (2013) as a guideline on economic analysis.

The simple and no computational elementary methods are required to carry out the analysis. These methods are well-suited with problems with a single decision maker, few options, and criteria that uncommonly characteristic in environmental decision making (Linkov et al., 2004).

In MAUT, the criteria that related with the weights are able to reveal the significance of the criteria merely if the scores a_{ij} are from a common, dimensionless scale. The

use of utility functions which is the basis of MAUT is capable to be applied in order to transform the raw performance values of the options to a common, dimensionless scale compared to various measures, both realistic (objective, quantitative) and judgmental (subjective, qualitative).

Besides, outranking methods commence that data accessibility are alike as for the MAUT methods necessity. The same data of the decision table must be used and options and criteria need to be specified. Elimination and Choice Translating Reality (ELECTRE) method basic concept is to deal with outranking relations by using pair wise comparisons among alternatives under each one of the criteria separately (Kahraman, 2008). Meanwhile, the score for data in PROMETHEE decision table is acceptable not to be normalized into a common dimensionless scale. Fulop (2005) assumes that the higher the score value, the better the performance is.

On the other hand, Salinesi and Kornyshova (2006) state that MCDM methods can be classified into six families as shown in Table 2.9. The families consist of Multi Attribute Utility Theory (MAUT), Analytic Hierarchy Process (AHP), outranking methods, weighting methods, expert classification and fuzzy methods.

Table 2.9

The Six Families of MCDM

Dimension	Facets	MAUT	AHP	Out-Ranking	Weighting	Fuzzy Methods	Expert Classification
Context	Problematic, choice	Yes	Yes	Yes	Yes	Yes	No
	Problematic, ranking	Yes	Yes	Yes	Yes	Yes	No
	Problematic, sorting	No	No	Yes	No	Yes	Yes
	Treatment of a new alternative	Yes	No	Yes	Yes	Different	Yes
	Taking into account of the multi-views	No	No	Yes	No	Different	Yes
Process	Approaches for defining evaluation	UCS	UCS	Outranking	UCS	Different	Iterative
	Approaches for decision criteria weighting	Yes, no interdep	Yes, interdep	Yes, interdep	Yes, no interdep	Yes, interdep	No
	Taking into account of various scales of criteria	Yes	No	Yes	No	Different	Yes
	Easiness of use	Difficult	Easy	Medium	Easy	Difficult	Difficult
Form	Notation	Utility function	Balanced sum	Textual	Weighted sum	Different	Textual
	Tools	No	Yes	Yes	Yes	Different	Yes, medical domain
Object	Data type	quan, qual	quan, qual	quan, qual	quan, qual	quan, qual	quan, qual
	Number of alternatives to be treated	Great	Small	Great	Great	Different	Great
	Treatment of incompatibility, alternatives conflicts	Yes	No	Yes	No	Yes	No
	Hierarchicality	No	Yes	No	No	Different	Yes

2.8.2 MCDM Techniques

Techniques used in decision making are still enhanced by the developers in order not only to improve the capability some fields, but they are trying to fulfil as much as areas as they would namely business, engineering, medical as well as telecommunication. These are among the reviewed analysis of each decision techniques relating to MCDM.

2.8.2.1 The Weighted Sum

The Weighted Sum Model (WSM) is one of the frequently used techniques in MCDM. This simple technique has additive utility assumption as the basic principle. The idea is, the alternative with the largest cumulative value is the best if the performance of each alternative for example the a_{ij} values (is of the same unit where higher is better) is assessable.

In WSM, the best alternative if there are m alternatives and n criteria, is any alternative that fulfils the formula (Fishburn, 1967):

$$P^*_{WSM} = \max_i P_i = \max_i \sum_{j=1}^{n} a_{ij}\, w_j \text{ , for } i{=}1,2,3 \ldots m$$

Next, Pi values for each alternative are allowed to be ranked accordingly, but the alternatives processes should be in numerical and conveyed in the same unit in WSM. However, multi-dimensional criteria may create a disruption because of the assumption of additive utility.

Besides, single dimensional value functions will exist if one employs an approach based on trade-offs and the data are not expressed in the same unit (Triantaphyllou & Baig, 2005).

2.8.2.2 Lexicographic

Lexicographic optimization would be defined as the computing process of a lexicographic minimum or maximum solution of a multi-criteria problem (Zheng, Wu, & Ling, 2010) and it gives more flexibility to deal with conflicting options in difficult combinatorial problems without the need to set up a priority for fixed preference values (Castro-Gutierrez, Landa-Silva, & Moreno-Perez, 2010).

Siti Mahfuzah and Norshuhada (2010) have studies on several MCDM methods in order to solve decision making problems. One of the methods is Lexicographic Method which criteria are ranked based on their ranking. The most important measure that has the best performance score of alternative is selected. The performance of the tied alternatives on the next most important measure will be matched if there are any draws until the process found a unique alternative (Linkov et al., 2004).

Lindeneg (2009) stated that Lexicographic method able to assist decision making involving multi-criteria alternatives. The formula for this method is:

$$maxF_i(x) \qquad i = 1, ..., k$$

$$st. \; g_j(x) \qquad \leq \qquad b_j$$

$$F_h \qquad = \qquad x^{i-1}$$

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Lexicographic method which is classified under elementary method in the MCDM classification is simple and not required computational support in order to perform the analysis.

2.8.2.3 Simple Multi-Attribute Rating Technique (SMART)

According to Fulop (2005) SMART is a method to evaluate the weight for each of the criteria to show the significance to the decision. The criteria are weighted and then multiplied by the scores of each package for all the criteria. Other than that, SMART use weighted linear average, which gives an extremely close approximation to the utility functions (Guitouni, 1997).

SMART is the simplest form of MAUT methods which involved a simple additive model (Fulop, 2005). The additive models are as follow:

$$X_j = \sum_{i=1}^{m} w_i \, a_{ij} \ / \ \sum_{i=1}^{m} w_i \, , \quad j = 1,...,n$$

Bahari, Ali, Zain, and Nee (2006) also describe the same algorithm in their study but using different variables to indicate each elements where,

$w_i =$ weighting scale which respect to j on m criteria

$a_{ij} =$ utilities for alternative i on criteria j

SMART consists of eight steps (Goodwin & Wright, 2004) to solve a problem. The steps are as follows:

Step 1: Identify the decision maker

Step 2: Identify the alternative ways of action.

Step 3: Identify the attributes which are applicable to the decision problem.

Step 4: allocate values to measure the performance of the alternatives on each attributes.

Step 5: Identify a weight for each attribute.

Step 6: Take a weighted average of the values assigned to on each alternative.

Step 7: Make a conditional decision.

Step 8: Carry out sensitivity analysis to achieve the final result.

Besides that, SMART too allows for weighting for each criterion to reflect its relative significance to the decision. The weighting method involves a few steps. The first step is, 10 points are allocated to the lowest significance condition and ranked for implication. After that, the lowest significance condition is selected and extra points will allocated. This stage is repeated iteratively to reflect their relative importance. Next, the sum of the points will be normalizing to one in order to obtain the final weights. This method allows the diverse scales of criteria and handles a great number of alternatives (Fulop, 2005).

Moreover, according to Demirci, Ayar, Kivrak, and Arslan (2009) SMART technique is straightforward which is uncomplicated and unobligated much time in decision making. Those traits make this technique becomes more effective than other techniques. Some other techniques involve a complicated calculation to obtain the final results. SMART also allows changes in alternatives' number and the changes will not affect the quality of final results.

Besides, changing the number of alternatives in SMART will not change the decision scores of the original alternatives and this is useful when new alternatives are added (Valiris, Chytas, & Glykas, 2005). They also argued that using SMART in performance measures can be a better alternative than other methods.

2.8.2.4 TOPSIS

Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS) is one of the methods to solve decision making problem. According to Opricovic and Tzeng (2004), the fundamental principle is that the chosen alternative must have the shortest distance from the ideal solution and the farthest distance from the negative-ideal solution. The TOPSIS procedure consists of the following steps:

(1) Calculate the normalized decision matrix.

(2) Calculate the weighted normalized decision matrix.

(3) Determine the ideal and negative-ideal solution.

(4) Calculate the separation measures, using the n dimensional Euclidean distance.

(5) Calculate the relative closeness to the ideal solution.

(6) Rank the preference order.

TOPSIS is a technique based on an aggregating function representing "closeness to the ideal" (Pourjavad & Shirouyehzad, 2011). Gangurde and Akarte (2011) in their study stated that, ideal solution is the solution that minimizes the benefit. Meanwhile solution that maximized the benefit is the negative-ideal solution.

Using this method, performance values represented in decision matrix is computed with respect to each criterion. The best value of alternative is the ideal solution and the worst value of alternatives is the negative-ideal solution. However, TOPSIS still requires the specification of weighting on objectives.

2.8.2.5 The Weighted Product Model

Instead uses addition in WSM, multiplication is used by the Weighted Product Model (WPM) technique to rank alternatives. The method compares each alternative for a number of ratios (one for each condition). Subsequently, respectively ratio is elevated to the power of the relative weight of the equivalent condition (Triantaphyllou & Baig, 2005).

Dimensionless analysis is resulting from units of measure eliminated by WPM. Hence, both single and multi-dimensional decision problems are accessible for the technique.

2.8.2.6 The Analytic Hierarchy Process

Analytic Hierarchy Process (AHP) is developed by Thomas L. Saaty in the 1970s. It is a technique which builds a decision-making problem in various hierarchies as goal, criteria, sub-criteria, and decision alternatives. In order to make the best decision among various alternatives, the AHP technique calculates the relative significance of elements at each level of hierarchy and assesses the alternatives at the lowest level of the hierarchy (Sipahi & Timor, 2010).

This technique is able to attract most of researchers and practitioners where the aij values of the decision matrix in AHP are normalized vertically. The features of each column in the decision matrix added up to one and this process is dissimilar with WSM. Therefore, once all the criteria indeed some benefits, dimensionless is formed by values with units of measurement. The following expression is fulfilled by the best alternative.

$$P^*_{AHP} = \max_i P_i = \max_i \sum_{j=1}^{n} a_{ij}\, w_j \text{ , for } i=1,2,3 \ldots m$$

This formula is alike with WSM, however the highlight is for the aij values that have been regulated (Triantaphyllou & Baig, 2005). Eliciting judgments approach has been used by Saaty (1980) to relate between two decision-making items of a single condition which is a set of options or a set of criteria at a time. The scale measurement for converting linguistic into numerical statements is used for the approach.

In AHP, the decision problem is mapped in hierarchical form to list the possible criteria and sub criteria accordingly from the most general to the most specific. This will narrow down the decision alternatives corresponding to the possible criteria thus assist people in making the right decision. This technique supports complex decision-making task involving multiple criteria.

According to Forman and Gass (2001), in a multi-criteria environment, the main use of the AHP is the resolution of choice problem. In that mode, its methodology comprises the alternatives and objectives that are compared in a natural, pair wise

manner. Individual preferences have been converting by this method into ratio-scale weights that are joined with linear additive weights for the related options. The options will be ranked by the weights result to assist the decision maker in making a selection.

Al-Azab and Ayu (2010) in their study give the guidelines on the steps taken to get the decision using AHP method as following:

i. Alternatives and criteria are identified.

ii. Pair wise comparison is constructed by creating the priorities for the existing criteria.

iii. Then, each pair is compared based on the utmost criterion.

iv. A matrix of the pair wise evaluation score is created to determine the significances for the available measures.

v. The contribution to the overall goal is calculated for priority of choosing the best between available alternatives.

This is followed by three steps so as to obtain a worthy estimate result.

i. Sum of each column in the matrix is calculated.

ii. Each of elements in the pair wise comparison matrix is divided by its column total. The resulting matrix is refers as Normalized pair wise comparison matrix.

iii. The average of elements in each row of the normalized pair wise comparison matrix is computed. This average shows the priorities for each criterion.

The major goal of AHP is to find candidate out a set of alternatives that best satisfies a set of criteria (Schmitt, Dengler, & Bauer, 2002). According to Triantaphyllou and Mann (1995), AHP is an approach based on the pair wise comparison which is used to determine the relative important of each alternative in terms of each criterion.

By using pair wise comparison, the pertinent data are derived. These comparisons are used to gain the weights of importance of the decision criteria, and the relative performance measures of alternative based on each individual decision criteria. Besides that, Triantaphyllou and Mann (1995) also claimed that AHP has nice mathematical properties of the method and the required input data are easy to obtain.

Using AHP, the decision problem is decomposed into sub criteria from general to specific in a hierarchical form. This will narrow down the decision alternatives thus facilitate people in making the right decision for them. This technique supports complex decision making task involving multiple criteria.

In short, Analytic Hierarchy Process (AHP) becomes the selected technique by Sipahi and Timor (2010) to be embedded in the system because it has been a favourite decision tool for research in many fields due to its simple and flexible mathematic. Furthermore, Coyle (2004) claimed that the key benefit of the AHP is its capability to rank set of choices in order of their efficiency in meeting contradicts objectives. He also highlighted that, AHP calculation is not complex and is a worthwhile method for discriminating between computing choices in the lights of a variety of objectives.

2.8.2.7 Implications of MCDM to the Study

MCDM introduces a variety of techniques that could be used to satisfy various area of decision making. Though, the issues of complex and structured mathematical model as shown before might reduce the interest among decision-makers to create a more sophisticated decision aid in the future. Therefore, PT and MI theory are fit to be personalized to the MCDM method to increase the accuracy of decision making aid. This improvised model will lead to a conceptual design model.

As highlighted, MCDM techniques able to accomplish various area of decision making. The techniques contain MAUT which is one of the MCDM; including The Weight Sum, Lexicographic, SMART, TOPSIS, The Weighted Product Model and AHP. Essentially, some of the techniques are quite the same in using ranking strategies and some are different. However, each technique has its own strengths in dealing with decision problems. Therefore, relevant technique and criteria as well as related theoretical foundation should be identified to be used as major components for the construction of design model of YouthPDA.

2.9 Related Works of Decision Aid

Many studies have been carried out for the decision making aids, which help users including youth in determining the best solution for their needs. One of them is Measy.com where this aid comprehends a process-of-elimination gadget finding engine that helps people find the perfect gadget. It also makes complex purchase decisions simpler. Measy helps the user make decision through inquiring a series of questions about the gadget they want and based on user criteria, the top three choices have been provided. There are three simple steps how Measy works:

i.   choose the category of the product they want such as net books, digital cameras, smart phone or printer.

ii.   answer simple question regarding the product features and criteria.

iii.   the system will provide the recommendation by matching the criteria and come out with the best product for the user.

However, the implementation of the decision aid itself is more important to sustain the best results to the user. Hence, there are few studies that explain on the methods used in the decision aids.

2.9.1 Personalized Decision Aid for Mobile Phone Selection

Based on Chen et al. (2010), AHP-based tool was demonstrated to construct a web-based aid system. They have led a measured experiment that concentrate on content and system satisfaction through 244 mobile phone users in order to experimentally evaluate the prototype.

Besides, this research also evaluate on standard systems constructed on ranking analysis as well as a comparative baselines using equal weight-based system. To construct effective recommendation systems, the findings propose the feasibility and significance of using AHP. In general, this study provides an impact to investigation and practice in aid systems and assists in constructing a mobile phone aid system mainly for online stores and users.

Figure 2.17 illustrates a screen shot of the system interface in the study. It shows the result of the mobile phone that system would recommend for the user based on user preferences.

Figure 2.17. Sample screen for personalized decision aid for mobile phone selection (Chen et al., 2010),

2.9.2 MCDM in Lightweight Concrete for Floating Houses

Nekooie, Mohamad, and Mahdinezhad (2011) have reviewed the new modified VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) in Serbian, which means: Multi-criteria Optimization and Compromise Solutionmethod based on fuzzy linguistic variables. This research determines the most resistant Lightweight concrete mixtures to enable the concrete floating in different conditions. Evaluation on alternatives performed by fuzzy linguistic variables extracted from semi-Delphi method.

Selecting of Lightweight aggregate for floating part of floating houses is frequently influenced by uncertainty in practice. Besides, the fact that determining the precise values of the criteria is difficult or impossible causes to consider them as fuzzy linguistic terms. By providing a maximum group utility for the majority, this approach determines a compromise solution. Using of Expanded Polystyrene (EPS) beads is suggested by this research as a lightweight aggregate in floating house. On the other hand, using of agricultural waste aggregates such as Oil Palm Shell (OPS) has enough possibility for performing in floating pontoons based on VIKOR mechanism.

2.9.3 MCDM System using AHP Method

This study is approximately on the use of AHP technique to assist decision makers sort out decision on certain problems. The precise and suitable result will be delivered based on the user's criteria and options. Through this system, users are able to get the final result of the decision (by presenting the best alternative based on the most significant criteria) in an appropriate, consistent and faster technique.

The system has been successfully established by Al-Azab and Ayu (2010) using AHP technique to provide chances for users to assist them in their decision by discover the best selection. However, there are still many modules for forthcoming improvement such as accumulate the number of options and criteria, generating forum, and constructing a decision library in order for the system to be more reliable, agile and user effective. A sample screen for the system interface is presented in Figure 2.18.
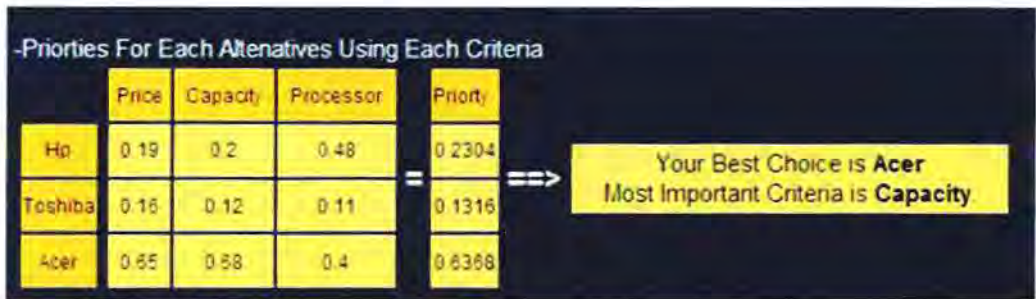
Figure 2.18. Sample screen of the final result (Al-Azab and Ayu, 2010)

The system will recommend the best alternatives to the user base on the highest rank. The study concludes that AHP is a flexible, consistent tool and a best technique to resolve user problems in a faster and flawless way.

2.9.4 An Enhanced Hybrid Fuzzy MCDM for Vendor Selection

The study by Vahdani, Alem-Tabriz, and Zandieh (2009) focuses on developing an empirically based framework for formulating and selecting a vendor in supply chain. The researchers relate the fuzzy set theory to evaluate the vendor selection decision by applying AHP in obtaining criteria weights and applied TOPSIS for obtaining final ranking of vendors. Experimental study through vendor selection that has been carried out has clarified the usefulness of the model.

In this research, the use of AHP method in obtaining criteria weight, and apply TFN to assess the linguistic ratings given by the evaluators. By using TOPSIS, aggregate the weight of evaluate criteria and the matrix of performance to evaluate the three vendors.

2.9.5 MCDM to Evaluate Mobile Phone Alternatives

Based on the Isiklar and Buyukozkan (2007), the objective of this research is to propose a multi-criteria decision making (MCDM) approach to evaluate the mobile phone selection according to the users' preferences order. In this study, a survey has been conducted among target group in order to identify the features influencing mobile phone selection.

The method used in this study is AHP and TOPSIS. AHP is applied to identify the relative weights of the evaluation criteria while TOPSIS technique is used to rank the mobile phone alternatives.

There are three main steps in the evaluation procedure of this study. The steps involved are identifying the mobile phone selection criteria that are considered the most important for the users. The criteria are illustrated in a hierarchy and the weights are calculated using AHP method. The final ranking results are achieved by conducting TOPSIS method.

The findings from this study show that methods used are appropriate in evaluating the selection of mobile phone and give the most accurate decision when purchasing a phone. The AHP method also may be used to rank mobile phone alternatives.

2.9.6 SMART Decision Support System

This decision aid tool is developed in University College Dublin. This tool adopts SMART in order to solve a problem. The user needs to define their problems, alternatives and attributes on the given field. Then, the user needs to rank the

attribute based on their preferences. The system will then weigh the attributes' rank and display the result to the user. Figure 2.19 shows how the results will be displayed to the user.
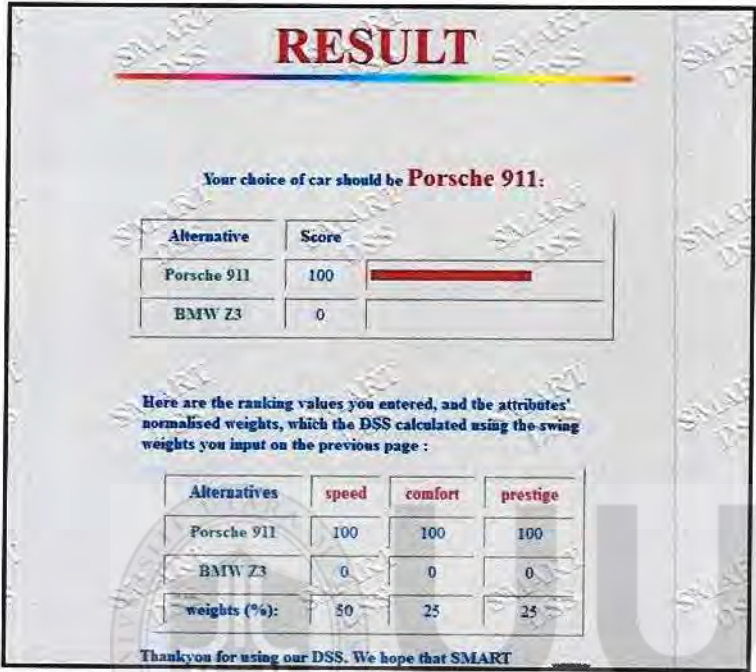
Figure 2.19. SMART decision support system

SMART is a simple tool that could be used in determining choices. The ranking styles that have been applied will effects the weightage of each alternative, and will contribute the recommendation to users.

2.9.7 Hunch Website

Mukherjee (2009) describes Hunch as an online personal decision making tool that assists people in making decision by asking the relevant questions related to their problem. Hunch requires users to sign in with them before using their service. Hunch website will suggest the opinions based on the collective knowledge of the whole Hunch member.

The users need to input their problem in a box given. Then, Hunch will ask the user to answer a few questions as in Figure 2.20. However, user is given the option to skip any question if they want to. Based on the answer, Hunch will suggest the appropriate alternative for the user.

Figure 2.20. Example of question for the user (Hunch, 2013)

2.9.8 Petri Logic

Rule-based decision making was used by Lee, Liu and Chiang (1999) to an application to the damage assessment of the Da-Shi Bridge in Taiwan. Petri Net-based Expert System (FPNES) has offers more informative results because the explanation provided in the system and the confidence level of the conclusions can be used as a way of justification on whether to take the recommendations (Figure 2.21) into account or not.

A fuzzy Petri nets approach to modelling fuzzy rule-based reasoning is proposed to bring together the possibility entailment and the fuzzy reasoning to handle uncertain

and imprecise information. Major features of FPNES include: knowledge representation through the use of hierarchical fuzzy Petri nets, a reasoning mechanism based on fuzzy Petri nets, and transforming modularized fuzzy rule bases into hierarchical fuzzy Petri nets.

The efficiency of rule-based reasoning is improved by designing an efficient reasoning algorithm based on fuzzy Petri nets. The explanation of how to reach conclusions is expressed through the movements of tokens in fuzzy Petri nets. The hierarchical fuzzy Petri nets make the handling of complex systems easy and facilitate reusability.
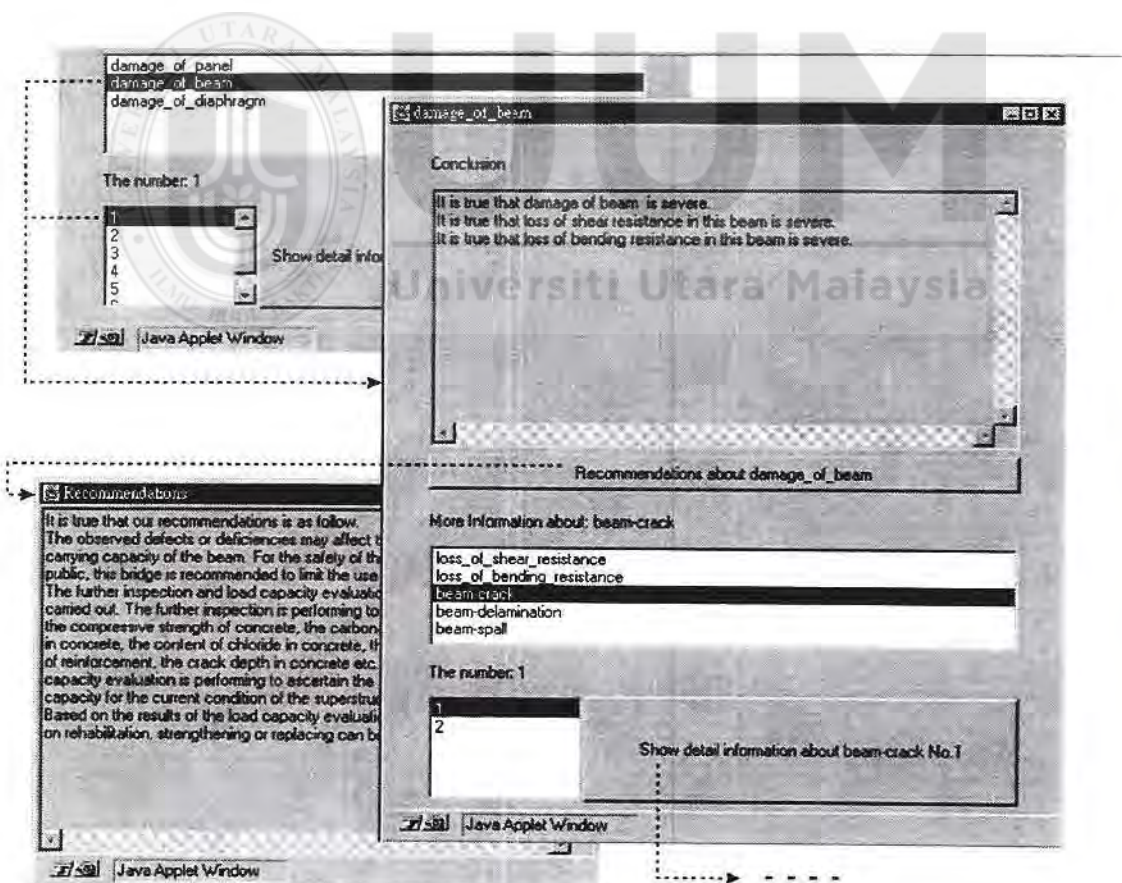
Figure 2.21. Recommendation to user based on result of damage (Lee, Liu and Chiang, 1999)

2.9.9 Implications of Related Works to the Study

Literature reviews in the early parts of this sub-section have shown that decision techniques used in each decision aid is one of the significant criteria, besides the design, layout or others.

In the related decision aids revised, most of the study is on AHP where researchers agree that AHP is a flexible, reliable tool and gives the most accurate decision in purchasing. Besides, the other techniques used including SMART, VIKOR and TOPSIS have positive feedback where they are also capable in solving the decision problems.

AHP and SMART methods used ranking styles in obtaining criteria weight while TOPSIS cumulate the weight of the evaluation criteria and the matrix of performance to evaluate alternatives that contribute the recommendation to users. To sum up, the chosen techniques in decision making aid must be accurate and precise as these criteria generally only able to solve some decision problems.

2.10 Summary

In the nutshell, theoretical concepts for this study is briefly discussed and explained in this chapter. It gives a clear view of the area that has been focuses in the literature review section. Design model, decisions making techniques, tools and method that will be used in the study have been explained. For this study, Knowledge-based that consists of Rule-based and Case-based Reasoning as well as the MCDM techniques were identified including Lexicographic method and Simple Multi Attribute Rating Technique (SMART). Computerised Decision Aid is the application of DSS to assist

the users in decision making. Apart from that, theories and guidelines in decision making are among the ingredients that must be gathered for a good decision making tool. The overview of the reviewed literature is shown in Figure 2.22.
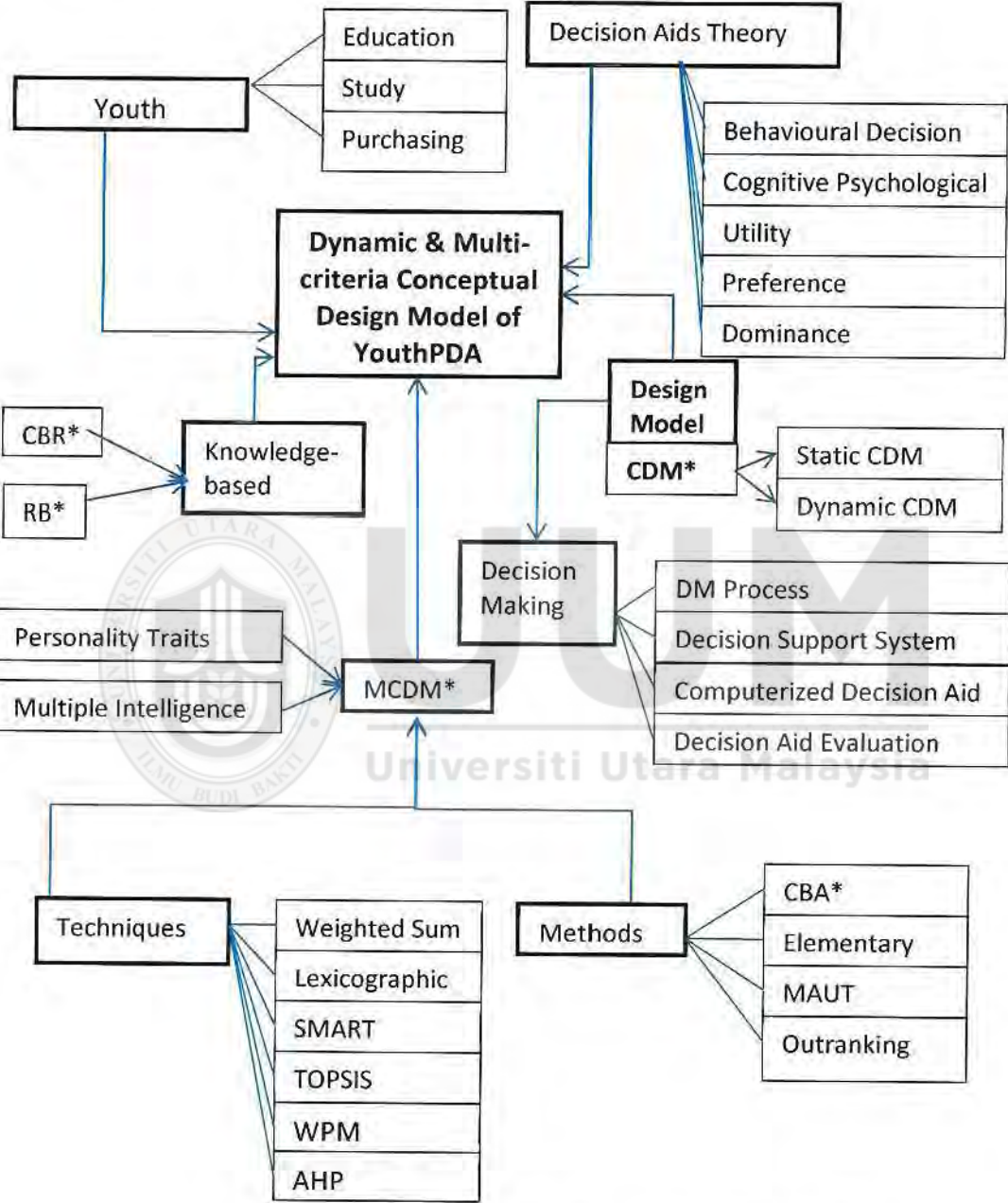
CDM* = Conceptual Design Model
CBA* = Cost Benefit Analysis
MCDM* = Multi-criteria Decision Making
CBR* = Case-based Reasoning
RB*   = Rule-based

Figure 2.22. Overview of the literature study

CHAPTER THREE
RESEARCH METHODOLOGY

3.1 Introduction

This chapter describes the process involved in the realism of the outlined objectives. Methodological approach that consists of all the processes is adapted from design science research in information system. It will demonstrate the whole flow of a project by detailing each phases involved as well as the relationship the outcomes and research objectives.

3.2 Design Science Research

Design science research (DSR) is one of the research paradigms that produces and assesses IT artefacts proposed to resolve recognised organizational problems. The artefacts are signified in an arranged form of various software, formal logic, and rigorous mathematics to ordinary language descriptions. There are roots in engineering and the sciences of the artificial of the design-science paradigm (Simon, 1996). It is fundamentally a problem solving paradigm. The idea is to create innovations through the analysis, design, execution, organisation, and use of information systems that describe the ideas, practices, technical capabilities, and products that able to be effectively and efficiently accomplished (Denning, 1997; Tsichritzis, 1997).

Appropriate process in design science research has been suggested by many researchers. Peffers, Tuunanen, Rothenberger, and Chatterjee (2008) review and evaluate the process for conducting design science research in information systems. March and Smith (1995) and Vaishnavi and Kuechler (2009) also carry out the

design research processes in their work. On the other hand, Hevner and Park (2004) have proposed seven design research guidelines as shown in Table 3.1 to assist researchers to understand the requirements and structuring suitable process for the approach.

Table 3.1

Guidelines for Design Research (Hevner & Park, 2004)

Guideline	Description
Guideline 1: **Design as an Artefact**	Design-science research must produce a viable artefact in the form of a construct, a model, a method, or an instantiation.
Guideline 2: **Problem Relevance**	The objective of design-science research is to develop technology-based solutions for important and relevant business problems.
Guideline 3: **Design Evaluation**	The utility, quality, and efficacy of a design artefact must be rigorously demonstrated via well-executed evaluation methods.
Guideline 4: **Research Contributions**	Effective design-science research must provide clear and verifiable contributions in the areas of the design artefact, design foundations, and/or design methodologies.
Guideline 5: **Research Rigor**	Design-science research relies upon the application of rigorous methods in both the construction and evaluation of the design artefact.
Guideline 6: **Design as a Search Process**	The search for an effective artefact requires utilizing available means to reach desired ends while satisfying laws in the problem environment.
Guideline 7: **Communication of Research**	Design-science research must be presented effectively both to technology-oriented as well as management-oriented audiences.

Thus, design research is relevant to be adopted in conducting this study based on several aspects. The most important outcome from this study is the artefact (instrument design, model used and prototype), will be provided by this approach.

Other than that, evaluation that will be conducted in this study as well as other activities will utilize the existing guidelines of design research based on phases that will be discussed in next section.

In order to increase the reliability of the results in this study, Triangulation Methodology is able to combine qualitative and quantitative methods in studying the same research phenomenon (Risjord, Moloney & Dunbar, 2001). In addition, Norshuhada and Shahizan (2010) stress that design research based on Iterative Triangulation Methodology (ITM), triangulates theoretical, development and empirical aspects of research to achieve the design research objectives.

3.2.1 Qualitative Research

Qualitative research offers understandings into the problem, by helping to develop ideas or hypotheses for possible quantitative research. This type of research is used to increase a thought of essential causes, ideas, and enthusiasms. The enquiry in the research are inaccessible from individual's personality and conditioned behaviours, but within the social, family, organisational, community (Patton, 2015). Qualitative data collection methods are using unstructured or semi-structured techniques. The method measures the trends by exploring the issues in greater depth comprising focus groups, individual interviews, and participation or observations. The respondents are selected to fulfil a given quota with a small sample size.

3.2.2 Quantitative Research

Quantitative research is designed for measuring thoughts, attitudes, behaviours, and other definite variables. The quantifiable data is used to convey proofs and reveal the research's patterns by producing data that can be changed into functional statistics. Quantitative data collection methods include different practices of studies such as online paper, mobile and kiosk surveys. The other approaches that can be applied are face-to-face and telephone interviews, longitudinal studies, website interceptors, online polls, and systematic observations such as experimental design (Balnaves & Caputi, 2007). The method uses more structured data and bigger number of respondents compared to Qualitative data.

3.3 Research Methodology Phases

The key idea of this research is to develop a conceptual design model that could support computerized personal decision aid among youth. In order to achieve this, the research methodology will be based on proposed research process by Offermann, Levina, Schonherr, and Bub (2009), which consists of three main phases:

i.   **Problem identification**: identify gaps, preliminary study, literature research, pre-evaluate relevance (hypothesis development), and consultation with experts

ii.   **Solution design**: design artefacts and additional literature research

iii. **Evaluation**: Hypothesis refinement, expert reviews, experimental studies, case study and data analysis

The realism of underlining outcomes will be determined by the research processes suggested by Offermann et al. (2009), that will be based more on the first (design as artefact), second (problem relevance) and fifth (research rigor) in the design science guidelines. The process involved is more focused on design and action where all the processes or activities in the three phases iteratively executed to deliver artefacts in achieving the outlined objectives.

All phases were interacted with each other and divided into steps as presented in Figure 3.1. The involved activities are the steps required in the research process and not necessarily executes in sequence. The artefacts that are listed in the outcome column are the consequence of processes that have been emphasised on. Details of each phase with its processes are elaborated in the next subsections.

PHASE	ACTIVITY	OUTCOME

PROBLEM IDENTIFICATION

- Literature research
- Preliminary study
- Consultation with experts
- **Identify gap** → Research problems
- Pre-evaluate relevance → Proposed aim and objectives

SOLUTION DESIGN

- Additional literature research
- Design artefacts
- Instrument design

- Objective 1 achieved → Relevant decision making criteria, techniques, and theories for YouthPDA
- Objective 2 achieved → Conceptual design model for YouthPDA
- Prototype of YouthPDA using inclusive modelling approach
- Instrument

EVALUATION

- Hypothesis development
- Experts review
- Experimental study
- **Data Analysis**

- Objective 3 achieved → Validate Conceptual design model
- Objective 4 achieved → Measure usefulness of YouthPDA
- Research publications and thesis

Main aim achieved

Figure 3.1. Phases in the research process

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3.4   Phase 1: Problem Identification

This is the first phase for the problems to be identified. The main processes involved in this phase are summarized in Figure 3.2, consist of identify research gap, literature research, preliminary study and hypothesis development to verify the research gaps. The intended outcomes from this phase are the research problems and research objectives.
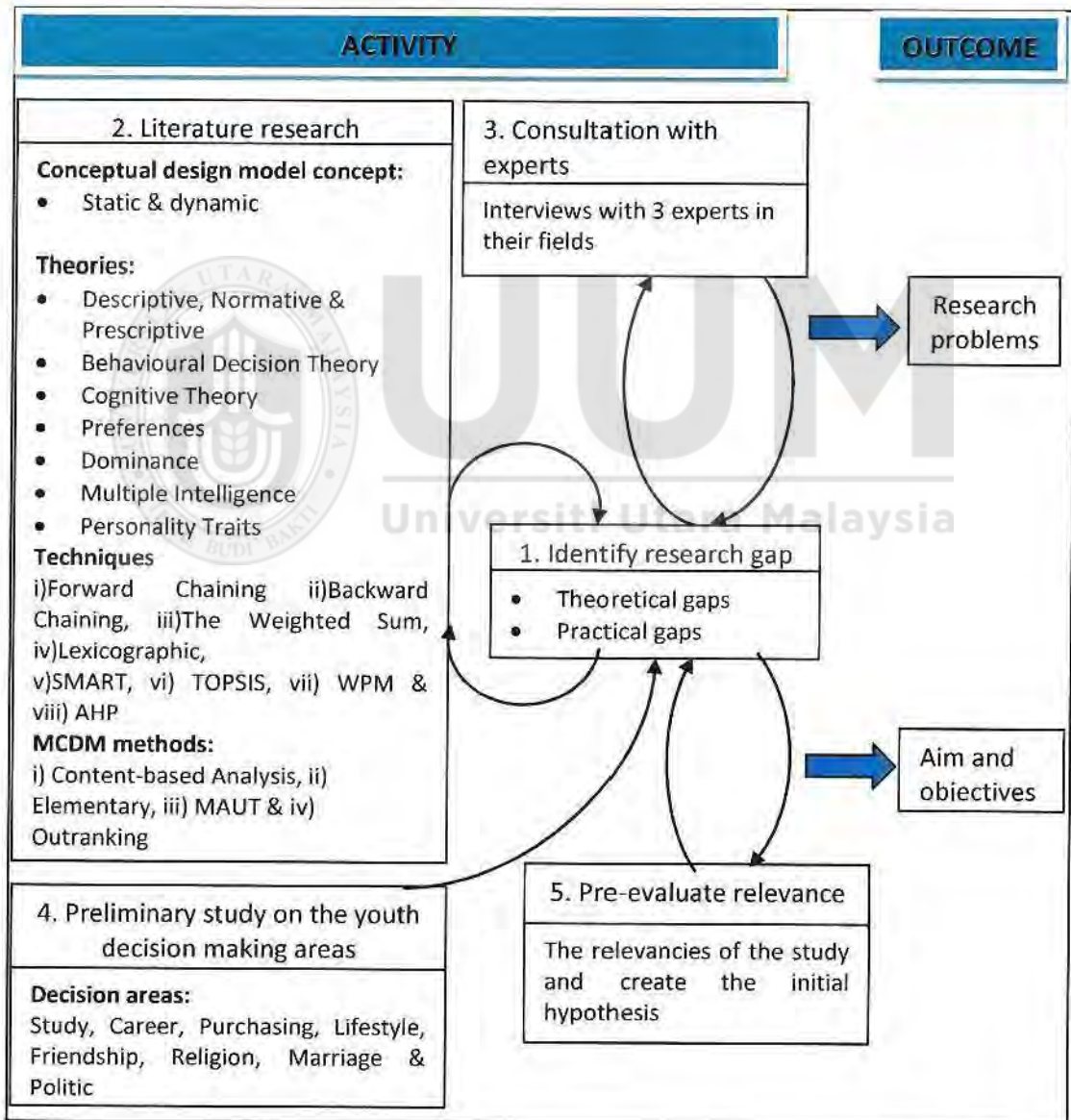
Figure 3.2. Phase 1 – Problem Identification

3.4.1 Identify Research Gap

Theoretical framework is one of the criteria that need to be fulfilled to find research gaps (Norshuhada & Shahizan, 2010). Other than that, the theoretical gaps as well as practical gaps in currently scenario of youth decision making practices were recognized in this study.

Current issues on youth have been discussed in Chapter 2 where the findings were integrated with a number of theories that concerned with the problems. The problems that have been identified and generalised should be of interest and relevance to more entities (Offermann et al., 2009) such as the youth.

Therefore, youths which are the most computer users need a mechanism to help them in many areas of decision-making.

3.4.2 Literature Research

Content analysis for the area of the identified problems can be used in literature research process by reviewing listed decision techniques, criteria, as well as decision theories as mentioned in Chapter 2. Figure 3.2 demonstrates the theories reviewed which includes conceptual design model concept, decision making theories including PT and MI, and also decision techniques and criteria. This is one of the ways to discover the components needed in constructing conceptual design model for YouthPDA.

3.4.3 Consultation with Experts

Expert interview is one of the practices to identify the relevancies of the addressed problems. This consultation comprises of suggesting of ideas and concepts, current trends of youth, technology involved, as well as reviewing on research material.

The experts consist of three dedicated individuals who are dominant in the field of Multimedia, Youth Behaviour and Software Engineering with vast number of experience.

3.4.4 Preliminary Study

Preliminary study for this research was conducted to identify the area that is most applicable for youth to utilize the PDA. Besides, this preliminary study is intended to know the aid types in each of the mentioned area as well as trying to figure out their intention to use the aid if provided. An online questionnaire was developed with 22 mixed format questions. The youths' responses were analysed, the complete findings and discussions for the preliminary study are discussed in Chapter 1.

3.4.5 Pre-evaluate Relevance

The purposes of the study have been recognized through the problems arose in the preliminary study. Based on the suggested solution to the problems, four research questions (RQ) were formed (Chapter 1) to pre-evaluate the relevancies of the study;

RQ1: What are the relevant decision making criteria, techniques, and theoretical foundations for the youth PDA?

RQ 2: How to construct a conceptual design model for the youth PDA?

RQ3: How useful is the conceptual design model of the youth PDA?

RQ4: Is there any positive correlation between dimensions in usefulness of the youth PDA?

Thus, the finding from this phase is the initial hypothesis that was created to propose the possible solutions to the stated questions as described precisely in Chapter 4. The general hypothesis is decision making application is able to increase the usefulness of the aid in order to help youth in making decision. Besides, there are four Research Objectives (RO) in Chapter 1 satisfied the listed Research Questions (RQ) as visualises in Figure 3.3 as part of the processes in Phase 1 of this study.

RQ1: What are the relevant decision making criteria, techniques, and theoretical foundations for the youth PDA?

RO1: To identify relevant decision making criteria, techniques, and theoretical foundations for YouthPDA.

RQ 2: How to construct a conceptual design model for the youth PDA?

RO2: To construct a conceptual design model for YouthPDA using the identified decision making criteria, techniques, and theoretical foundation.

RQ3: How useful is the conceptual design model of the youth PDA?

RO3: To validate the conceptual design model of YouthPDA through experts review.

RQ4: Is there any positive correlation between dimensions in usefulness of the youth PDA?

RO4: To measure correlation between dimensions in usefulness of YouthPDA via prototyping.

Initial Hypothesis: Decision making application able to increase the usefulness of the aid in order to help youth in making decision

Main objective: a conceptual design model that intended designed for youth called Youth Personal Decision Aid (YouthPDA).

RQ: Research Question

RO: Research Objective

Figure 3.3. The relevancies of the study

3.5   Phase 2: Solution Design

The solution design is the second phase that contains additional literature research and the development of design artefacts. A solution in the form of three artefacts has been developed to overcome the research problems that were identified in the first phase. The main outcome from this phase is a conceptual design model for YouthPDA; i) relevant decision making criteria, techniques, and theories, ii)

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conceptual design model for YouthPDA, as well as iii) the prototype that is mainly designed to attain objective 1 and objective 2 of this study as depicted in Figure 3.4.

3.5.1 Additional Literature Research

Additional literature research is an extended from the literature research process in Phase 1. This literature research was given more details on the relevant scientific publication especially related to designing the artefacts especially in the decision making techniques, design model, prototypes and research instrument. Accordingly, each designed artefact in this phase will be referred to theories and framework discussed in Chapter 2 as well as based on concrete evidence from this additional literature.

3.5.2 Design Artefacts

Artefacts are the most essential products for design research. Thus, the results as showed in Figure 3.4 are the four outcomes that comprise of decision making techniques for YouthPDA, conceptual design model of YouthPDA, prototype of YouthPDA from selected areas that were produced in this phase, besides the instrument that has been used for evaluation.
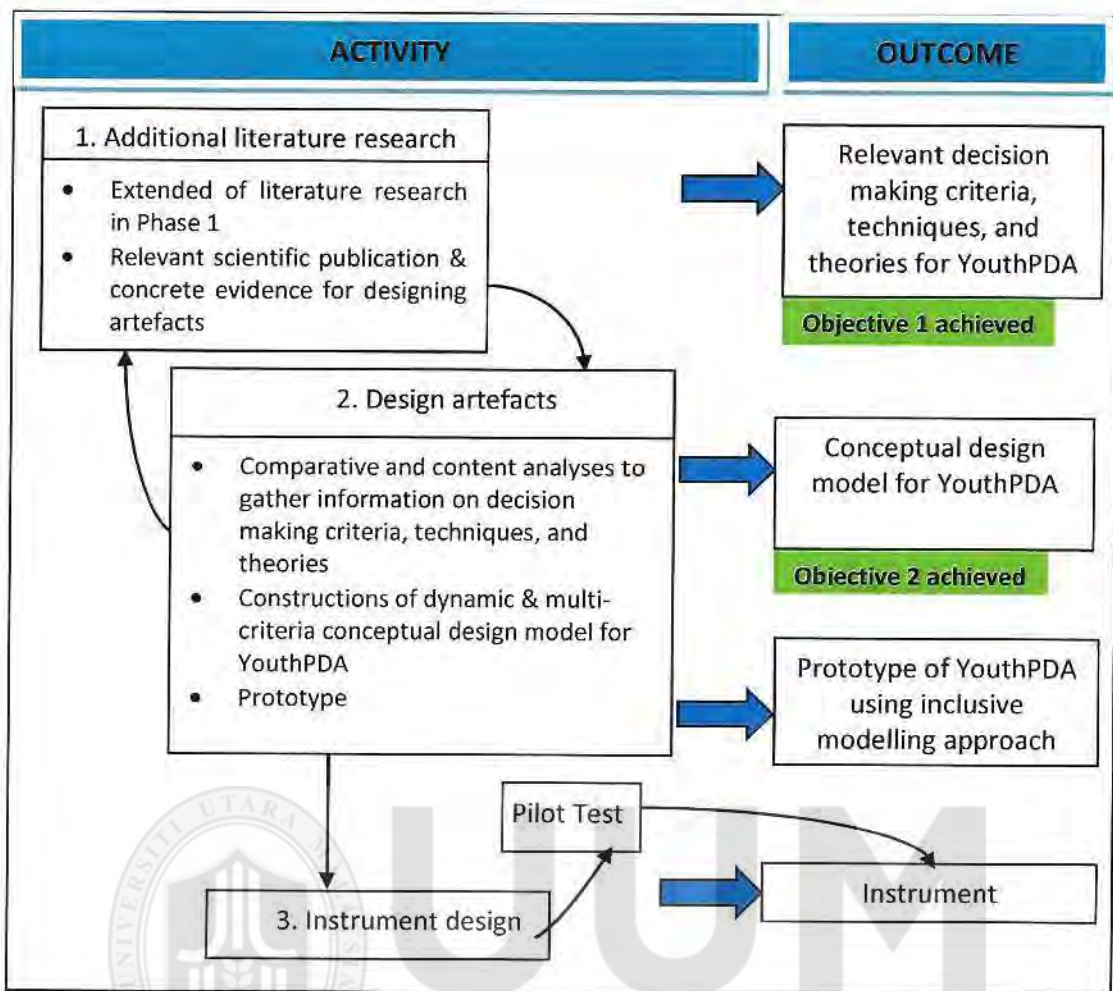
Figure 3.4. Phase 2 – Solution Design

3.5.2.1 Decision Making Criteria, Techniques, and Theories

Multi-criteria in the decision making are one of major components in the development of a design model. The criteria of the youth should be dynamic and in line with their development. It should not be pre-determined by the decision making application designer as a youth is likely to change in terms of personality and skill level possessed by them. In this regard, a comparative analysis is carried out to analyse the existence of selected criteria in different types of decision making application.

In order to satisfy various areas of decision making, there are still room for improvement for the current MCDM method. A comparative study was conducted on various types of decision making application to identify the used techniques in weighing solutions to the users. Personality Trait (PT) and Multiple Intelligence (MI) are suitable to be adapted to the decision making techniques to enhance the accuracy of decision making aid. PT will be used to describe youth personality since it has the ability to measure different traits in personality such as behaviour, emotion and thought without overlapping. On the other hand, MI will be able to measure the cognitive part of youth by short-answer tests or MI test (Gardner, 1983; 1993; 2011).

In addition, relevant theories are also able to contribute as components in designing the YouthPDA conceptual design model. The decision making theories, human behaviours and other related theories have been studied, selected, and used. Also, the justification on the used theories was completed to strengthen the appropriateness of the theories to be incorporated in the design model. All related theories are included in the development of conceptual design model and the decision making application itself, especially for the user interface.

Although it may not be possible to know which criteria, techniques, and theories are appropriate, this study attempted to blend the all three components into the designing of the conceptual design model. The processes of identifying the most suitable components for the YouthPDA design model that fulfils the objective 1 of this study are fully explained in the next chapter (Chapter 4) in order to have a helpful decision making aid to solve problems considering various criteria and area of decision making.

3.5.2.2   Conceptual Design Model of YouthPDA

The construction of a conceptual design model of YouthPDA is one of the specific objectives for this study. This design model acts as the general conceptual framework through the presented functionality (Mayhew, 1992). The proposed conceptual design model should be a systematic guidance of organized way for youth to perform their personal decision making. Johnson and Henderson (2002) and Preece, Rogers, and Sharp (2007) state that conceptual model acts as a high-level description of how a system is organized and operated.

There are a few tasks that have been involved in this activity. One of the tasks is to study decision making process and the techniques that are involved. Next step is the process of identifying the criteria that may vary in the decision making process. Then, the apt theories that might affect the youth were studied. Finally, the selected criteria, technique, and decision aid theories including PT and MI theory were designated in the construction of a conceptual design model for YouthPDA to fulfil objective 2 of this study.

3.5.2.3   Prototyping

The design model for YouthPDA was constructed has its own concepts and functionality and these features should go for validation process. One of the methods in validating the functionality is through prototyping. Dix, Abowd, and Beale (2004) define prototyping as the process of translation system's specification into a tangible outcome in order to gain users' feedback. The prototype of YouthPDA provides the opportunity to the users to explore the personal decision aid as well as give their

comments on the functionality, design and the flow of the proposed conceptual design model. Therefore, inclusive modelling approach was utilised in this stage.

Inclusive modelling is known as a user centred approach for agile software development which is the key practices is Active Stakeholder Participation. Stakeholder as defined by Scott (2002) is any person who is involved either directly to the system development (direct, indirect user, manager, operation staff member, the financier of the project and support staff) or developers who occupied on other system that interrelates with the project under development, or maintenance professionals that potentially affected by the development of a software project.

However, most of them will not easily recognise the complex diagrams used by most of the system developers. In this regard, an inclusive model has been adopted to help them in capturing and analysing the systems' requirements by using simple tools as well as simple techniques. Figure 3.5 shows the inclusive approach used in system development where the stakeholders will continuously inform and update from early process.
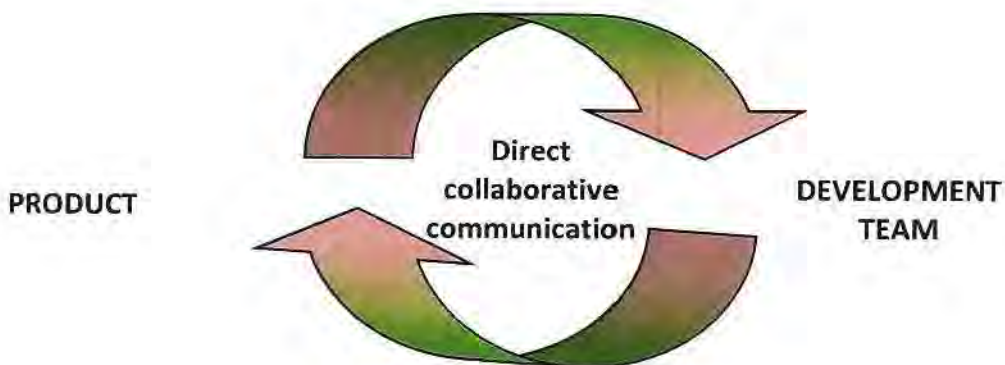
Figure 3.5. Inclusive model for prototype development

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Thus, the prototype was refined to produce a high-end prototype, which was evaluated and acted a feeder to fulfil objective 3 in the next stage, Evaluation phase. Figure 3.6 demonstrates the overall prototyping process.

Figure 3.6. Prototyping process

Prototyping plan is the first process in prototyping as stated in the diagram. Objectives that support the development of the prototype were built in this process. Next, the prototype functionality was outlined and guided accordingly with the specified objectives. Then, the prototype was developed to ensure the executable prototype able to manage the implementation of decisions made accordance as planned. Lastly, the phase is on the evaluation report that was based on the evaluation report carried out by youth in the experimental study. The details prototype with interface and evaluation report and process were elaborated in Chapter 5 and 6 in this thesis.

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3.5.2.4 Instrument Design

Ease of use, effectiveness, efficiency, and usefulness are several parameters used to validate applications. The quality of a system that has been produced might able to be tested by this single factor or combination of several factors. For this study, usefulness is the chosen parameter to be validated (refer to Appendix D).

Pilot Testing

The instrument was adapted from Siti Mahfuzah (2011) where the instrument was determined, drafted and tested through Pilot Testing for its validity and reliability. There are five dimensions utilised in many previous works of decision aids in various fields such as management, education, medicine and personal decisions. The dimensions and related items are:

i. **Accuracy** (application functions, suitability on decision making style, intended support ability, required advice capability, with limited time)

ii. **Decision Strategy** (logical decision process, simplicity process, decision process understanding and justification interpretation)

iii. **Satisfaction** (recommended solution satisfaction, selection making confidence, selection justification, and experience kind)

iv. **Knowledge Acquisition** (awareness on alternatives, decision process subconscious, dependency, and realisation on the problem)

v. **Overall Usefulness** (making choice capability, consideration on decision, decision making ability, and youth details clarification)

The five dimensions from the built instrument were pilot tested to 100 respondents as rule of thumb by Hair, Black, Babin, and Anderson (2014) to check on the instrument's adequacy. This test is needed to ensure that the data is sufficient and to find factor loading to represent the correlation between the measuring item and related factor.

Test indicator that was used is Kaiser-Meyer-Olkin measure of sampling adequacy (KMO test) where KMO test is a supportive measure to find the sufficiency of data for a factor analysis. Henry (2003) summarised that KMO scores >0.9 are exceptional, >0.8 are commendable, >0.7 are good, while >0.6 are acceptable. In general, the smaller the value index, the less appropriate the model.

Other than that, Bartlett test of sphericity (Pett, Lackey, & Sullivan, 2003) was run to demonstrate the testing assumptions before proceeding with the factor analysis test. The correlation matrix is highly significance with the value p< 0.000.

Findings

The KMO and Bartlett's test of sphericity demonstrate that there is relationship to investigate, thus factor analysis is practicable. The results had shown that KMO test ≥ .50 which satisfies rules of thumb by Hair et al. (2014) as stated in Table 3.2.

Table 3.2

KMO and Bartlett's Test Result

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy		.925
Bartlett's Test of Sphericity	Approx. Chi-Square	1846.421
	df	231.000
	Sig.	.000

Factor Analysis

Meanwhile, factor analysis results have shown that all items in each dimension are $\geq$ 0.5, which indicate that all the items are acceptable and significant for data collection in this study. The results are tabulated in Table 3.3 showing that the five dimensions are proved to be useful and important in the instrument.

Table 3.3

Factor Loadings for 5 Dimensions and 22 Items in YouthPDA's Instrument (N=100)

Items	Factor Analysis
A. ACCURACY	*.810*
1) This application can be relied to function properly.	.675
2) This application is suitable to my style of decision making.	.649
3) This application provides the help that I need to make a selection.	.736
4) This application provides the advice that I require to make my decision.	.844
5) This application is suitable even during limited time to make a decision.	.545

Table 3.3 continued.

B. DECISION STRATEGY   *.826*

1) The decision process in this application is logical to me.   .587
2) The decision process in this application is simple to me.   .637
3) I understand how decision process in this application works.   .699
4) I found it very easy to interpret the decision justification provided by this application.   .673

C. SATISFACTION   *.832*

1) I am satisfied with the recommended solution.   .804
2) I am confident that I am able to make selection with this application. .744
3) I am confident that I can justify the selection that I made with this application.   .687
4) I am very pleased with my experience using this application.   .711

D. KNOWLEDGE ACQUISITION   *.718*

1) This application makes me realize I cannot get everything from just one alternative.   .636
2) This application shows my subconscious decision process.   .633
3) This application helps me not to be easily influenced by others in making selection.   .685
4) This application makes me more independent of others in making a selection.   .667
5) I learned a lot about the problem using this application.   .662

E. OVERALL USEFULNESS   *.793*

1) This application is capable of helping me in making a choice.   .774
2) This application allowed me to carefully consider the decision made.   .690
3) I feel that the problem in making selection is solved.   .564
4) This application is an aid for me in clarifying what I want.   .815

Overall, it can be observed that all the values for KMO $\geq$ .50. Also, the Barlett's test of sphericity too provided the significance level of .000 (p < .05) for all dimensions.

Reliability Test

Besides, in the reliability test, Cronbach Alpha acquired .934 for the pilot study. This result shows the consistency of the data, and as stated by Sekaran (1992) the value of figured Cronbach coefficient alpha indicates the value of alpha to be accepted as reliable. Table 3.4 shows the summary of alpha values confirming that the measurements are consistent. These values indicate that the instrument can be used for the intended purpose.

Table 3.4

Summary of Cronbach Alpha for Each Dimension in Reliability Test

Dimensions	Cronbach Alpha	Number of Items
Accuracy	.893	5
Decision Strategy	.876	4
Satisfaction	.906	4
Knowledge Acquisition	.864	5
Overall Usefulness	.897	4
ALL DIMENSIONS	**.934**	5

3.6 Phase 3: Evaluation

Evaluation phase was prepared when a proposed solution design reaches an adequate state. According to Dix et al. (2004), three main goals should be derived from evaluation which are to assess the extent and accessibility of the system's functionality, to assess users' experience of the interaction and to identify any specific problems with the system. Meanwhile, there is a necessity to carry out the

evaluation for both design and implementation, to assess extent of system functionality, assess effect of interface on user, and identify specific problems. The evaluation in decision aids consists of two approaches which are outcome oriented and process oriented (Jungermann, 1980). Outcome oriented approach stresses the consequence of the decision made, while the process oriented approach emphasises on effect produces by the process itself.

In this study, the evaluation includes expert reviews and experimental study to ensure that the constructed design model as well as decision making application are really helpful and suitable for youth as shown in Figure 3.7.
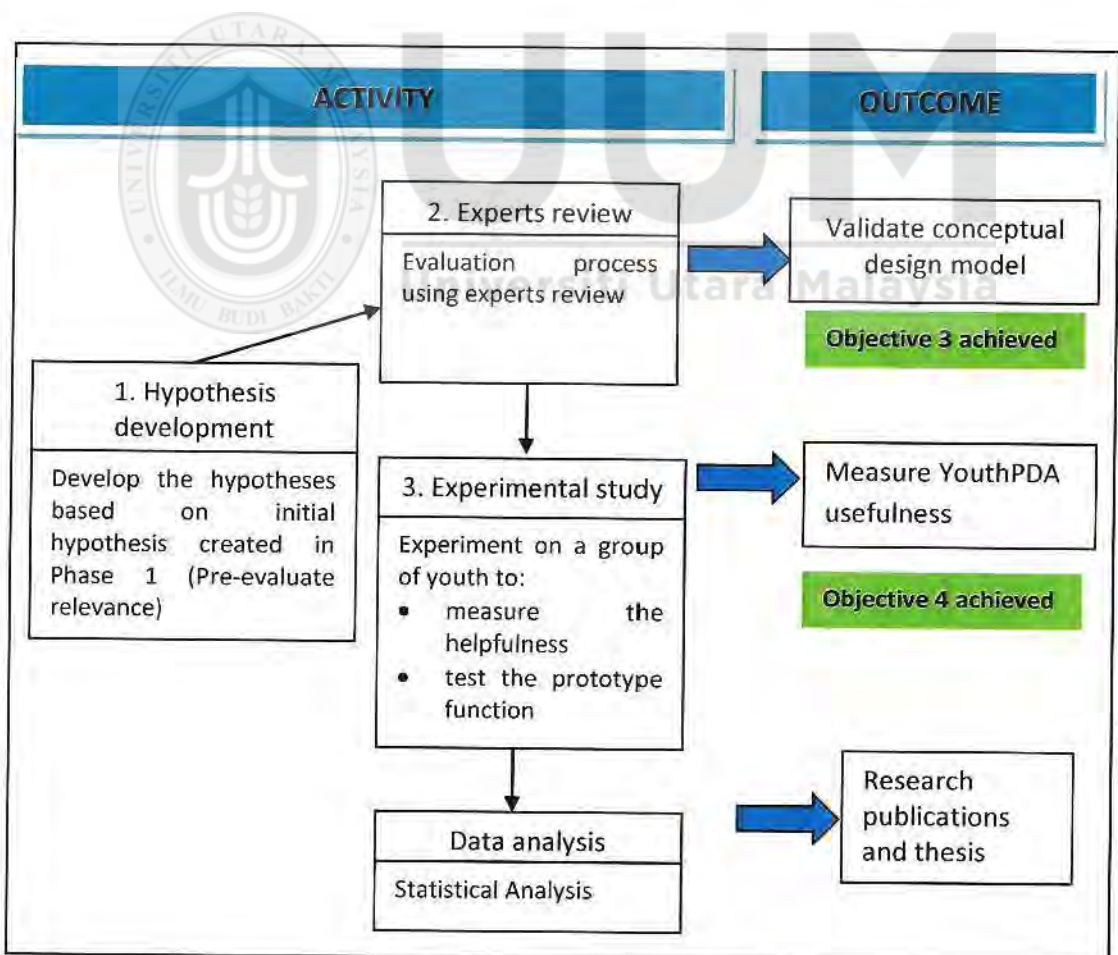
Figure 3.7. Phase 3 – Evaluation

A few groups of users were selected to examine the design model and test the final prototype. The YouthPDA design model and prototype were used during the evaluation process to get data for analysis. In general, the unit of analysis in this study are:

i) Respondents of preliminary study: 80 respondents participated in the preliminary study. Youth from diverse backgrounds participated to investigate the areas of decision-making that are required by these youngsters. The samples are adequate as Sekaran (2000) stated that selecting a small group of 30 respondents from a convenient sample is common for preliminary study. The details process involved in the preliminary study have been explained in Chapter 1.

ii) Expert in expert review: 7 experts are sufficient (Nielsen, 1992) to validate the conceptual design model of YouthPDA. The experts have experiences in various fields including Computer Science (CS), Human Computer Interaction (HCI), Software Engineering (SE), and Information System (IS).

iii) Respondents in experimental study: The experimental study involved 200 subjects (represent youth) who experienced the YouthPDA prototype. The number of respondents is appropriate as indicated by Sekaran and Bougie (2010).

3.6.1 Hypotheses Development

The assessment for the general research hypothesis constructed in Phase 1 (Pre-evaluate relevance) was challenging. Therefore, the hypothesis was developed by

dividing the initial hypothesis (Figure 3.3) into few parts with more rigid but more accurate scope. The developed hypotheses should be mutually exclusive and collectively exhausted (MECE) in regard to the general hypothesis (Offermann et al., 2009).

Thus, there were a few enhancements on the general hypothesis to achieve objective 4 of this study. A list of hypotheses was formulated to validate the usefulness of the proposed conceptual design model that was portrayed by YouthPDA prototype.

In this study, usefulness was chosen to be measured since usefulness is possible to be considered as analytical review. The analysis concept is reliable by making usefulness as the measurement dimension, and was accepted in the decision making process (Jiang & Benbasat, 2004, 2007; Pavlou & Fygenson, 2006; Pavlou, Liang, & Xue, 2007). The correlations between all the four dimensions (accuracy, decision strategy, satisfaction, and knowledge acquisition) with the overall usefulness are important to be measured.

Therefore, four hypotheses were created to ascertain the correlation between the dimensions so as to measure the usefulness of the YouthPDA prototype. The four hypotheses are:

H_1: There is a positive correlation between Overall Usefulness and Accuracy

H_2: There is a positive correlation between Overall Usefulness and Decision Strategy

H_3: There is a positive correlation between Overall Usefulness and Satisfaction

H_4: There is a positive correlation between Overall Usefulness and Knowledge Acquisition

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These hypotheses were constructed based on the relationships between accuracy, strategy, satisfaction, and acquisition with usefulness in previous studies. Orr, Porter, and Hartman (1995) did a research on decision making based on probabilistic reasoning. The focus is to review ultrasonography test performance and to develop recommendations for the use of ultrasonography to aid in the evaluation of potential appendicitis. Result shows that accuracy is able to determine the usefulness of ultrasonography for the prospect of appendicitis.

Besides that, Wang and Benbasat (2009) measure the accuracy and strategy dimensions through their research on measuring the performance of interactive decision aids for consumer decision making for effort-accuracy framework. The study shows that the relation for these dimensions is worthwhile to be studied. Meanwhile, Doll, Hendrickson, and Deng (1998) studied on perceived usefulness and ease of use in decision making for multi-group invariance analysis. They have confirmed that there is solid correlation for validity and reliability in the instrument.

A research on user satisfaction was carried out by Calisir and Calisir (2004) through Enterprise Resource Planning systems which have different usability features that affect end-user satisfaction. From the research, usefulness and learnability are determinants for end-user satisfaction. As for the acquisition, Endsley and Garland (2000) have evaluated the awareness in measuring the relevancy with usefulness. They have concluded that the requirements for raising awareness or knowledge acquisition are relevant in decision making.

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3.6.2 Experts Review

Expert review is one of the ways of evaluating the YouthPDA. This evaluation was carried out by a group of 7 experts (Nielsen, 1992) in various fields. The experts were selected based on their experience dealing with conceptual design model, decision making and have PhD in various fields including Human Computer Interaction, Information System and Software Engineering. Their validations are very essential in order to accomplish Objective 3 of this study; to validate the conceptual design model of YouthPDA through experts review.

The proposed design model including techniques, criteria and theoretical foundation as the components were validated using expert review form (see Appendix E) during the assessment. The amendments of the design model were modified accordingly in the Solution Design Phase. This process was repeated until the experts satisfied.

3.6.3 Experimental Studies

Offermann et al. (2009) stated that experimental study is a process of evaluating refined hypothesis that can be done either by laboratory or field experiments. The experiment which also part of the Objective 4 of this study was carried out in two conditions; in the computer laboratory and in the open environment (field). Lab experiment was conducted by giving five tasks to the respondents to be completed via computers. Meanwhile, field experiments have been accomplished at three venues; i) international exhibition, ii) two schools during Sijil Pelajaran Malaysia (SPM) results released day, and iii) Higher Learning Institutes (IPTA).

3.6.3.1 Sampling

In this study, simple random sampling was used to decide the proper sample size for subjects' population. A large sample size of the youth as subjects is important to achieve a high confidence level of the user, high accuracy results and minimum acceptance for error.

There are a few suggestions for the number of sampling. However, most of them used the general rule of thumb where Roscoe (1975), Sekaran and Bougie (2010), and Chua (2006) stipulated that 30 to 500 samples are sufficient for most studies. Therefore, this study targeted 200 samples as adequate to represent youth in the experiment to the YouthPDA prototype.

In this study, youths' ranged from 17 to 22 years old are divided in three different educational level groups. The first sample group is the secondary school students from two schools in Kedah and the visitors at Malaysia Technology Expo 2014 in Kuala Lumpur. Second group is the bachelor degree students from Higher Learning Institutions (IPTA) in Malaysia, and the third group is the youth who are still within the age range taken place in Malaysia Technology Expo 2014 and Innovation and Invention Technology Exhibition 2014.

3.6.4 Data Analysis

Data analysis results are the evidence to prove each finding in this study. A lot of facts, assertions, and evidences were identified. All these proofs were assessed through data analysis. The following are the statistical procedures that were used on the collected data:

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i)   **Descriptive analysis:** used to present quantitative descriptions in manageable summaries about the sample and the measures. Descriptive statistics are able to simplify large amounts of data and lots of measures in a practical way with simple graphics analysis (Holcomb, 1998). Each descriptive statistic reduces lots of data into a simpler summary and was used in preliminary study and general findings in experimental studies.

ii)   **Factor analysis:** used to determine possibly lower number of disregarded variables called factors between correlated variables. This statistical method (factor analysis test) was used in pilot study to measure Cronbach coefficient alpha for the reliability analysis (Kline, 2014).

iii) **Pearson correlation test:** used to define statistical relationship between two random variables or two sets of data. Correlations are useful because they can indicate a predictive relationship that can be exploited in practice (Gravetter & Wallnau, 2014). Pearson Correlation test was used for hypotheses testing in this study.

IBM SPSS Statistic was used as a tool for data analysing and graphical to represent the output of analysed data. At the end of the research process cycle, the outcome of this study is a prototype of YouthPDA using proposed conceptual design model and ended with research publications and thesis.

3.7 Summary

Design research was chosen as the approach and three main phases created by Offermann et al. (2009) were adopted in this study. Problem identification, Solution design and Evaluation phase were followed accordingly to ensure the realism of expected outcomes. Problem Identification is the first phase includes literature reviews, consultation with experts and preliminary study in order to identify the existence of gaps. As a result, research problems along with the proposed aim and objectives were determined. In phase two which is the Solution Design, solutions were proposed and artefacts were designed. Objective 1 and Objective 2 were achieved besides the decision making techniques and criteria, and theories for conceptual design model for YouthPDA, and a prototype of YouthPDA as the outcomes. The evaluation phase consist of expert reviews activity to examine the conceptual design model, experimental studies to analyse the constructed prototype using usefulness validation instrument, as well as hypotheses testing.
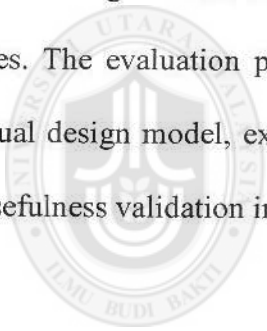
CHAPTER FOUR
CONCEPTUAL DESIGN MODEL OF YouthPDA

4.1 Overview

It is believes that there are important components missing in the design and development of computerised decision aid pertinent to youth personal decisions. Those components are necessary to gratify the youth's needs by assisting them in making better decision. Thus, elements under the main components like the decision criteria, decision techniques and decision theories were considered. The idea is to find the most relevant elements to be integrated in the conceptual design model.

Comparative and content analyses were mainly involved in the development of the conceptual design model in order to gather information on the main components, sub-components (i.e., elements), and the underpinning of the previous two (as shown in Figure 4.1). These activities were the core of the third phase of the research methodology adopted in this study (i.e., the Solution Design) as described in Chapter 3.
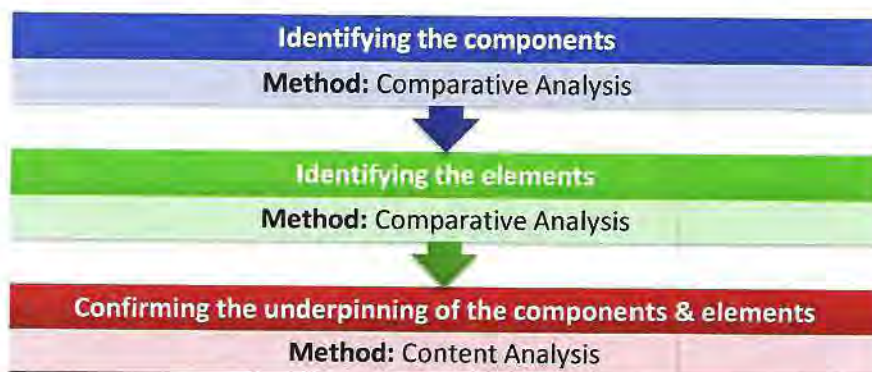
Figure 4.1. The sequence of activities involved in development of the conceptual design model

The comparative study was used to find the existence of decision criteria and techniques that were used in fourteen selected decision making tools or aids as presented in Table 4.1. On the other hand, content analysis was carried through on theories to clarify why the elements were chosen to develop the conceptual design model for youth as elucidated in the next sub-section.

Table 4.1

Description for Sample of Decision Making Aids

Decision Aid	Decision Aid Name	Description
A_1	Personalized Decision Aid for Mobile Phone Selection (Chen et. al.,2010)	Mobile phone selection
A_2	MCDM in Lightweight Concrete for Floating Houses (Nekooie, Mohamad, & Mahdinezhad, 2011)	Determines the most resistant lightweight concrete mixtures
A_3	MCDM System using AHP Method (Al-Azab & Ayu, 2010)	Assists decision makers sort out decision on certain problems.
A_4	An Enhanced Hybrid Fuzzy MCDM for Vendor Selection (Vahdani, Alem-Tabriz, & Zandieh, 2009)	Selects vendor in supply chain
A_5	MCDM to Evaluate Mobile Phone Alternatives (Isiklar & Buyukozkan, 2007)	Evaluates mobile phone selection
A_6	SMART Decision Support System (University College Dublin)	Evaluates many areas
A_7	Hunch Website (Mukherjee, 2009)	Online personal decision-making tool
A_8	Let Simon Decide (Ayax System Inc., 2014)	Online personal decision-making web
A_9	Choose It! (Choose IT, 2015)	Business, financial, and personal life decisions
A_{10}	Decision Oven (Dataland Software, 2009)	Personal and business decisions

Table 4.1 continued

A_{11}	DEXi (Bohanec, 2016)	Provides many options in various decision problems
A_{12}	Logical Decision v6.1 (Logical Decision, 2016)	Let decision maker organize the information they have collected about the choices
A_{13}	Super Intuition	Considers alternatives list, decision table, facts, value rankings and value ratings in many area of decision making
A_{14}	Fuzzy Petri nets Lee, Liu and Chiang (1999)	A recommender for damage assessment of Da-Shi Bridge

4.2 Identifying the Main Components: Decision Process, Decision Criteria, Decision Technique, and the HCI Components

Various things need to be taken into account to make a decision. Activities (i.e., decision making process) (Turban, 1995), the required criteria (decision criteria) (Caroll & Johnson, 1990), the techniques used (decision technique) (Wood, Dong & Dym, 2005), Human Computer Interaction (HCI) principles (Benyon & Murray, 1993), and also the theories (supporting theories) (Dillon & Morris, 1996) are advised to assist in the production of a conceptual design model. The next sub-sections discuss all of the components that have been mentioned above.

4.2.1 Decision Process

In order to categorise general decision process that are suitable with personal decision, this study adopted the comparative analysis of seven samples of decision making process made in Siti Mahfuzah (2011). The seven samples with different decision making processes are generalised as follow:

i.   **Decision Process 1 (DP1):** Beach and Mitchell (1978)

(Problem Recognition, Evaluation of Task, Strategy Selection, Information Processing, Strategy Implementation, and Choice)

ii.   **Decision Process 2 (DP2):** Carroll and Johnson (1990)

(Recognition, Formulation, Alternative Generation, Information Search, Evaluation/Choice, and Action/Feedback)

iii. **Decision Process 3 (DP3):** Baker et al. (2002)

(Define Problem, Determine the Requirements, Establish Goals, Identify Alternatives, Define Criteria, Select a Decision Making Tool, Evaluate Alternatives, and Validate Solutions against Problem)

iv.   **Decision Process 4 (DP4):** Hammond, Keeney and Raiffa (1999)

(Define Decision Problem, Identify Objectives, Establish Set of Alternatives, Layout the Consequences of Each Alternatives, Make Trade-Offs, Resolve Uncertainty, Quantify Risk Tolerance, and Make Linked Decisions)

v.   **Decision Process 5 (DP5):** Bahl and Hunt (1984)

(Problem Identification, Formulation/Reduction of Selected Alternatives, Choosing Decision Criteria, Prediction/Evaluation of Outcomes, Evaluation of Alternatives, Make Choice, and Execution)

vi.   **Decision Process 6 (DP6):** Power (2002)

(Define the Problem, Decide Who Should Decide, Collect Information, Identify/Evaluate Alternatives, Decide, Implement, and Follow-up Assessment)

vii. **Decision Process 7 (DP7):** Girod et al. (2000a; 2000b)

(Gathering External Information, Identifying/Refining Criteria, Identifying/Refining Alternatives, Generating Experimental Results, Choosing the Best Alternative)

The samples for the process are selected from various decision fields, which include engineering decision, organizational and managerial decision, individual and general decision making.

Simon (1965) has proposed the most referred model of decision-making process which involves three main phases that are ***intelligence***, ***design*** and ***choice***. "Intelligence" is a process of problem identifying before the process will proceed to problem solving. Then, "design" phase highlights on emerging and considering proposed actions to the situation. Lastly, the "choice" phase which involves listing all the possible options and requires the user to determine their decision. Accordingly, every step that relate to personal decision making in each samples was mapped to phases suggested in Simon's as summarised in Table 4.2.

Table 4.2

Summary of Selected Steps in Decision Making Process (Siti Mahfuzah, 2011)

Phases	Steps	DP1	DP2	DP3	DP4	DP5	DP6	DP7
Intelligence	Problem definition	√	√	√	√	√	√	
	Information gathering			√	√		√	√
Design	Alternative identification	√	√	√	√	√	√	√
	Criteria definition	√		√		√	√	√
	Evaluation	√	√		√	√		√
Choice	Make choice	√	√	√	√	√	√	√

Note: DP1 = Decision Process 1

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Most frequently occurring steps in the samples of decision making process are selected to be included in the proposed conceptual design model as summarised in Table 4.2. In the **Intelligence** phase, the two steps contain Problem Definition, and followed by Information Gathering from the user. Then, **Design** phase consists of Alternative Identification, Criteria Definition, and Evaluation which will be provided to the user. Lastly, **Choice** phase is the phase where the user will make their choice.

4.2.1.1   Intelligence

Intelligence phase is the process of how the decision tool can help in understanding the problems by searching for conditions that call for decisions. This initial concept of design model is designed to ease the understanding in the decision problem identification and information gathering steps. Therefore, the conceptual design model has to stress on the problem solving by including the decision techniques, decision criteria, HCI components and supporting theories in the development process.

4.2.1.2   Design

The designing process in second phase of decision making involves inventing, developing and analysing possible courses of action. There three steps stated in Siti Mahfuzah (2011)'s design phase which are alternative, criteria and evaluation are simplified into two steps which are;

    i.   extract user information, and

    ii.   calculate decision using RBR

User information is extracted based on the youth context will regulate the possible alternatives for them. The suitable criteria and technique are used in calculating the best options in helping the youth to make decision.

4.2.1.3   Choice

The last process of the Design Phase is to develop and display list of recommendations or alternatives to the youth. This final process involves the options of either accepting or rejecting the recommendation (followed by re-evaluation process).

In the choice phase, recommendations are delivered from the design phase and shown to the user (i.e., youth). However, user has the right to reject the recommendations. Thus, the application provides the ability to re-evaluate threshold by repeating the first phase of the decision making process which is the intelligence phase.

4.2.2   Decision Criteria

Criteria can be classified as the property of an object. For instance, a car has colour, design type, gear category, as well as the engine capacity as its criteria. As for multi-criteria decision-making, the problem solving used several criteria in order to determine the solutions. In order to provide dynamic recommendation to the decision maker, this study will look into the potential of adapting the contextual aware approach in considering the decision criteria. This approach is one of the requirements in personalised decision aid in providing better options for the decision maker based on user's personal backgrounds (Xu, et al., 2008). Furthermore,

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contextual-aware recommendation enhances the interactions between the user and the decision aids (Adomavicius & Tuzhilin, 2011).

Contextual-aware approach has been used in many areas such as mobile customer (Schiller & Voisard, 2004), social activity (Brown et.al, 2005), database (Agrawal, Rantzau & Terzi (2006), information retrieval (Sieg, Mobasher, & Burke, 2007), and marketing management (Bettman, Johnson & Payne, 1991). One of the applications that use the context-aware approach is COMPASS, which is a context-aware mobile tourist application, developed by van Setten, Pokraev, and Koolwaaij (2004). The recommender system uses user's interests and current context and with a context-aware application to facilitate and enhance information to tourists.

This study is considering the personality type and the intelligence level of youth as the determinants that define youth decision criteria. As the matter of fact, Odom and Pourjalali (2011) found that intelligence level and personality type of an individual are two major factors that affect the decision to be made. Both of the criteria will determine the level of an individual's uniqueness. Personality type is the set of emotional qualities, and ways of behaving, which makes a person different from other people. In other words, it refers to individual differences in characteristic patterns of thinking, feeling and behaving. Apart from the Personality Style, intelligence level is also another factor that should be considered in the decision aid development (Armstrong, 2009). An individual is able to judge himself (based on the level of intelligence) whether that choice is suitable for him or not. Multiple Intelligence is the act of understanding which is considered as awareness, consciousness, responsiveness, and decision.

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Personality Style and Intelligence Level are relevant components that able to complement each other in identifying the user's character (Nardi, 2001). Studies by Silver, Strong and Perini (2000) and Foong, Shariffudin, and Mislan (2012) used hybrid of both personality style and intelligence level to identify student's learning style. Besides, personality and intelligence are correlated and most of the correlations are statistically significant (Andi, 2012). Besides that, Ghiabi and Besharat, (2011) stated that individuals are more capable especially in interpersonal and social interactions, and have certain inferences in educational settings and university staff employment processes (Atta, Ather, & Bano, 2013),

4.2.2.1 Determinant 1: Personality Style

Personality style is the personal conditions of an individual in terms of his external or internal behaviour. As mentioned in previous chapter (i.e., Literature Review), Myer Briggs Type Indicator (MBTI) and Big Five personality traits are two styles of indicators in recognising individual's characteristics.

Big Five that consists of five major factors, namely Extraversion, Neuroticism, Conscientiousness, Agreeableness and Openness are non-theoretical model (Barrick, & Mount, 1991). The five characteristics in Big Five are more on actual behaviour of a person, which is unmatched with the requirements of conceptual design of this study (i.e., criteria, technique, and theory). Meanwhile, MBTI has relation with theory (i.e., cognitive theory) for measuring personality characteristics toward inside and outside world. MBTI is coincident with one of the requirements of the conceptual design model of this study.

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MBTI as stated in Coe (1992) and The Myers & Briggs Foundation (2014), started with eight indicators of personality namely Extroverted (E), Sensing (S), Thinking (T), Judging (J), Introverted (I), Intuitive (N), Feeling (F) and Perceiving (P). The personalities were developed into 16 types then produces four categories of persona including i) NF: valuing (manifesting universal values and valuing people), ii) SF: relating (including and building trustworthiness), iii) NT: visioning (pulling people with ideas to an optimistic future), and iv) ST: directing (action from a strategic perspective).

The personality of a person can be judged through the attractive qualities such as energy, friendliness, and humour; that make a person interesting and pleasant to be with. According to Kassin (2003), personality has to do with individual differences among people in behaviour patterns, cognition and emotion. Meanwhile, different personality theorists present their own definitions of the word based on their theoretical positions.

For this research, MBTI is chosen to assess the youth personality because the character of a person in MBTI is scaled down and making it easier to distinguish each characteristic of an individual. Therefore, the result from the Personality Traits test is the criteria and value of each youth that based on MBTI indicators. The finding shows that personality of each individual is unique that will discern their behaviours and thoughts from one to another.

4.2.2.2 Determinant 2: Intelligence Level

Meanwhile, intelligence is a cognitive process that enables humans to remember descriptions of things and use those descriptions in future behaviours. It gives humans the rational abilities to experience, think, learn, and form concepts. Intelligence level of each individual is unique has the capacities to identify patterns, understands ideas, plan, problem solving, and use language to communicate. The Multiple Intelligence test demonstrates unique criteria that are able to identify each and every single person's intelligence level (Barrington, 2004).

Gardner (1983; 1993; 2011) in his prominent study suggested nine types of intelligence which are i) linguistic, ii) logical/mathematical, iii) musical rhythmic, iv) bodily/kinaesthetic, v) spatial, vi) naturalist, vii) intrapersonal, viii) interpersonal, and ix) existential intelligence. The main outcome from the Multiple Intelligence test shows the level of individual's intelligence clearly. Each intelligence is valued personally that portrays the youth capability discretely.

Having considered all of the above, it seems reasonable to include Personality Style and Intelligence Level as the decision making criteria in the conceptual design model. In general, the contextual-aware approach (mentioned earlier) is used to match the personality type and intelligence level of the youth with the area of decision in the determining the appropriate recommendation. Figure 4.2 illustrates the whole concept of the conceptual design model where the contextual-aware approach is added to the general framework of the decision-making process as proposed in Siti Mahfuzah (2011).
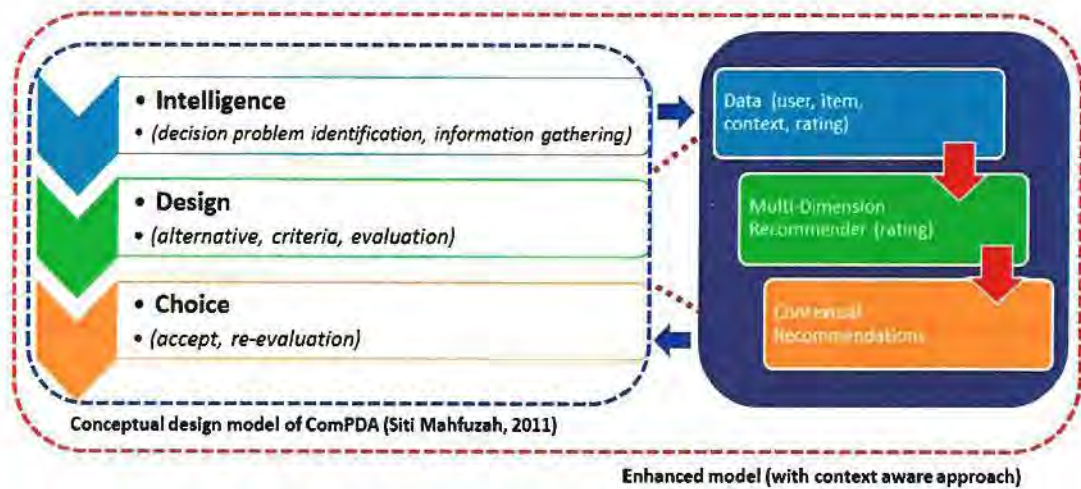
Figure 4.2. The basic framework of the conceptual design model (Siti Mahfuzah, 2011) with enhanced model

4.2.3 Decision Making Technique

MCDM is widely used in existing decision aids because the ability of this technique to deal with multi-criteria in the decision making process. Generally, MCDM techniques are used in the existing decision aids for various purposes. The techniques are mainly involved with criteria calculation process, using ranking, decision table, decision matrix, or weightage in order to determine the solutions to the users.

However, as stated by Velasquez and Hester (2013), MCDM can be a complex decision making technique to be used in a decision aid. This statement is also supported by Sirigiri, Hota and Sharma (2015) where MCDM uses complex mathematical calculations that required more time to solve, especially when extra number of criteria and alternatives involve. Table 4.3 shows the various techniques for the available decision aids (please refer Table 4.1).

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Table 4.3

Comparative Study on Technique Component in Decision Aid Samples

Decision Aids	Technique	Method
A_1	Analytical Hierarchy Process (AHP)	• Ranking analysis • Equal weight based system
A_2	Multi-criteria Optimization and Compromise Solution Method (VIKOR)	• Fuzzy linguistic variables
A_3	Analytical Hierarchy Process (AHP)	• Ranking user preferences
A_4	Technique for Order Preference by Similarity to an Ideal Solution (TOPSIS)	• Weightage decision matrix • Ranking preference order
A_5	• Analytical Hierarchy Process (AHP) • TOPSIS	• Identify relative weights • Rank mobile phone alternatives
A_6	Simple Multi Attribute Rating Technique (SMART)	• User ranking their preference attributes • System weightage attribute's ranking
A_7	Ranking	• Suggest alternative for the user
A_8	Weighted decision analysis	• Combines user qualitative input with a weighted, mathematical formula
A_9	Decision Matrix	• Decision matrix for business, financial, and personal life decisions
A_{10}	Decision Matrix	• Decision matrix for personal and business decisions
A_{11}	Qualitative multi-attribute model	• Incorporates qualitative multi-attribute models for the evaluation and analysis of options
A_{12}	• simple rank • tradeoffs • AHP	• Let decision maker organize the information they have collected about the choices from spreadsheet and database
A_{13}	Decision table	• Considers alternative list, decision table, facts, value rankings and ratings
A_{14}	Rule-based technique	• used for defining and implementing business logic rules

Note:
A_1 to A_{14}: the decision aids

Meanwhile, Rule-based reasoning (RBR) is one of the decision techniques that able to satisfy multi-criteria problems in decision making (Ferreira & Garcia-Marques, 2006) by representing the decision making process in the form of rules. RBR is also used to determine the options for decision making application (Kahn Jr, 1994), which also supported by Ahmed, Begum, and Funk (2012).

Rule-based Reasoning (RBR) uses rules in the algorithm to solve the business problem. Rule-based reasoning has two methods for processing the information namely Forward Chaining and Backward Chaining. Data-driven reasoning or Forward Chaining method starts with the available data and practices suggestion rules to extract more data until a goal is accomplished. Meanwhile, goal-driven reasoning or Backward Chaining method starts with a goal and look for rules which apply to that goal until an inference is reached.

RBR is a natural knowledge representation (Negnevitsky, 2005) where an expert generally clarifies the problems solving procedure with natural languages. These languages can be accessible quite naturally as IF-THEN rules. Rules are capable to precise the way of thinking by experts since rules signify natural knowledge using natural language expressions.

Besides, the RBR has a uniform structure where the rules have the uniform IF-THEN structure. Each rule is a discrete knowledge unit that able to be inserted into or removed from the knowledge base, which grants flexibility during the development of rule-based applications.

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Likewise, Prentzas and Hatzilygeroudis (2007) point out the ability of RBR in dealing with incomplete and uncertain knowledge. This is because most rule-based expert system is capable of representing and reasoning with incomplete and uncertain knowledge. Furthermore, RBR is competent to separate knowledge from its processing which the structure of a rule-based expert system provides an effective separation of the knowledge base from the inference engine. A knowledge engineer basically adds some rules to the knowledge base without intervening in the control system in order to make the system smarter.

Rule-based systems are practiced in a huge number of application areas. According to Abraham (2005), a significant advantage of the technique is that the knowledge is expressed as easy-to understand linguistic rules. Moreover, the technique can be taught using neural network learning, EC, or other adaptation techniques if the data is available. The achievement of the technique has been recognised evidently, and the number of applications that using the technique is expected to increase.

For this study, RBR is used to establish the rule of the personal decision aid. Rules are built based on the Personality Style and Intelligence Level of the decision maker (i.e., youth) through the Intelligence Phase processing. The rules will accommodate outcomes of the Personality Style and Intelligence Level test (i.e., the decision criteria) with the area of decision to determine better recomendations for the youth.

In this study, the Forward Chaining method is used as the main technique in identifying the best recommendations to the youth in the decision making application because the Personality Style and Intelligence Level (data) provided by analysed

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decision criteria component are available for the method to define rules in determining the suggestions (goal). The way Forward Chaining works is it starts with personality style and intelligence of youth resulting from PT and MI tests. Then, the process continues with considering the rules which apply to the newly acquired data from the two criteria; personality style and intelligence. Finally, the applied rules were used to determine the results for youth decision-making application.

Therefore, based on the rules that are made up of Personality Style and Intelligence Level, this RBR technique is avoiding the use of complex mathematical approach. This will make it easier for designers to produce the personal recommender system.

4.2.4 HCI Components

It is believed that proper considerations of the HCI components are also important in the development of the decision aid (Zhang et al., 2011). Therefore, this study considers the inclusion of HCI components that will be used as additional components for decisional guidance in the conceptual design model.

The HCI components are user interface, graphic design principles, interaction styles and design elements that were adapted from Shneiderman (1998) and Galitz (2007) as depicted in Table 4.4. As far as the development of the conceptual design model is concerned, each component has implications (i.e., consistent layout for easy reading) over the proposed decision aid content and each of the layouts is determined by certain principles (Te'eni, Carey, & Zhang, 2006) such as Graphic Design Principles.

Table 4.4

HCI Components in Personal Decision Aid

Components	Principles	Implications
User Interface	i) *User familiarity*	The interface should be based on user-oriented terms and concepts rather than computer concepts. For example, provide youth with interface items that relate to their real world, so they will familiar with the environment.
	ii) *Consistency*	The aid should display an appropriate level of consistency. Commands and menus should have the same format, command punctuation should be similar, screen layout, and becomes more predictable on the process to avoid confusion.
	iii) *Minimal surprise*	If a command operates in a known way without a bit of surprise element, the youth should be able to predict the operation of comparable commands.
	iv) *User guidance*	Some guidance should be supplied to youth such as help systems and on-line manuals, to facilitate ways to use the aid and to avoid wasting their time.
	v) *User diversity*	Interaction facilities for different types of user should be supported to suit them. For example, some users have vision difficulties and so larger text should be available.
Graphic Design Principles	i) *Metaphor*	Interface should tying presentation and visual elements to some familiar relevant items for easy understanding.
	ii) *Clarity*	Every element in an interface should have a reason for being there. White space will allow eyes to rest between elements of activity. It is used to promote simplicity, and strengthens impact of message.
	iii) *Consistency*	Layout, colour, images, icons, typography, text, should be constant within screen or across screens, and stay within metaphor everywhere for readability.
	iv) *Alignment*	It is "Read-flow" principle where the grids horizontal and vertical lines help to locate window components. Only one alignment either left, centres or right is recommended to be chosen and to use it everywhere in the application. To allow the users' eye to parse display more easily.

Table 4.4 continued.

	v)	*Contrast*	Contrast is able to pull and guide the eyes around the interface, supports skimming and can be used to distinguish active control, to set off most important item. The advantage is to add focus and to energize an interface.
Interaction Styles	i)	*Menu*	Set of options should be displayed on the screen, for shortens learning, permits use of dialog management tools and allow easy support of error handling.
	ii)	*Object manipulation*	The style that used to represent objects as icons (or symbols) that directly manipulated by user.
	iii)	*Form fills*	Primarily for data entry or data retrieval, and should be applied to simplify data entry and requires good design and modest training.
	iv)	*Pull-down*	A sub-menu should be used to make the design appear as a superimposed drop-down menu on the screen. Available for user to make selections on a top menu bar.
	v)	*Point & Click*	Should be used in multimedia, web browsers, hypertext, icons, text links or location on map because it requires minimal typing.
Design Elements	i)	*Graphs*	Represent decision outcome in a form of numerical data plotted on axes, used to illustrate and compare data.
	ii)	*Charts*	Used to show decision outcome in a graphical format, help to illustrate and compare data.
	iii)	*Images*	Should be used with meaningful graphics, representation and explanations with pictures for easy understanding.
	iv)	*Text*	Characters and symbols for text (titles, instructions and captions) should be used in each interface to provide information.
	v)	*Colours*	A good contrast colour between foreground and background is advisable, a way to call attention to extreme data values, differentiate among items and speedily convey information.
	vi)	*Icons*	Should be applied to represent object or action in a familiar and recognizable manner to user.
	vii)	*Hypermedia*	Documents that could contain several types of media which allow information to be linked by association.

Thus, the HCI components were analysed in the existing decision aid samples. The components of existing decision aids are used as a guideline to propose standard components for YouthPDA. Table 4.5 compares the findings from analysis of the implementation of HCI components in various samples of personal decision aids.

Table 4.5

Content Analysis of HCI Components in the Decision Aid Samples

Components		A_1	A_2	A_3	A_4	A_5	A_6	A_7	A_8	A_9	A_{10}	A_{11}	A_{12}	A_{13}	A_{14}
User Interface	User-familiarity	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Consistency	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Minimal-surprise	√		√	√	√	√	√	√	√	√	√	√	√	√
	User-guidance	√	√	√	√	√	√		√	√	√		√	√	√
	User-diversity	√		√	√	√	√	√	√	√	√	√	√	√	
Graphic Design Principles	Metaphor	√	√	√	√	√	√	√	√	√	√		√	√	√
	Clarity	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Consistency	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Alignment	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Proximity	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Contrast	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Interaction Styles	Menu	√	√	√	√	√	√	√	√		√	√	√		
	Object-manipulation	√	√	√	√	√	√						√	√	
	Form fills	√	√	√	√	√	√	√	√						√
	Pull-down	√	√	√	√	√	√		√			√	√		
	Point & Click	√	√	√	√	√	√	√	√	√	√	√	√	√	√
Design Elements	Graphs												√		√
	Charts	√	√	√	√	√	√		√	√	√	√	√	√	
	Images	√	√	√	√	√	√	√	√					√	
	Text	√	√	√	√	√	√	√	√	√	√	√	√		√
	Colours	√	√	√	√	√	√	√	√	√	√	√	√	√	√
	Icons	√	√	√	√	√	√	√	√		√	√	√	√	
	Hypermedia							√	√	√				√	

Note:
A_1 to A_{14} = Decision Aid samples as referred to Table 4.1
√ = states that the component is used in the aid

Accordingly, from the total of existence of each component in the samples, this study proposes a list of standard components in HCI components of YouthPDA. The conditions for classifying compulsory and recommended general components are as displayed in Table 4.6.

Table 4.6

Classification of Generic Components Condition

Conditions (Total score)	Indications
Above 10	Compulsory
6 to 10	Recommended
0 to 5	Discarded

Based on the conditions stated previously, the standard components of HCI for YouthPDA are proposed and demonstrated in Table 4.7.

Table 4.7

Standard HCI Components for YouthPDA

Components		Total	Indication
User Interface	*User familiarity*	14	Compulsory
	Consistency	14	Compulsory
	Minimal surprise	13	Compulsory
	User guidance	13	Compulsory
	User diversity	12	Compulsory
Graphic Design Principles	*Metaphor*	13	Compulsory
	Clarity	12	Compulsory
	Consistency	14	Compulsory
	Alignment	14	Compulsory
	Proximity	14	Compulsory
	Contrast	14	Compulsory
Interaction Styles	*Menu*	11	Compulsory
	Object manipulation	8	Recommended
	Form fills	9	Recommended
	Pull-down	9	Recommended
	Point & Click	14	Compulsory

Table 4.7 continued.

Design Elements	Graphs	2	Discarded
	Charts	12	Compulsory
	Images	9	Recommended
	Text	14	Compulsory
	Colours	14	Compulsory
	Icons	12	Compulsory
	Hypermedia	4	Discarded

Note:
Total = Number of existence for each components

Having completed the review and analysis of HCI components, there are four significant aspects; user interface, graphic design principles, interaction styles, and design elements should be included in the conceptual design model.

User interface has a few guidelines in their principles. As far as the interface development for youth are concerned, user familiarity, consistency, minimal surprise and user guidance are appropriate for the interface. However, user diversity principle which supports different type of users is unsuitable to be used in the interface as the decision making application is using youth as the specific user for the aid.

Graphic design principle contains metaphor, clarity, consistency, alignment, proximity and contrast to enhance the user interface. Interestingly, all of these principles can be applied. The graphic design concerns on the 'look and feel' for the users to enjoy using the decision making application without being distracted.

The *styles of interaction* are very crucial to the users as it becomes the major communication for non-linear medium. The listed principles are suitable enough to

be used and able to facilitate and accelerate the user when using the personal decision aid.

Then, text, colour, images, icons, and charts are the basic *design element principles* that are adapted in the majority of decision making or any system application. Besides that, there is other design element such as hypermedia that is unsuitable for personal decision aid application. This is due to the type of design that required several types of media to allow information to be linked with other association, and handling graphic, which are not provided in the proposed decision aid application.

Decision making system that is easy, simple and compact is the main goal of the conceptual design model development. The developed prototype with the additional elements is explained along with the prototype development in Chapter 5.

4.2.5 Supporting Theories

Eight theories are selected in the construction of conceptual design model for youth, namely theory of personality traits, multiple intelligence, decision theories, behavioural decision, cognitive psychology, utility, preference, and dominance. Table 4.8 lists the justifications for the selection in the conceptual design model.

Table 4.8

Justifications on the Theories Used in Personal Decision Aids

	Theory	**Justification**
1.	Personality Traits	Able to recognise the characteristic of youth where each individual has uniqueness on the thoughts, feelings, attributes motives, value, and behaviours.
2.	Multiple Intelligence	Identify the intellectual background because youth is born with a uniform cognitive capacity that different kinds of intelligence reflect different ways of interacting with the world. Each youth has unique combination intelligences.
3.	Decision Theory (Descriptive, normative, prescriptive)	Contain mode of analysis in the decision study. The major concern of this study is prescriptive that acts as the guideline on how this study should be carried out. The attention will be on the actual decision makers, specifically youth.
4.	Behavioural Decision	Combine youths' values and beliefs into decisions and courses of action. The list of alternatives and recommendations are evaluated in the decision tools.
5.	Cognitive Psychology	Shows the way a youth understands and solves problems. These principles help to reflect the type of design that should be integrated in the development of personal decision aid. These principles are chosen because of the ability to influence human in decision making
6.	Utility	The utility resulting from youth's actions for making a decision. This theory has two basic decision-rules in selecting the options and decision-making (i. choose the alternative with the highest utility, and ii. choose the alternative with the highest utility. If more than one has highest utility, pick one of them). It also based on the four assumptions (completeness, more-is-better, mix-is-better, and rationality)
7.	Preference	Assist in finding the best recommendation out of available alternatives in the decision aid
8.	Dominance	Searching for dominance structure where one alternative is perceived to be governing over the others. Able to be practiced on decisions under uncertainty where this is essential to this study

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Each theory has certain inference to this study. The decision theory that involves descriptive (how the decision maker makes decision), normative (how the decision maker should to make decision) and prescriptive (how the decision maker should to make decision on the real people) decision are theories that guide the mode of analysis made in the decision studies.

Commonly, the modes of analysis act as the standard on how this study should be executed. In the personal decision aid, Behavioural and Cognitive theories comprise the understanding of youth in making a decision. Specific actions (Behavioural) and mental representations (Cognitive) have significant impacts to human in decision making. Therefore, both of these theories should be taken into account in preparing a youth decision aid.

Besides that, Utilities, Preferences and Dominance theories contain the practice of operation in youth decision aid commenced by decision makers. Human decision process that covered by these theories are vital to this study including rationality, transitivity and dominance structure.

The justifications of the deliberated theories indicate the ability of the theories in enhancing the results in decision making process. Thus, the integration of those theories is something useful in the design model development of personal decision aid.

4.3   The Proposed Conceptual Design Model

Having identified the components, sub-components, and elements, a conceptual design model to assist youth with personal decisions is finally developed. Generally, the model consists of three main phases, aligned with what have been outlined in Simon (1965); i) Intelligence, ii) Design and iii) Choice. Basically the phases represent the first main component of the model. Each phase contains respective decision-making processes, which serve as the input to the next phase. In Intelligence phase, two psychological test inventories are included, which are Personality Trait and Multiple Intelligence tests. The two test inventories are used for problem identification as their ability to work as System Investigator (in SDLC) to recognise problems. This phase contains three steps (setup the user profiling, store accepted threshold and normalize user profile) that have been explained previously.

The Design phase holds the core decision-making process that consists of two activities which are extract user information, and calculate decision. This phase acts as System Analysis in SDLC that capable to develop the options from the specified problems in Intelligence phase.

Finally, the Choice phase which also called Select Solution in Scientific Approach displays the recommendations that contains two options; "Yes" (where user accepts the solutions and proceeds with database updating process) or "No" (rejects the provided solutions and continues with re-evaluation of the decision threshold). If the latter is opted, all processes in the Intelligence phase has to be repeated and completed before new recommendation is provided.

With respect to the Design phase, the proposed model embeds three other components of the design model namely the Decision Criteria, Decision Technique, and HCI component, into it.

- Decision Criteria – This component consists of Personality Style and Intelligence Level of the youth that derived from comparative study (refer to Section 4.2.2). The Personality Style part is adapted from the work of Myers & Brigg in 1940s where 16 types of personality can be differentiated using MBTI test inventory. As for the Intelligence Level, the Multiple Intelligence test inventory by Gardner (1983) is used where nine different intelligence levels can be determined. The result from the two previous test inventories constitutes the main criteria of the decision making process in YouthPDA. The recommendations shown in the YouthPDA also will dynamically change if changes are made to the test inventories. These changes are possible due to the constant change in the way an individual feel, think and judge along the growing up process. Thus, the dynamic of individual's personality styles and intelligence level resulting in different recommendation in the decision making process.

- Decision Technique - the Design phase of the YouthPDA model is supported with the contextual-awareness approach. The approach is used in the design model because of the ability to personalizing the personality types of the user. Technique component used in the YouthPDA is Rule-based Reasoning (RBR) using the Forward Chaining method. RBR that went through comparative study process along with other available techniques is chosen for defining and implementing business logic rule in integrating the provided Personality Styles and Intelligence Level criteria.

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- HCI component - This component consists of User Interface Design Principles (with sub-components; User Familiarity, Consistency, Minimal Surprise, and User Guidance), Graphic Design Principles (with sub-components; Metaphor, Clarity, Consistency, and Alignment), Interaction Styles (with sub-components; Menu, WIMP, Form Fills, Pull-Down, and Point-and-Click) and Design Elements (with subcomponents; Text, Colour, Image and Icon). In the model, these components are recommended (but not compulsory) to be integrated together as they are used to smarten the interface design by concentrating on the interfaces between users and computers.

Lastly, all the components mentioned above are supported by related theories. Altogether there are eight theories incorporated in the model namely; personality type, multiple intelligence, decision theories (descriptive, prescriptive, and normative), behavioural decision, cognitive psychology, utility, preference as well as dominance. All these theories are basically more on the behaviours of individual in making a decision. Figure 4.3 illustrates the whole phases and components in the conceptual design model.
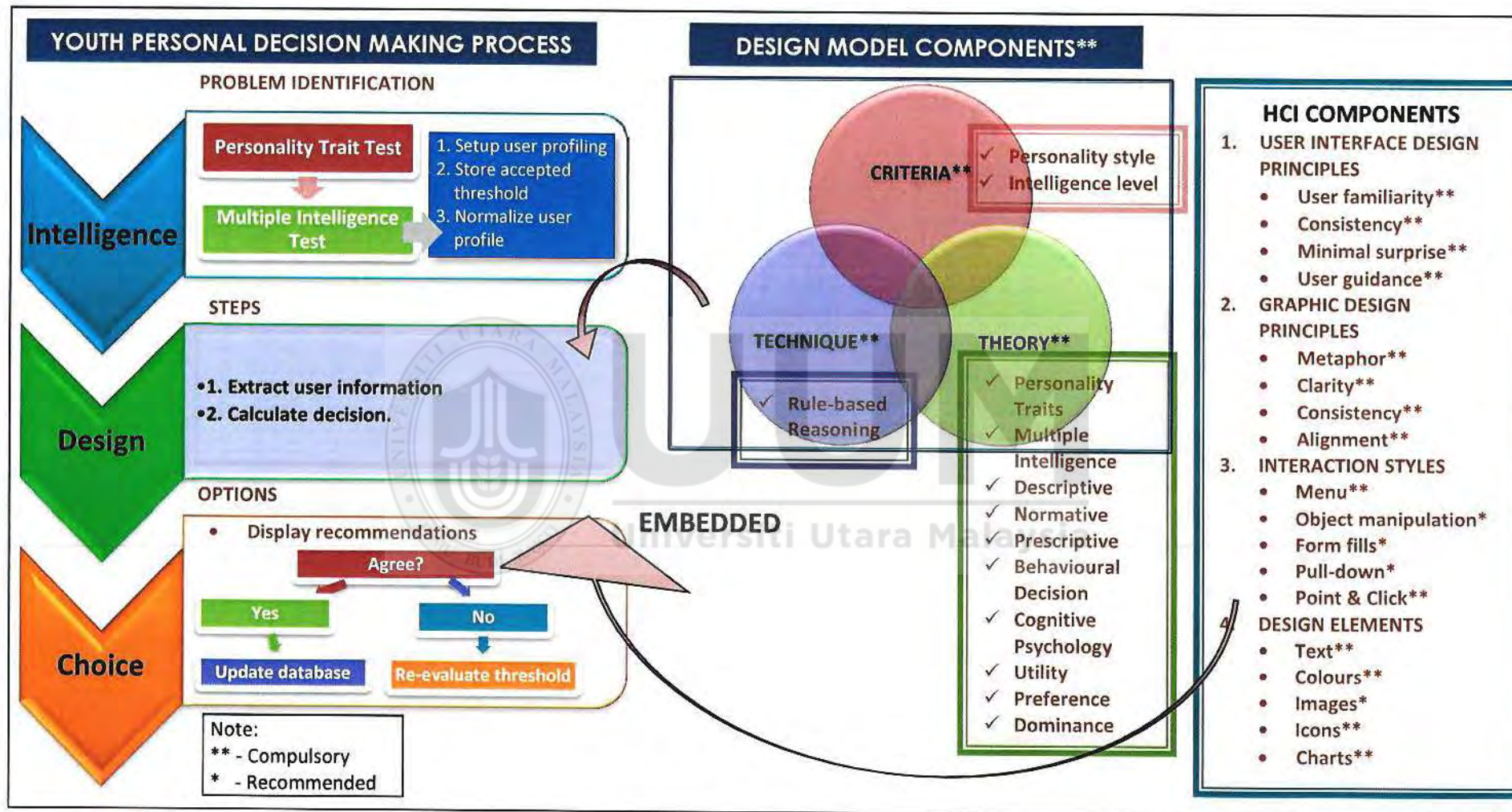
Figure 4.3. Proposed conceptual design model of YouthPDA

4.4 Expert Evaluation of the YouthPDA Conceptual Design Model

Expert review technique is chosen to evaluate the proposed conceptual design model of YouthPDA to accomplish Objective 3 in the study. Seven experts were selected to act as evaluators. They were chosen for their expertise and have PhD in respected fields including Computer Science (CS), Human Computer Interaction (HCI), Software Engineering (SE), Information System (IS) and other related areas. Besides that, some of them have more than 15 years' experience and holding key positions in their department.

The demographic profiles presented in Table 4.9 consist of the seven experts who evaluated the design model of YouthPDA. The numbers of experts are considered adequate as stated in the conditions set by Folch-Lyon and Trost (1981), Kitzinger (1995), Morgan (1996) and Nielsen (1997).

Table 4.9

Profile of Expert

Expert	Gender	Age (Year)	Field	Affiliation	Experience (Year)
1	Female	45	CS	Universiti Malaysia Terengganu	21
2	Male	37	HCI	Universiti Teknologi MARA	8
3	Male	50	CS	Universiti Utara Malaysia	24
4	Female	37	SE	Universiti Teknologi MARA	10
5	Male	39	HCI	Universiti Utara Malaysia	15
6	Male	45	CS	Universiti Putra Malaysia	19
7	Female	37	HCI	Universiti Tun Hussein Onn	14

4.4.1 Instrument and Procedure

The review process starts with the invitation via email to the identified experts. After the experts replied, the official appointment letter by the dean (Appendix B) and consent form (Appendix C) were sent to them. Next, the experts received an illustration of the proposed YouthPDA's Design Model together with Expert Review Form (Appendix E) through email. The experts took approximately two to six weeks to accomplish the task.

Expert Review Form contains a brief description of the YouthPDA as well as a set of questionnaire as the main instrument. Overall, seven questions were asked, containing; 1) terminology used in main components, 2) process involved in each components, 3) proposed elements in the design model components, 4) proposed additional elements in the design model components, 5) connections and flows of the components, 6) usability of the design model to the development of YouthPDA, and 7) practicality of the design model. In addition, open-ended questions as well as the recommendations or comments toward the proposed design model are included. Besides that, the demographic questions (age, gender and experience) were also asked.

4.4.2 Findings

The instrument was provided to the expert together with the proposed conceptual design model. The components in the reviewed design model are the items that will be asked in the instrument (please refer Appendix E).

From the proposed design model, two of the terminologies used are easy to understand. Though, the 'Intelligence' term required further clarification on the meaning.

In general, overall responses from the experts show that they have accepted most of the processes in each component on Question 2 as easy for their understanding. However, 'Problem Identification' term needs some clarifications on the Personality and Multiple Intelligence test. Besides that, 'Re-evaluate Threshold' term in the Choice process is another component that needs further explanations. It is due to 'Re-evaluate Threshold' component that stopped in the process, whereas it should be connected back to the 'Problem Identification' component.

The experts generally agreed on the relevancy of the proposed elements in the conceptual design model components (Question 3). Technique, Criteria and Theory are the three main elements which are the pillars of the establishment of the design model.

The conceptual design model also needs additional elements such as User Interface Design Principles, Graphic Design Principles, Interaction Styles and Design Elements in the development. These proposed additional elements were said to be relevant by majority of the experts (Question 4).

Furthermore, the experts also agree on Question 5, Question 6 and Question 7 where;

   i)   the connections and flows of all the components are logic,

ii)   the proposed design model is usable to the development of YouthPDA, and

iii)   the design model is practicable.

Table 4.10 depicts the frequency of responses from the experts' evaluation that based on the proposed conceptual design model.

Table 4.10

Frequency of Responses from Expert Evaluation

ITEMS	Frequency (n=7)		
	Needs very detail explanations	Need some explanations	Is easy to understand
Q1: Terminology used in main Components			
a) Intelligence	1	4	2
b) Design		3	4
c) Choice		3	4
Q2 : Process in each component			
Intelligence (*Problem Identification)*	1	5	1
a) Set up user profiling	1	1	5
b) Store accepted threshold	1	2	4
c) Normalize user profile	1	2	4
Design			
d) Extract user information		3	4
e) Calculate decision		3	4
Choice			
f) Update database		1	6
g) Re-evaluate threshold		5	2

Table 4.10 continued.

	Some are definitely not relevant	Some may be not relevant	All are relevant
Q3: Proposed elements in the design model components			
a) *Technique*			7
b) *Criteria*			7
c) *Theory*		2	5
Q4: Proposed HCI components			
a) *User Interface Design Principles*		2	5
b) *Graphic Design Principles*		2	5
c) *Interaction Styles*	1	2	4
d) *Design Elements*	1		6
		Yes	**No**
Q5: The connections and flows of all the components are logical		7	
Q6: The model is usable to development of YouthPDA		7	
Q7: The design model is practicable		7	

Note:
Q1= Question 1

As discussed previously, most of the terminologies used, connections as well as the flows, and the design model itself are acceptable by the experts. Conversely, the experts believe that there are some improvements need to be made in certain areas on the design model as shown in Table 4.11.

Table 4.11

Further Comments by the Experts

Experts	Comments
1	• Include 1 more phase under Youth Personal Decision Making Process which is Implementation. • Add phase such as Monitoring, so it will be a complete process of decision making and inclusive conceptual design model.
2	No comments
3	• Background knowledge as 1 element or part of the main elements in design process model. Background knowledge (e.g. experiences) of the youth can influence the decision.
4	• The elaboration of what is intelligence is needed before the design is implemented. The term "intelligence" should has its own scope in this research so that we can map which is the best theory (s) that can be adapted for the tool.
5	• Should identify why PT & MI are called Problem Identification
6	• The model is quite comprehensive. It depends on the platform for running the application.
7	• Design Model Components & HCI components: o From all the steps as stated in the design phase, where will the components be embedded?

Consequently, the experts additionally provide their further recommendations in the provided space. Their comments have been put in the Table 4.12 for easy understanding.

Table 4.12

Further Recommendations by the Experts

Experts		Comments
1	i)	Add some iconic explanation in the Intelligence phase for PT and MI tests.
2		No comments
3	i)	Representing an additional component in design model as one of the "bubble" and concatenate with all the bubbles. There is no need to put the explanation about each of the HCI components in the diagram. So the diagram will be more concise and pictorial (more graphics and less words)
	ii)	The linked between Youth Personal Decision Making Process and Design Model Components is not clear. Some "flows" between them need to be established in order to make the model clearer.
4	i)	The model is beneficial for decision making. During problem identification, the two tests should be significantly mapping the design so that it can be demonstrated properly by using the model.
	ii)	The techniques mentioned are relevant to be used.
	iii)	The design model should be able to tackle the problem identified in 'Youth Personal Decision Making Process".
	iv)	Overall, this research is beneficial for storing tacit knowledge.
5	i)	In the Design Components (Youth Personal Decision Making Process), are you proposing the algorithm for system analyst or programmer? The algorithm is not clear. It is ok if it is a process flow.
	ii)	In Choice phase, it is recommended that the proposed design should show the repetition flow when the process needs to "re-evaluate" value.
	iii)	Design Model Components are acceptable.
	iv)	HCI components are acceptable.
6	i)	The design of YouthPDA should consider the device used by the user for running the application. As an example, this application should be running with very minimal requirement for memory, space etc.
7	i)	In Choice phase, it is recommended that the proposed design should show the repetition flow when the process needs to "re-evaluate" value.
	ii)	The proposed approach (PT & MI) was used in Intelligence phase (Youth Personal Decision Making) and Criteria + Theory (Design Model Components). What is the difference of this approach in each phase?
	iii)	Are the PT and MI tested in Intelligence phase used to determine "criteria" in the Design Model? The outcome of the first phase is not clearly shown how it will be used in the next phase (Design phase).

4.4.3   YouthPDA Design Model Refinement

A number of tasks have been carried out to refine the relevant decision criteria, techniques and supporting theories for the development of YouthPDA's design model. A few lacking points in the design model are studied thoroughly. The justifications are elucidated either it should be taking into account or not.

The recommendations by the experts are valuable in improving the clarity of the design model. YouthPDA is a decision making application that specifies a few areas for youth. The conceptual design model of YouthPDA is reviewed and restructured to enhance the readability of the model so as to cater the comments concerning clarifications of terminologies used, iteration link, and the relation between decision making processes with design model components as discussed clearly in previous sub-section.

There is one suggestion from the expert to include another two phases called Implementation and Monitoring in order to have a complete process of decision making and inclusive conceptual design model. However, as mentioned in the Chapter 1, this study is intended to help only in providing recommendations to the youth. They will choose the provided alternatives freely as the options are coming from their own personality. Therefore, the process for YouthPDA will discontinue at Choice phase.

Another suggestion is to make Background Knowledge as part of the main elements in the Design Process Model. The idea is good, but then the Background Knowledge is more focused on intelligence and it is already considered in the decision criteria.

Besides, explanations to PT and MI somewhat less resulting experts are confused about the terms used. In addition, the term 'Intelligence' is also mixed-up with Multiple Intelligence. Thus, it is suggested that the two terms are explained in the instruction to the experts before they review the proposed conceptual design proposed model. Besides that, the terms also are explained in a clearer way as depicted in Figure 4.4.

There is a confusion of one expert where she asks question on the relation of Design Model and HCI Components with Design phase. It is admitted that the two curve arrows connection are unclear. Thus, the refinement is made to emphasise the connection as shows in Figure 4.5.

As for the *'Further Comments by the Experts'*, a few experts prefer to have icons or any graphical images referring to the elements in the conceptual design model. In other words, they prefer to have less word in the model. Conversely, there are also some of them who accept the way of Design Model Components and HCI components are presented. The techniques mentioned are said to be relevant to be used.

Another suggestion by the experts is the proposed design should show the repetition flow when the process needs to "re-evaluate" value. It is a good suggestion since there is misperception about the existing design. The recommendation is accepted and the refinement is made as exhibits in Figure 4.6.

There is also a question on how the first phase (Intelligence) determines the second phase (Design phase) in the design model. Basically, the outcome from the first phase is clearly showed by the "down arrow". Thus, there is no modification on the matter. Remarkably, one expert did mention that this research is beneficial for storing tacit knowledge.

4.4.3.1 Clarification of the terms used

Firstly, the clarification on the terms used in the design should be depicted in short, easy and understandable descriptions as shown in Figure 4.4.
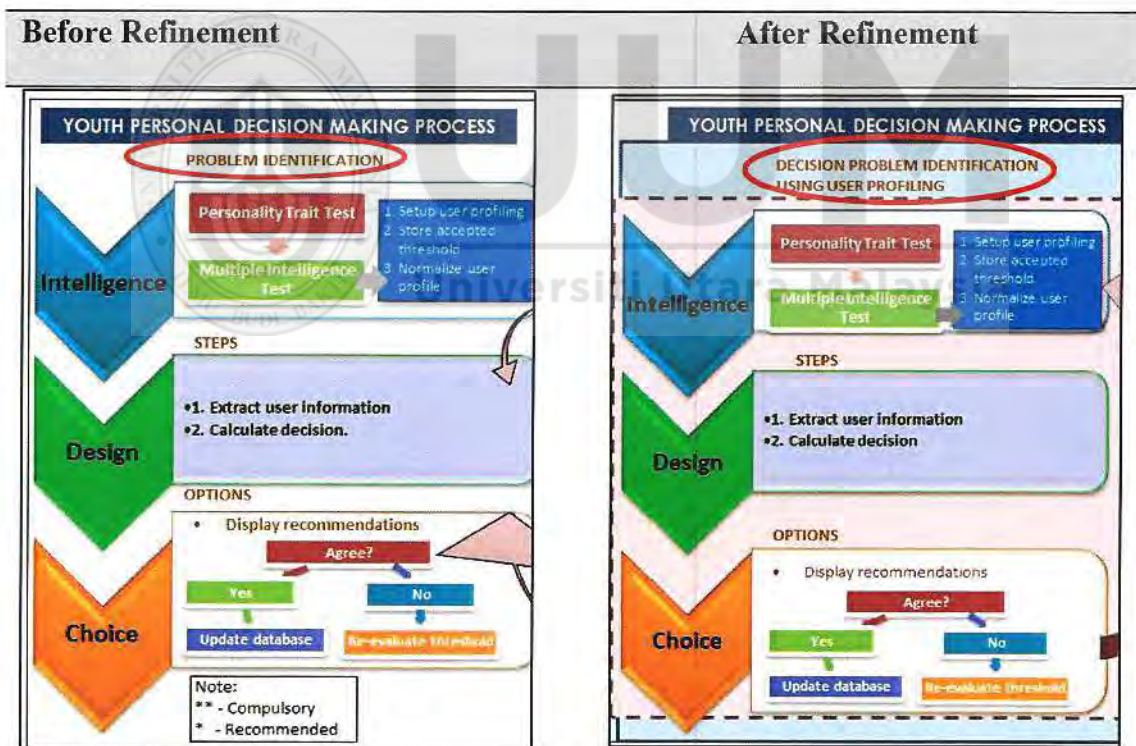
Before Refinement	After Refinement
1. Intelligence term is only clarified as problem identification.	1. Intelligence term is explained in an understandable sentence.

Figure 4.4. Clarification of the terms used in the design model

4.4.3.2 Connection between Decision Making Process and Design Model Components

As stated, design model components are the input to the decision making process. However, the flow for this connection was unclear. Issue of clarity on which components in the Design Model Components that 'embed' in which phases of Decision Making Process is depicted in Figure 4.5 with a circle.
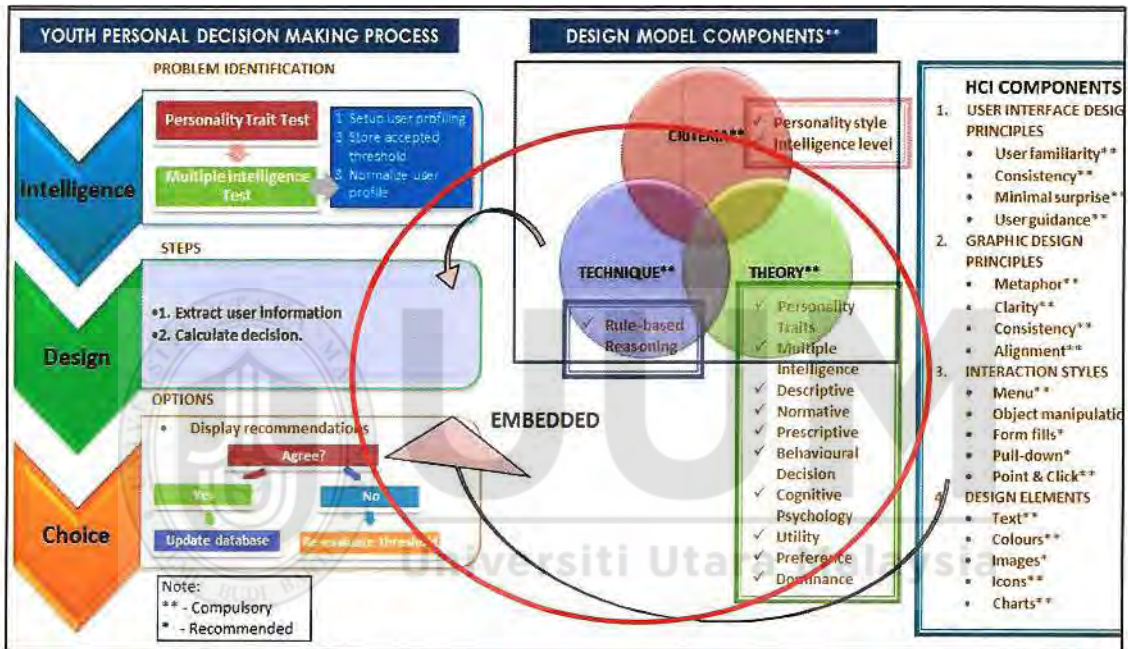
Figure 4.5. Proposed connection between decision making process and design model components (before refinement)

In order to make the designer understand more on the process, the proposed design model has been reworked and revised for better understanding as depicted in Figure 4.6. The two confusing arrows in the proposed version were removed and replaced with one connection from merging the Design Model Components and HCI components (highlights with circle), that directly were embedded in the Design phase of decision making process. Next, the position of Decision Making Process is

swapped with Design Model Component for better visual interpretation on design model.
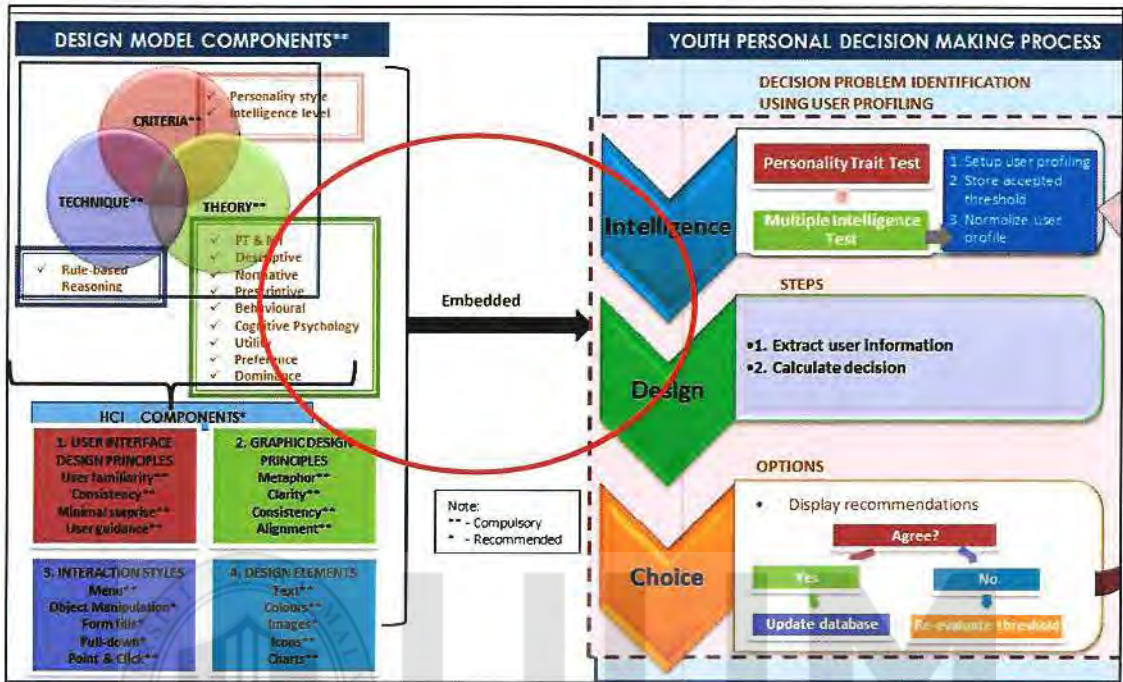
Figure 4.6. Finalised connection between design model components and decision making process (after refinement)

4.4.3.3 Repetition Flow at 'Re-evaluate Threshold'

As discussed previously, the 'Re-evaluate Threshold' option gives another opportunity the youth in order to improve the recommendations by the YouthPDA. If the youth do not accept the recommendations, the value will be re-evaluated, and the process should be restart at the Intelligence phase. The process 'Re-evaluate Threshold' in the existing conceptual design model is static without being connected to other process. In the refinement as shown in Figure 4.7, there is one big arrow symbolised as iterative process is place between 'Re-evaluate Threshold'. The recommendation is accepted and the refinement is made as exhibits in Figure 4.7.

Before Refinement	After Refinement
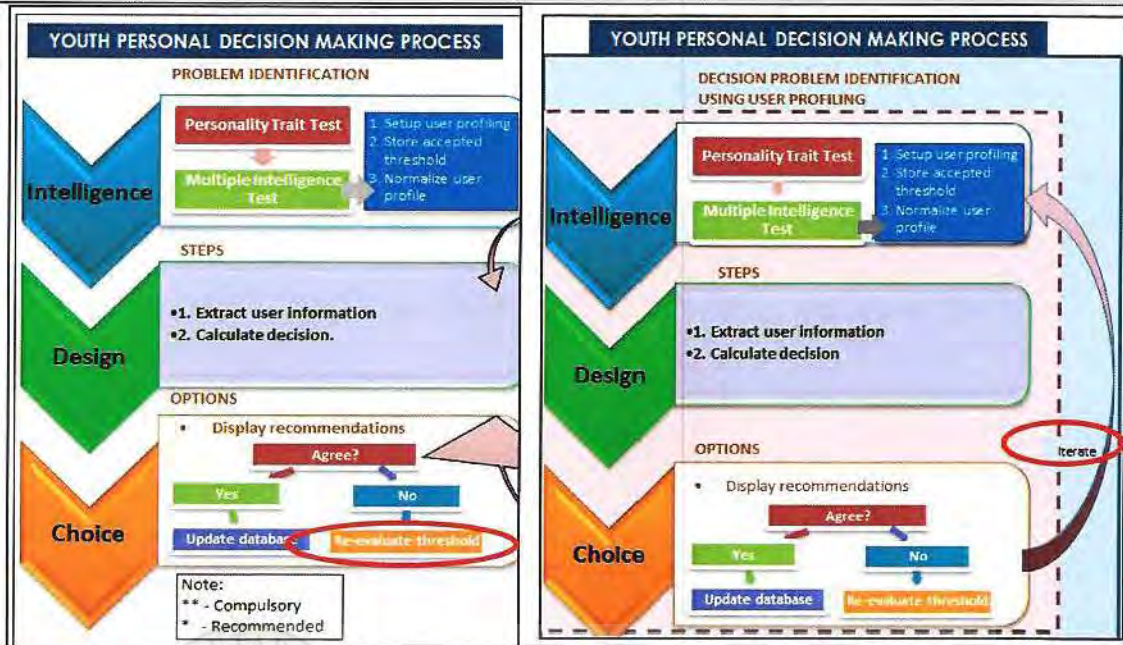
• Re-evaluate Threshold process is stopped, and not connecting to any other process.	• Re-evaluate Threshold process is connected iteratively to the Intelligence process.

Figure 4.7. Repetition flow at 'Re-evaluate Threshold' process

Other than that, the experts accept on the Design Model and HCI components, and the conceptual design model for YoutPDA is relevant to be used. Figure 4.8 illustrates the refinement on the Conceptual Design Model of YouthPDA.
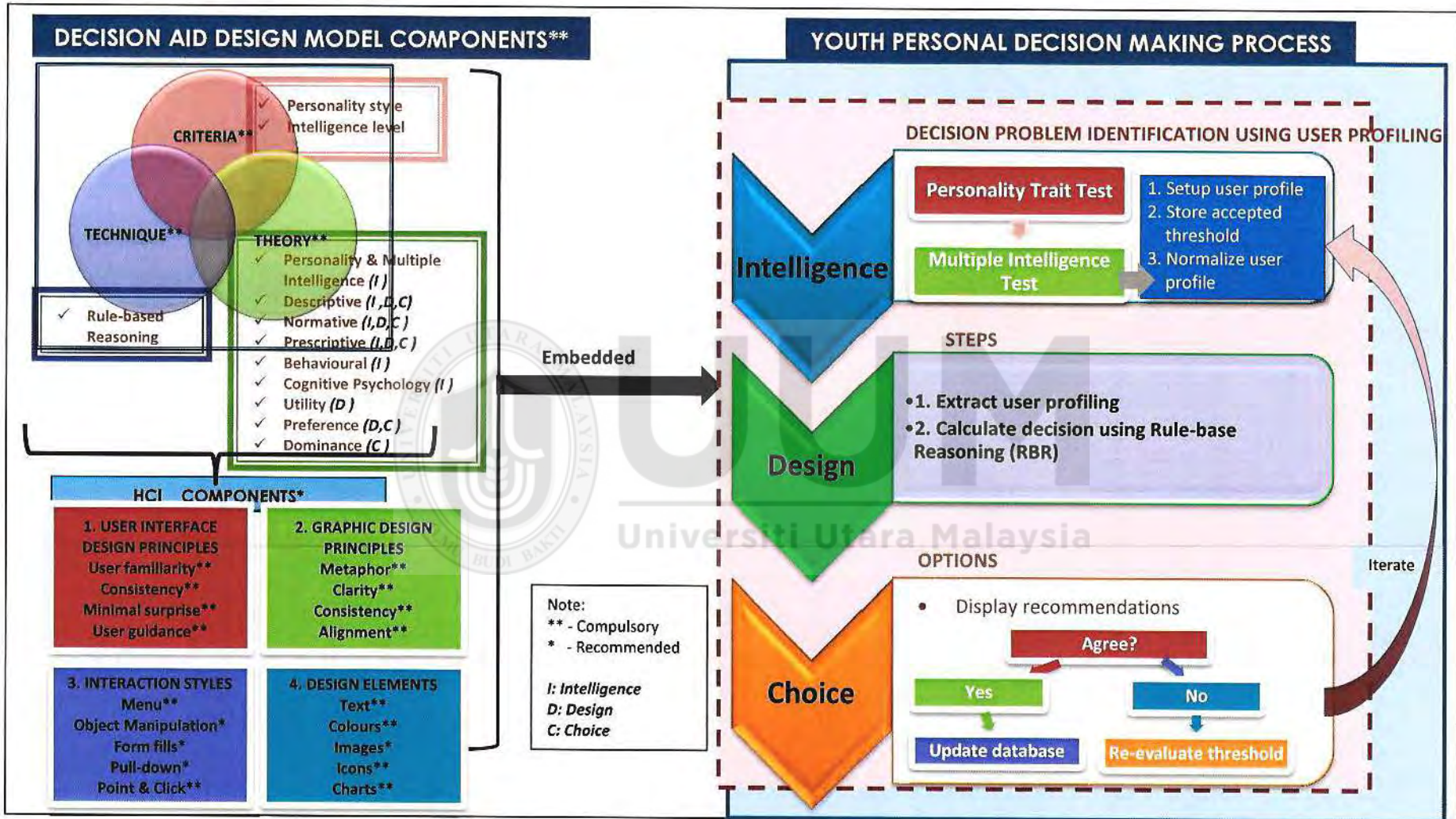
Figure 4.8. Revised YouthPDA conceptual design model

4.5 Summary

Design model development involves a few undertakings processes. The comparative study, content analysis as well as justifications were carried out to support the selected technique, criteria and theories. The three components were then embedded in the Design phase of the decision making process. The outcomes from these two activities have achieved Objective 1 and Objective 2 of this study. This chapter too has another activity called experts review. The proposed design model was examined by experts in related areas to ensure the accuracy and appropriateness of the term used, and usability of developed design model. Refinement process then took place where the design model was revised based on the reviews. The finalised YouthPDA design model based on the validation by the experts review is the outcome of Objective 3 in this study. After that, the design model was used as the basis to develop the YouthPDA prototype. The purpose of the prototype is to measure the usefulness of YouthPDA which is the Objective 4 of this study.
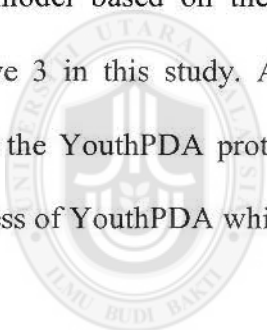
CHAPTER FIVE
YouthPDA PROTOTYPE

5.1 Overview

Prototype of YouthPDA is constructed for the validation of the usefulness. The process involved the youth profiling that has been derived from the PT and MI tests as clarified in previous chapter. There are two areas of decision making identified; study and career help youth with recommendations of the intended area. The construction processes and menu involved will be explained in the next sections.

5.2 Process Flow of YouthPDA

The YouthPDA application process flow starts with the users' input requirements which are; youth's academic achievement and their characteristic values in both Personality Traits and Multiple Intelligence tests for profiling purposes. Those are the three main criteria that give a huge impact to the results of the application. The multi-criteria might have changes throughout the decision making process. Therefore, threshold setting is set up prior to the user profiles that have been normalized, followed by storing in user profiles database.

Next, both of the tests results from users were calculated precisely after the extraction of youth information. The outputs (recommendations) were retrieved and displayed directly to the users. However, if the users are unsatisfied with the results, the threshold re-evaluation process will helps the users to redo the user profiling. This process generally will change the results dynamically because of some factors that able to change the interests or habits of the users, and might affects their personality while undergo the PT and MI tests.

The results that have been generated were updated in the database and the recommendations are displayed to the users. In this case, the pointed out areas for YouthPDA which are study and career will notify the youth's personality type as well as their multiple intelligence level. User profiling (youth's personality and intelligence level) was set up based on the test given, followed by recommendation results provided for youths to choose the best selection out of multiple alternatives given. Figure 5.1 depicts the overall process of decision making in YouthPDA.
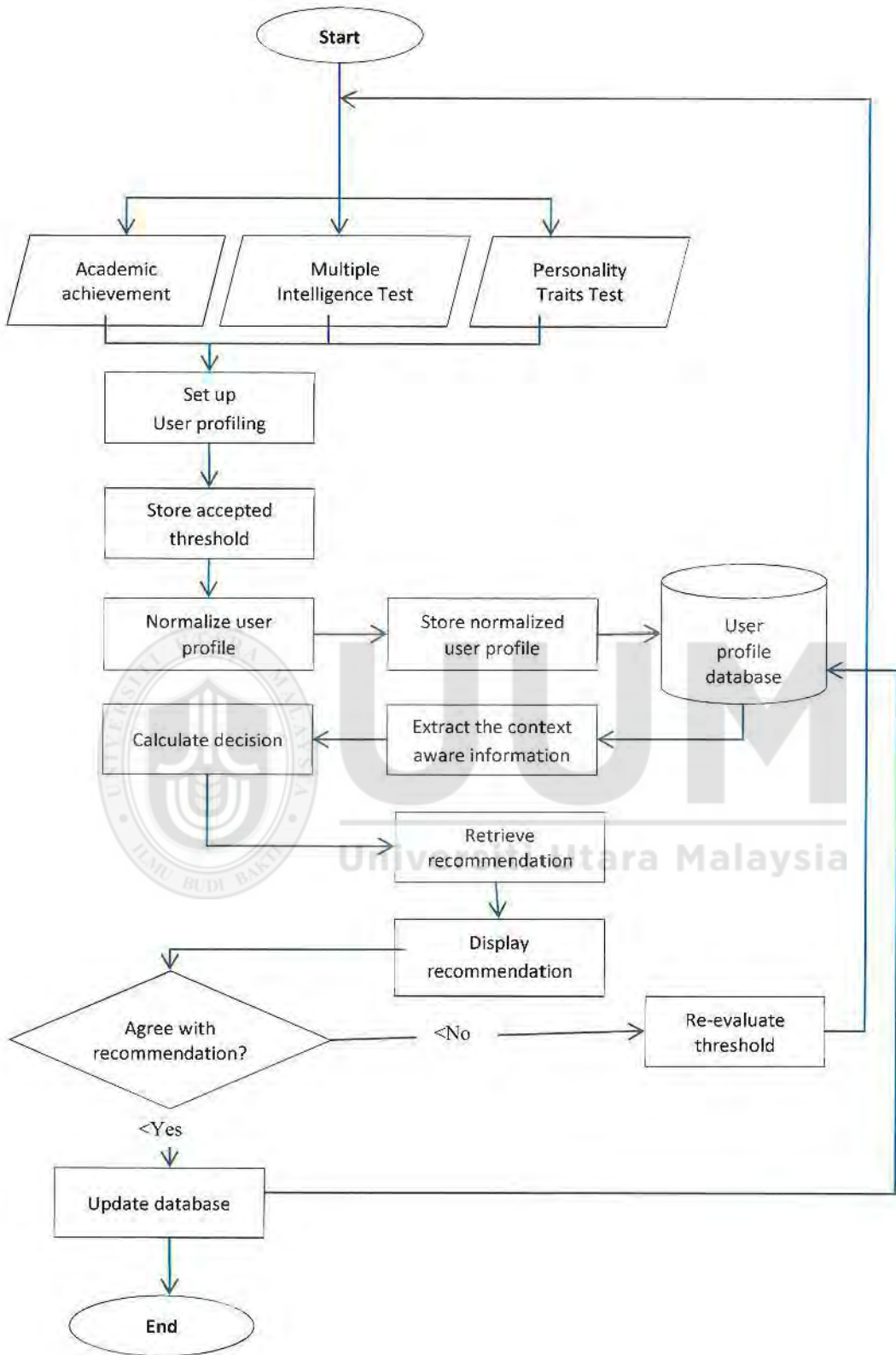
Figure 5.1. Process flow of YouthPDA Prototype

5.2.1 Discussions on Process Flow of YouthPDA Prototype

Having multi-criteria for youth in a decision-making application such as i) academic achievement, ii) Personality Traits, and iii) Multiple Intelligence are very important to grab as much as user details to be calculated for the recommendation results. However, the results are not conclusive as the multi-criteria are not pre-defined before the users using the YouthPDA. All the mentioned criteria are changed when the user alters their personality and intelligence levels in the available test (the academic achievement results are usually permanent unless they repeat the SPM examination).

Then, the user profiling is changed based on the output from re-evaluation process in both PT and MI test. Recommendations provided are dynamic as it is not fixed, which can be altered depending on the changes in the specified criteria. Some factors of the changes are insincerely reading and answering the PT and MI tests, or the aging factor that able to change the interests or habits of the users, that might affects their personality.

5.3 YouthPDA Construction

As mentioned earlier, the YouthPDA consists of two decision areas; study and career. The prototype would provide assistance in a way that not only helps youth to choose but also learn from the process. By using YouthPDA, the users (youth) will not only received the recommendation results, but they will also know the kind of personality (from the PT test) and intelligences (from the MI test) that they possess.

As stated in Chapter 4, there are 3 processes involved in the YouthPDA development which are intelligence, design and choice. In brief,

i. **intelligence** process: user profiling is introduced by capturing data from Multiple Intelligence and personality trait questions;

ii. **design** process: the normalized user profiles together with the acceptance threshold will go through rule-based system before recommendation is presented to the user; and

iii. **choice** process: involves the options of either accepting or rejecting the recommendation while updating the knowledge repository with new case. The knowledge repository is also referred to in situation where recommendation is rejected or deadlock takes place.

The YouthPDA system requires user input for profiling purposes, including academic achievement as well as their characteristic values in both personality traits and intelligence. Before the user profile is normalized, threshold setting should be set up and stored in user profile database. In the study section where youth is presented with best solution in finding a suitable program in the IPT after their SPM examination, the youth is required youth to fill in their academic achievement (SPM's result) and answer the questionnaires in MI test. MI test is used to measure the youth's intelligence level discretely. Both of SPM and MI test results are the main requirements to process the necessary recommendations.

In the career section, the youth is required to complete both of the personality assessment (PT) and intelligence level (MI) questions. This process is essential since each of individual is unique (even the biological twin), and they have to answer the

questionnaires themselves in order to get the precise results. The YouthPDA application displays the type of the youth's personality traits as well as the most prominent intelligence type before the user could perceive the given result of recommendations. This is the process where the context aware information was extracted and subsequently the results from the user are calculated. The recommendations as output are retrieved and directly will be displayed to the user.

YouthPDA recommendations for study and career are displayed to the youth using the tag clouds concept by providing a larger font to the suggested recommendations to emphasise the selected results. The results go through the threshold re-evaluation process if they are unable to satisfy the user and will go through the user profiling once again.

Lastly, the results that are generated will be updated in the database and the recommendations will be displayed to the user.

5.3.1   Prototype Development of YouthPDA

YouthPDA uses RBR specifically Forward Channing Method in the development stage which applies inference that creates step-by-step logic rules for achieving appropriate solutions based on facts. This Artificial Intelligent (AI) approach, RBR consumed the "if-then" rule statement (Buchanan & Shortliffe, 1984) and the solutions are based on gathering knowledge of literature that has been formed as bunch of rules.

Thus, the suitable technique for integrating both of the criteria is mapping the job scope for the specific of youth's personality using RBR as recommended by Tieger and Barron-Tieger (1992), Kroeger and Thuesen (2013), Robinson (2014), Reinhold (2014), and PersonalityPage (2014).This technique is used since the classification made (known as the knowledge base) from set of rules as suggested from previous studies about relation between MI and PT in career and study. In other word, this type of reasoning method could classify the solutions by using those facts (MI and PT) to be integrated as new solution as shown in Figure 5.2. This structure is the combination of Multiple Intelligence and Personality Traits theories that were adapted in the MI and PT tests and thus produce highly precise recommendations as the results in YouthPDA.
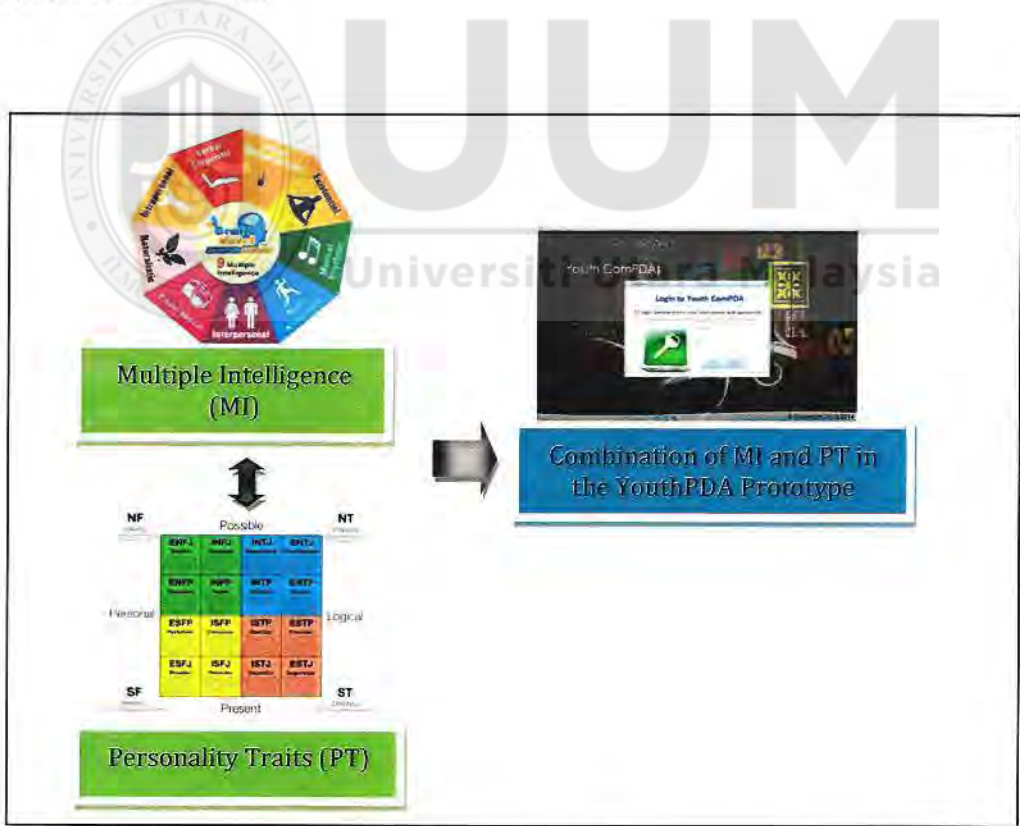
Figure 5.2. Structure of YouthPDA

Forward Channing contains rule statements that create patterns for each of given solutions. These patterns are used for inference engine to match the users input towards database as the provided solutions. In particular, the "if" statement here means "when condition is true", the "then" means "perform action A" and the "else" means "if the condition is not true take another actions". Inference engine are programs that can process those rules based on facts of a certain condition.

The YouthPDA application is developed using Netbeans software (java programming) as a desktop application. The development of this application also uses MySQL database as rule-based knowledge to determine the study and career results. The java coding below is the example of how to acquire the recommendations from personality test by the youth. The complete process of determining and acquiring the recommendations is clearly shown in APPENDIX F.

```java
    mm.callRequisteInterface(name.getText());
}//GEN-LAST:event_formInternalFrameClosed

public void calculateResult()
{
    String A = null;
    String B = null;
    String C = null;
    String D = null;

    ////1
    if(I > E)
    {
        A = "I";
    }else if(E > I)
    {
        A = "E";
    }else if(I>0 || E>0)
    {
        A = "E";
    }
    ////2
    if(S > N)
    {
        B = "S";
    }else if(N > S)
    {
```

```java
        B = "N";
    }else if(N>0 || S>0)
    {
        B = "N";
    }
    ///3
    if(T > F)
    {
        C = "T";
    }
    else if(F > T)
    {
        C = "F";
    }
    else if(T>0 || F>0)
    {
        C = "F";
    }
    ////4
    if(J > P)
    {
        D = "J";
    }
    else if (P > J)
    {
        D = "P";
    }
    else if(J>0 || P>0)
    {
        D = "P";
    }

    String result = A+B+C+D;

    String resultDesc = db.getDataFromTable(result);
    String                    newLine                    =
System.getProperty("line.separator");
    Integer                   process                    =
JOptionPane.showInternalConfirmDialog(this,
resultDesc,result+newLine+newLine+"Job Accomplish, Press Yes
to      go       next       step"+"       Personality
Type",JOptionPane.YES_NO_OPTION);
    if(process==0)
    {
        mm.callRequisteInterface(name.getText());
        db.add_personality_user(username,
result,editStatus);
        this.dispose();
    }
}
```

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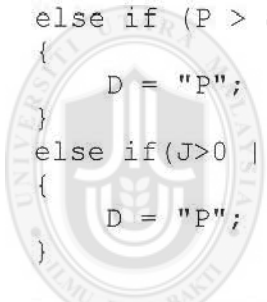
5.3.2 Functionality and Features of YouthPDA

A few main parts exist in YouthPDA interfaces including Login/Sign Up, Profile Details, Study Menu, Career Menu, PT Test, MI Test, Personality Result, Intelligence Result, Study Recommendations, and Career Recommendations' page. The functionality of YouthPDA in each interface is described accordingly with adapted features from the listed HCI components as justified in Chapter 4.

Firstly, this application requires a user to login into the system by signing up and completing the profile requirement (Figure 5.3). This page uses user familiarity principle from User Interface component for the login as the required information is only user name and password. Besides, user guidance principle is used to help a new user to register their information before user name and password are provided. The clarity concept from Graphic Design Principle component also is used to make eye slowly read the instruction as this is the starting page.

Figure 5.3. Login interface

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The process starts with login or sign up for a new user plus completing the profile details as depicted in Figure 5.4. Next, the user will choose either to acquire assistance of decision making on the study field (SPM results required) or career undertaking. This page uses the clarity and proximity from Graphic Design Principle and are applied to the interface for becomes more proficient. Clarity is used in the page for the form fills, while proximity is applied to the label and text box. User guidance principle is also used to help them with the form, such as calendar for date, and also notification if the required information is left in blank.
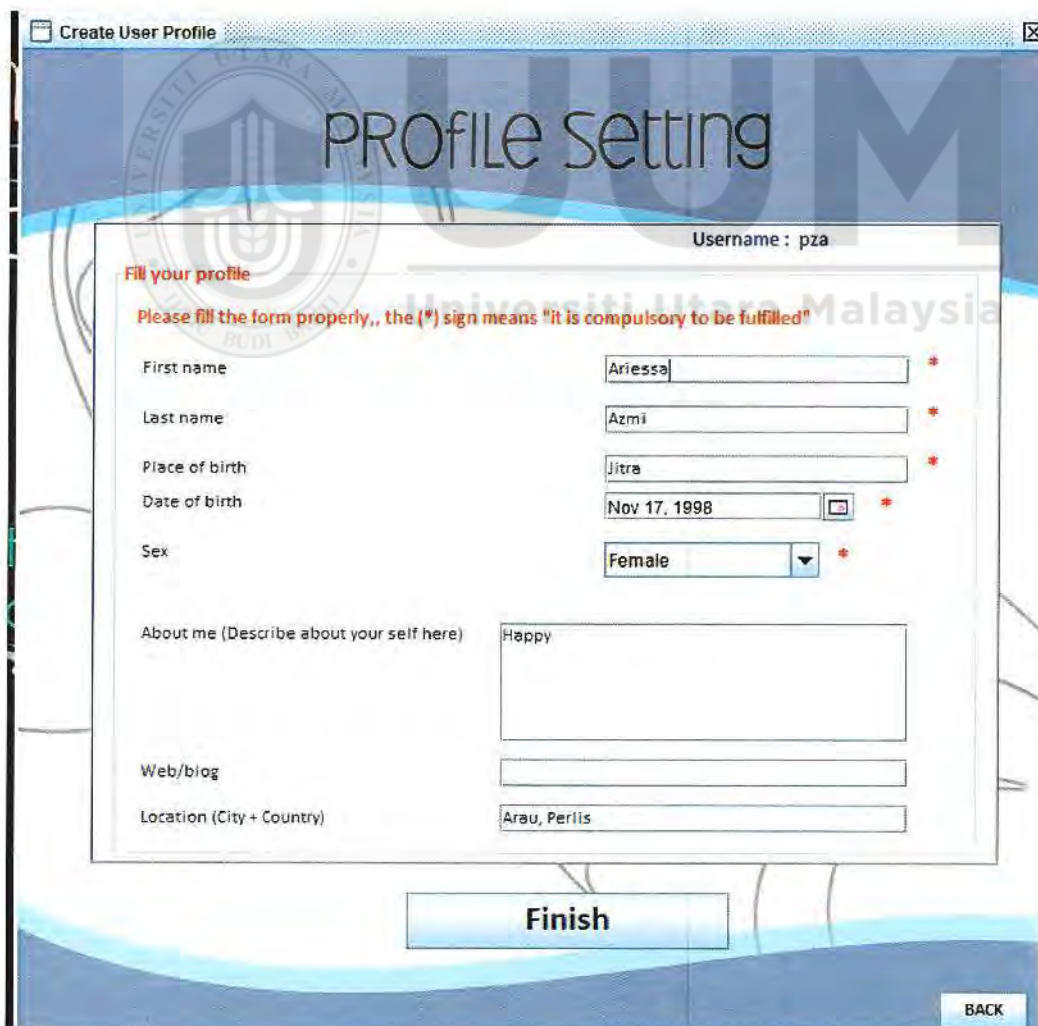
Figure 5.4. Profile user setting interface

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Figure 5.5 shows the main menu that provides entry to the career and study sections. Youths are allowed to choose STUDY DECISION if they are SPM's candidates who wish to know the best suggested suitable program in the IPT based on their results. Meanwhile, CAREER DECISION is generated for those who have necessity to get a suggested career solution based on their own character of personality. Besides the clarity principle, text, colour, and two icons from Design Elements component are used in representing study and career decision making.

Figure 5.5. Main menu (Study and Career)

5.3.2.1 Study Area Option

The welcome page for Study Area is depicted in Figure 5.6, where the process of MI test will be started. Consistency is of the colour, layout, and font is ensured from this page onwards.
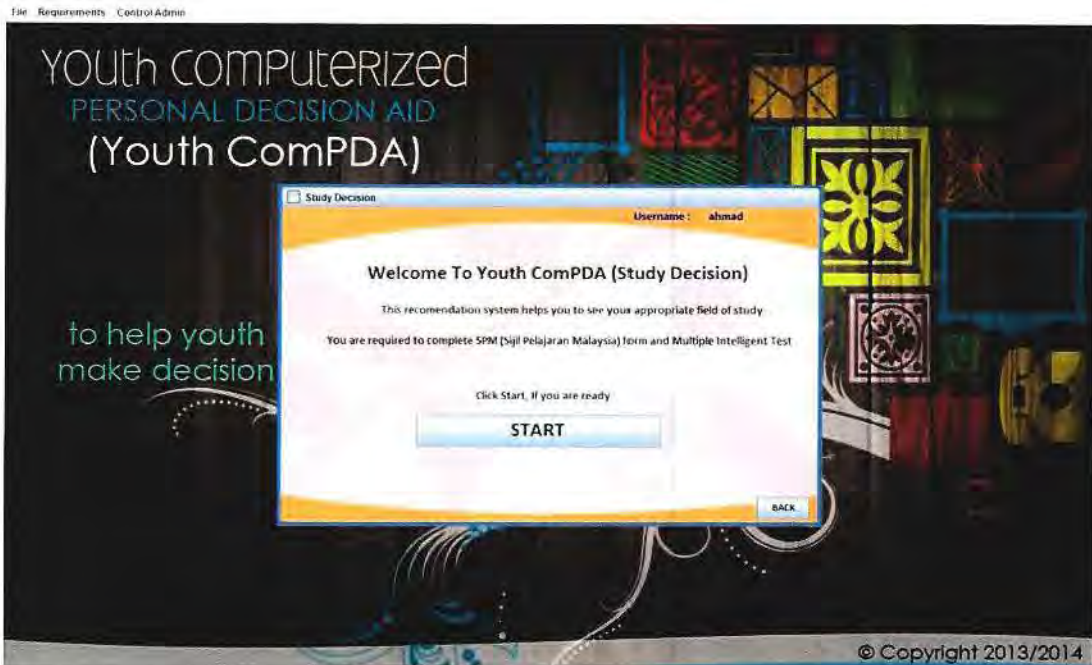
Figure 5.6. Welcome page- Study menu

The study section in the application provides SPM results form to be filled by the user as shown in Figure 5.7. Users fill the SPM before they are guided to the next sequence, the Multiple Intelligent assessment.

Interaction style of this page uses drop-down menu to list down all fields, subjects and grades of SPM result. Metaphor, clarity, and consistency from graphic design, and user interface principles were adapted to this page.

Figure 5.7. SPM's result interface

On the assessment page as represented in Figure 5.8, the two icons are the symbol for MI test which is on the left, and PT test is on the right. MI symbol represents the multi type of intelligences in each human, and PT symbolises the personality types of a mankind.

Figure 5.8. Multiple Intelligence and Personality Traits test

MI test consists of ten parts of questions involving the level of eight intelligences in each individual. The intelligences including Linguistic, Logical/Mathematical, Musical Rhythmic, Bodily/Kinaesthetic, Spatial, Naturalist, Intrapersonal, as well as Interpersonal will be evaluated in this process. Figure 5.9 shows the first part of the sample questions in the MI test.

Alignment of the questions asked in the MI test is designed to be readable by the users. The inquiries arranged horizontally by putting the check-box to the left of each question. Each page of the 10 parts of questions was designed so the text, check-box and buttons are within the screens. The point and click was used for easy interaction with the choice of two tests and the calculation button.

Figure 5.9. Sample questions of Multiple Intelligence test

Consequently, the process of calculating the result will be done after the CALCULATE DECISION button in Figure 5.10 is clicked. The icon used for MI test

is the same as the previous page for familiarity and easy recognition by users. The icon itself can be clicked if the user needs to re-sit for the test.
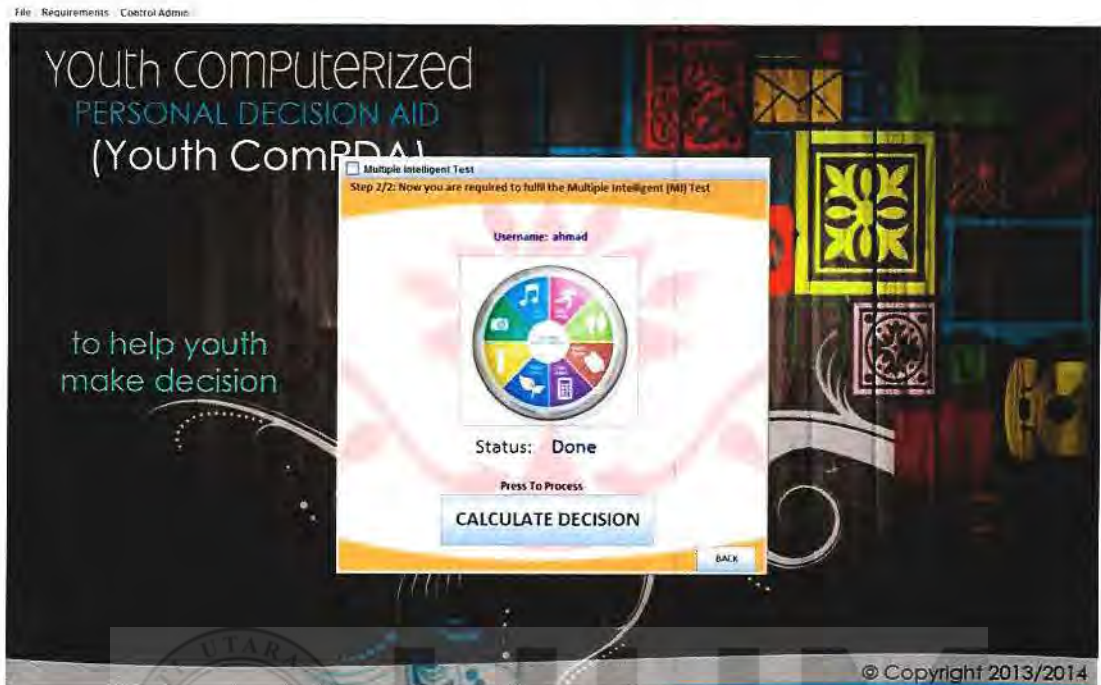
Figure 5.10. Calculate decision for Multiple Intelligence test

As a result, the level of eight intelligences in each of the youth will be displayed as shown in Figure 5.11. Based on the SPM result together with the intelligence level exclusively, the application is able to calculate exactly every single intelligence percentage, which shows that each youth is unique and has different capabilities.

The idea of this page is to grab the youth's attention towards the results provided by the application. Design elements adopt the different font style for text, multi-colour for results and explanation. This is quite important to distinguish marks for each level of intelligence.

Figure 5.11. Multiple Intelligence result

Lastly, the application will display the recommendations by using tag clouds visualization method. The tag clouds are used for faster insight understanding towards users to see what their prominent study areas are. Tag clouds visualization indicates the calculating results by exhibiting the bigger word for prominent recommended study area as revealed in Figure 5.12. Besides, the red text colour and font size are used to highlight the best recommendations for the youth based on their academic achievement and intelligence level.

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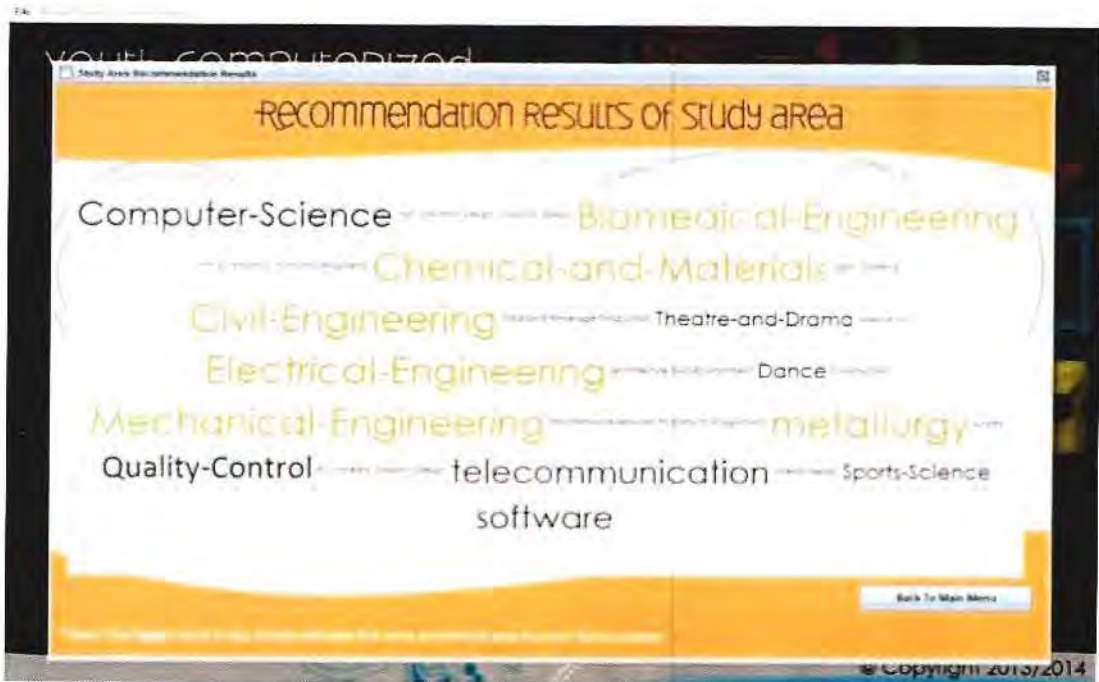
Figure 5.12. Recommendations display of study area

5.3.2.2 Career Area Option

Career decision making is another one of the youth's most required area based on the preliminary study by Norfiza (2013). Figure 5.13 shows the welcome page for the career decision making. The same additional elements from the Study menu pages also were implemented in these Career menu pages, except a slightly different colour used.

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Figure 5.13. Welcome page- Career menu

In order to provide thoughtful and appropriate recommendations, the youth's personality and intelligence level are taken from MI and PT tests. The youth is required to complete both assessments as part of career recommendations requirement. In the meantime, if the youth chose the STUDY DECISION as the first process in the application, the MI test would have been filled. Therefore, the youth is only required to complete the PT test questionnaires. Otherwise, the youth has to answer both of the tests sequentially. The PT test (Figure 5.14) contains of four parts of personality trait questions.
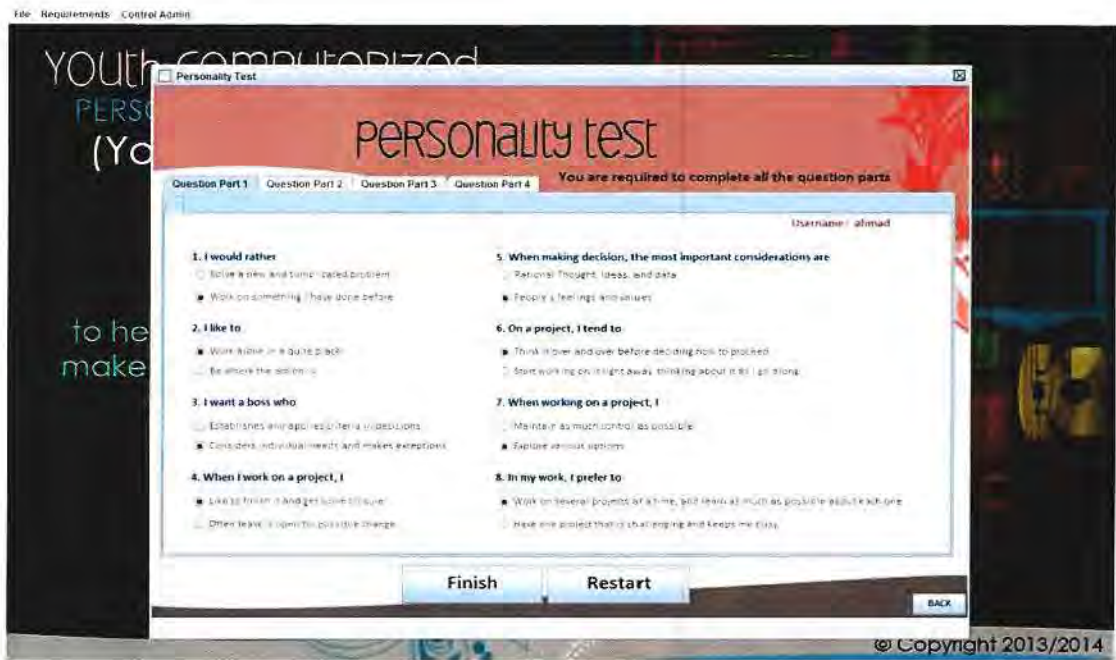
Figure 5.14. Sample questions of Personality Test

The application displays the type of characters based on current state of the youth. The results might differ from one youth to another and will also change if the youth is trying to use the application in five-year time. This is due to our interest and personality traits mostly will change over time. Figure 5.15 reveals the youth's personality type based on the generated PT test.

From the result, the youth will learn their personality and be aware of what are appropriate for him/her. Clarity and alignment from Graphic Design Principles were used to strengthen impact of the information regarding personality type of the youth. The left alignment make the reading more comfortable and the information is easy to be generated.

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Figure 5.15. Personality types result

Finally, the list of the required recommendations for both study and career are displayed using tag cloud visualization model. Recommendations for the Career Area (Figure 5.16) are calculated from the two tests; PT and MI.

The recommendations for the career area uses contrast in the graphical design where the red text colour and bigger font size presenting the top recommendations for the youth based on their personality style and intelligence level. In addition, tag clouds visualization is also used to recommend the fit career.

Figure 5.16. Recommendations for Career interface

5.4 Summary

This chapter mainly describes on YouthPDA prototype that consists of two main parts involving study and career solutions. The study section (specifically designed for suitable program in Higher Learning Institutions) and career (appropriate occupation) were constructed in the prototype. The prototype construction has applied the conceptual design model that was discussed in Chapter 4. The proposed conceptual design model was used in developing YouthPDA for two are area of decision making; study and career.

This chapter has implemented all the design model components (theories, criteria and technique) in the prototype construction. Other than that, the flow of the prototype is outlined accordingly with phases in decision making process in the design model

which started with PT and MI tests to identify problem, followed by six steps in the design process, and finally with recommendations provided to the youth.

Furthermore, the YouthPDA prototype also ensured that the HCI components are emphasised is explained along with the respected interfaces. The prototype was tested to the youth, and the validation on the YouthPDA usefulness is deliberated on the next chapter.

CHAPTER SIX
YouthPDA USEFULNESS

6.1 Overview

The YouthPDA application was validated through prototyping method; a series of lab experiments and walk in experiments were carried out for this purpose. This study focuses on measuring the usefulness of the decision aid by using questionnaire as the mean of data collections. The next sections explain further on the instrument used and result from data analysis.

6.2 Instrument

The usefulness evaluation of the YouthPDA prototype considers five dimensions for the measurement as follows:

i. *Accuracy*: measured based on accuracy of the outcome and its consistency with user's preferences. (5 items)

ii. *Decision strategy*: facilitates the cognitive effort of processing information for making decision. (4 items)

iii. *Satisfaction*: helps to increase decision maker's satisfaction in the process as well as the outcome. (4 items)

iv. *Knowledge Acquisition*: makes the user more aware of his own decision processes. (5 Items)

v. *Overall Usefulness*: (4 items)

The evaluation of above-mentioned dimensions uses a seven-point Likert scale (1 to 7) which is two polar scales with a neutral value in the middle. Additionally, the evaluation also includes the following items, (i) the intention to use the application

again, (ii) conferment to the application, and (iii) time spent as depicted in the instrument (Appendix D). Results of the pilot test are detailed out in section 3.5.2.4, Chapter 3.

6.3 Testing

As mentioned earlier, the evaluation measures usefulness and respondents' experience towards the YouthPDA. There were 189 respondents involved in the experiment where 52.4% are male and 47.6% are female.

The experiment was conducted in two settings; in the computer laboratory (97 respondents) and in the open environment (92 respondents). Lab experiment was carried out where the respondents were given five tasks to be completed using the laboratory PC. In addition, walk in experiments have also been carried out at four venues; at the Malaysia Technology Expo 2014 (MTE2014), International Invention Innovation and Technology Exhibition (ITEX 2014), and at two schools on the 2014 SPM results released day.

A set of questionnaire was given to each respondent. The questionnaire acts as an instrument to measure the usefulness of the developed YouthPDA. In the instrument, all the dimensions (accuracy, decision strategy, satisfaction, and acquisition) that contain in both process and outcome approaches were evaluated. There are three parts of the instrument that need to be filled which are dimensions, general questions on user's acceptance as well as respondent's demographic.

6.3.1 Response Rate

In this study, all the 189 youths approached for this survey answered the questions, giving a 100% response rate. Table 6.1 shows the summary of the response rates by the youth.

Table 6.1

Summary of the Response Rates

Questionnaire Administered	189
No. of Responses	189
Response Rate	100%

6.3.2 Sample Adequacy

The sample in this study is considered adequate because the value of KMO is larger than 0.6. Particularly, Table 6.2 confirms that the KMO value is 0.942 which is higher than 0.6.

Table 6.2

KMO and Barlett's Test

Test		Value
Kaiser Meyer Olkin Measure of Sampling Adequacy		0.942
Barlett's Test of Sphericity	**Approx. Chi-Square**	2856.042
	df	231.000
	Sig.	.000

6.3.3 Respondent Profiles

The respondent characteristics in this study include four major variables which are gender, age, race, and level of education as shown in Table 6.3. The table

demonstrates the youth's frequencies and percentage of these variables in a summarised form.

Table 6.3

Respondents Profiles

GENDER	Frequency	Percentage
Male	99	52.4
Female	90	47.6
Total	189	100.0
AGE	Frequency	Percentage
17-19 years	125	66.1
20-22 years	64	33.9
Total	189	100.0
LEVEL OF EDUCATION	Frequency	Percentage
Bachelor Degree	7	3.7
Diploma	97	51.3
Secondary School	85	45.0
Total	189	100.0
EMPLOYMENT STATUS	Frequency	Percentage
Unemployed	0	0.0
Employed	7	3.7
Student	182	96.3
Total	189	100.0

The education levels of respondents are from secondary schools students until bachelor holder with age ranged from 17 to 22 years old. The employment statuses of the youth are unemployed, employed, and student. There are some employed youth who took the survey to determine and comparing their current career that based on their academic qualification with the recommended career by YouthPDA that is based on their personality and intelligence. The testing on school students is taking place at two selected schools which are Sekolah Menengah Mahawangsa, Jitra a

public school (Figure 6.1) and Sekolah Menengah Sains Pokok Sena a boarding school (Figure 6.2).

Figure 6.1. Prototype testing at Sekolah Menengah Mahawangsa

Figure 6.2. Prototype testing at Sekolah Sains Pokok Sena

As for the diploma student participants, a few groups of respondents were involved from local Higher Learning Institutions (Figure 6.3).

Figure 6.3. Prototype testing at Higher Learning Institutions

Other than that, there are quite a number of employed and student respondents who get involved during MTE 2014 at Putra World Trade Centre (PWTC), and ITEX 2014 located at Kuala Lumpur Convention Centre (KLCC). Figure 6.4 shows the environment of prototype testing at the MTE 2014.

Figure 6.4. Prototype testing at MTE 2014

6.4   Findings

The following sections discuss the results of data analysis including reliability and validity assessments, as well as descriptive statistics. Lastly, this chapter presents the results of correlation matrix to show significant correlation amongst YouthPDA factors.

6.4.1   Reliability and Validity of the Measurement Items

The reliability of the measurement items is tested using Cronbach alpha, and the validity of the measurement items is tested using factor analysis. The value for Cronbach alpha for all factors is 0.919, which is larger than 0.6, and is considered acceptable.

As shown in Table 6.4, the Cronbach alpha values for all factors; Accuracy, Decision Strategy, Satisfaction, Knowledge Acquisition, and Overall Usefulness are reliable and acceptable. The factor analysis was done to the sample size of 189 respondents.

The measurement items are considered valid if the anti-image correlation matrix values are greater than 0.5 and the factor loading for each item is more than 0.3. The results of the anti-image correlation matrix showed that almost all factor loadings are more than 0.5.

Table 6.4

Results of Cronbach Alpha Values for All Dimensions

Factors	Cronbach Alpha values	Number of items
1) Accuracy	0.871	5
2) Decision Strategy	0.827	4
3) Satisfaction	0.898	4
4) Knowledge Acquisition	0.828	5
5) Overall Usefulness	0.870	4

6.4.2 Analysis

Table 6.5 shows the descriptive statistics of the composite factors. The mean values for all the measured factors are greater than 5 using the 7 point Likert Scale showing that YouthPDA is accepted to be a helpful youth decision making tool.

Table 6.5

Mean Values of the Composite Factors

Factors	Mean
1) Accuracy	5.51
2) Decision Strategy	5.50
3) Satisfaction	5.39
4) Knowledge Acquisition	5.54
5) Overall Usefulness	5.44

The next paragraph highlights on the results of the mean values for each measurement item in the composite factors for 189 respondents. Table 6.6 shows that the strength among all items in Accuracy dimension is on advice provided for the decision making, with 5.62 mean value. The capability of YouthPDA to provide useful advices as required was agreed by the respondents. YouthPDA is found to be well-functioned and suitable in the decision making process.

Table 6.6

Mean Values for Accuracy Dimension

Items	Mean
1) A1 - This application can be relied to function properly.	5.60
2) A2 - This application is suitable to my style of decision making.	5.33
3) A3 - This application provides the help that I need to make a selection.	5.47
4) A4 - This application provides the advice that I require to make my decision.	**5.62**
5) A5 -This application is suitable even during limited time to make a decision.	5.37

The Decision Strategy dimension in Table 6.7 shows that the utmost mean value is on decision process simplicity item, with the value of 5.60. The straightforwardness steps in the application eases the process of recommendation. The youth only have to complete the personal details through academic achievement, sit for PT and MI test before get the overall details of youth personality and multiple intelligences, and finally the recommendations for both study and career areas have displayed. As a result, this item is observed to be the strength for this composite factor. Though, the other three items in the dimension also have quite high mean values.

Table 6.7

Mean Values for Decision Strategy Dimension

Items	Mean
1) B1- The decision process in this application is logical to me.	5.46
2) B2 - The decision process in this application is simple to me.	**5.60**
3) B3 - I understand how decision process in this application works.	5.56
4) B4 - I found it very easy to interpret the decision justification provided by this application.	5.40

Next, the strength for composite factor among the items in Satisfaction dimension is as presented in Table 6.8. Having a pleased experience of using the application, with the mean value of 5.71 is the highest mean. However, some of them were unsatisfied with the recommended solutions. Further probe indicated that this is due to the youth who admitted that they have answered the given questions without reading the questions properly, resulting in recommendations that do not suit their interests. Nonetheless, overall, the youth are satisfied and have good motivation and confidence in using YouthPDA.

Table 6.8

Mean Values for Satisfaction Dimension

Items	Mean
1) C1- I am satisfied with the recommended solution.	5.11
2) C2- I am confident that I am able to make selection with this application.	5.33
3) C3- I am confident that I can justify the selection that I made with this application.	5.43
4) C4 - I am very pleased with my experience using this application.	**5.71**

Knowledge Acquisition factor shows that the youths agree on the application that is able to help them not to be easily influenced by others in making selection (with the mean value of 5.68 as displayed in Table 6.9). So, this item shows that the youth agree that they are able to make their own decisions based on what the application suggested. They also agree that the application makes them be independent of others when making a selection.

Table 6.9

Mean Values for Knowledge Acquisition Dimension

Items	Mean
1) D1 - This application makes me realize I cannot get everything from just one alternative.	5.46
2) D2 - This application shows my subconscious decision process.	5.42
3) D3 - This application helps me not to be easily influenced by others in making selection.	**5.68**
4) D4 - This application makes me more independent of others in making a selection.	5.53
5) D5 - I learned a lot about the problem using this application.	5.59

Meanwhile, Table 6.10 indicates that the highest mean value among the Overall Usefulness in YouthPDA is on the decision consideration item, with the mean value of 5.58. Besides that, the capability of the YouthPDA in helping youth in making choice is also undeniable. However, the lowest mean value of Overall Usefulness is on the capability to solve the decision making, with the value of 5.27. This result may be due to YouthPDA is only helping in providing the list of the best recommendations but the final decision is for the youths themselves to decide.

Table 6.10

Mean Values for Overall Usefulness

Items	Mean
1) E1 - This application is capable of helping me in making a choice.	5.50
2) **E2 - This application allowed me to carefully consider the decision made.**	5.58
3) E3 - I feel that the problem in making selection is solved.	5.27
4) E4 - This application is an aid for me in clarifying what I want.	5.41

Generally, accuracy, decision strategy, satisfaction, knowledge acquisition, and overall usefulness dimensions have very impressive mean values (>5) that represent level of usefulness in the YouthPDA. Table 6.11 and Table 6.12 show the summary of strengths and weaknesses with details for each composite factors of YouthPDA.

Table 6.11

The Strengths and Weakness Items of the YouthPDA

YouthPDA Factors	Strengths		Weaknesses	
	Item	Mean	Item	Mean
1) Accuracy	A4	5.62	A2	5.33
2) Decision Strategy	B2	5.60	B4	5.40
3) Satisfaction	C4	5.71	C1	5.11
4) Knowledge Acquisition	D3	5.68	C1	5.11
5) Overall Usefulness	E2	5.58	E3	5.27

Table 6.12

The Strengths and Weakness Items' Details of the YouthPDA

Strengths		Weaknesses	
A4	This application provides the advice that I require to make my decision.	A2	This application is suitable to my style of decision making.
B2	The decision process in this application is simple to me.	B4	I found it very easy to interpret the decision justification provided by this application.
C4	I am very pleased with my experience using this application.	C1	I am satisfied with the recommended solution.
D3	This application helps me not to be easily influenced by others in making selection.	D2	This application shows my subconscious decision process.
E2	This application allowed me to carefully consider the decision made.	E3	I feel that the problem in making selection is solved.

6.4.3 Discussion

The factor analysis was done to the sample size of 189 respondents. The measurement items are considered valid if the anti-image correlation matrix values are greater than 0.5 and the factor loading for each item is more than 0.3. The results of the anti-image correlation matrix showed that almost all factors loadings are more than 0.5.

For overall accuracy of YouthPDA, the recommendations of career path by YouthPDA have met the expectations of the respondents. Based on the collected data, 100% of the respondents agree with the suggested career provided by YouthPDA. The results revealed that the PT and MI were able to get inner side of someone attitudes and behaviour to determine appropriate careers for them.

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Therefore, YouthPDA could be said as a reliable tool with predictive validity for youth decision making.

The minimum, maximum and mean of all dimensions from the conducted evaluation are stated in Figure 6.5 for a clearer understanding. As far as the usefulness of the prototype is concerned, dimension of accuracy, satisfaction and knowledge acquisition recorded the lowest score of 2 but with a small number of frequencies. In contrast, all four dimensions recorded the highest score of 7. As a result, this experiment shows a very impressive mean value of overall usefulness. The mean value for each dimension that is greater than 5 indicated that the YouthPDA is accepted to be a useful tool for youth in making decision.
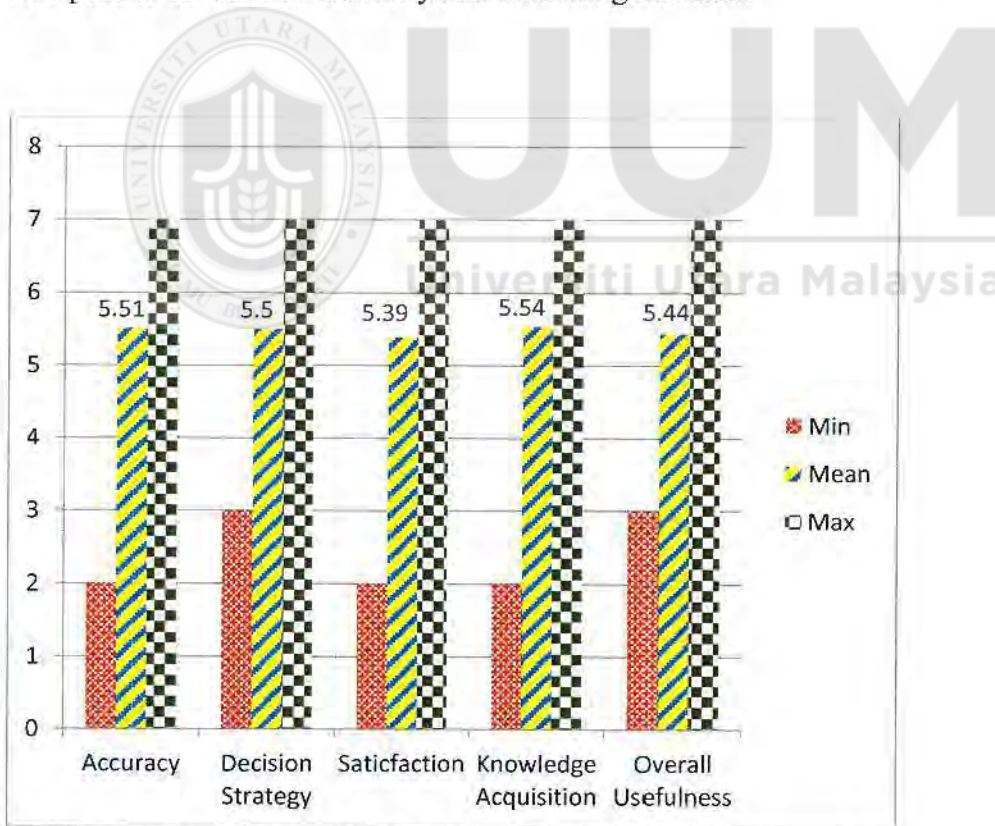
Figure 6.5. Min, mean and max of dimensions

Additionally, the percentage of youth's acceptance, which includes the intention to use the application again, conferment to the application, and time spent, towards

YouthPDA application have also been evaluated. The result is as described in Table 6.13.

Table 6.13

The Result of Users' Experience towards YouthPDA

	Use YouthPDA Again		Confer to YouthPDA		Reduce Decision Making Time	
	f	%	*f*	%	*f*	%
YES	183	96.8	179	94.7	180	95.2
NO	6	3.2	10	5.3	9	4.8

The result shows that 96.8% of the respondents agreed and interested to use YouthPDA application again in the future. Meanwhile, 94.7% of the respondents seconded that youths should refer to YouthPDA application before making decisions. Whereas, 95.2% of the respondents agreed that YouthPDA application has shortened the time spent in decision making pertinent to study and career matters. Figure 6.6 illustrates the youth's acceptance towards the YouthPDA graphically.
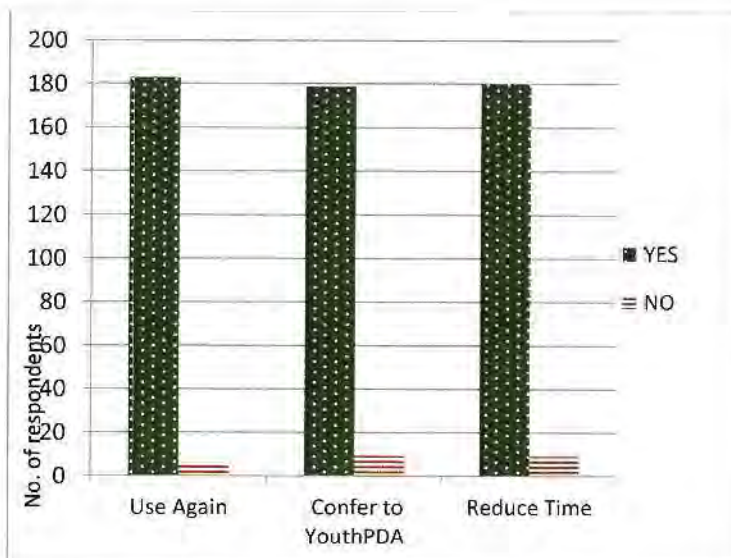
Figure 6.6. Youth's Acceptance towards YouthPDA

6.5   Correlation

Correlation (R) between two factors determines the measurement of the linearity relationship between the two factors. The correlation level is defined with the significant value of approximately 0.1 and less than 0.3 as a small correlation, 0.3 and less than 0.5 as a medium correlation, and greater than 0.5 as a greater correlation.

In this study, the correlation matrix is used to measure the linearity relationship between two factors among Accuracy, Decision Strategy, Satisfaction, Knowledge Acquisition and Overall Usefulness dimensions. Therefore, the hypotheses that have been built for this evaluation stage can be tested.

The next subsections deliberates the hypotheses testing and their findings separately. This experimental study contained 189 subjects using YouthPDA to determine their needs on study and career decision making. Pearson correlation coefficient (r) is used to test H_1 to H_4 with several assumptions were made before Pearson's correlation was executed such as:

- The relation between the variables is linear
- The data are normally distributed.
- The data collected must be interval from continuous distributions.

The following subsections discuss the results from H_1 to H_4 tests as follow:

i. H_1: There is a positive correlation between Overall Usefulness and Accuracy

ii. H_2: There is a positive correlation between Overall Usefulness and Decision Strategy

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iii.   H$_3$: There is a positive correlation between Overall Usefulness and Satisfaction

iv.   H$_4$: There is a positive correlation between Overall Usefulness and Knowledge Acquisition

6.5.1   Hypothesis Testing H$_1$

If seen in H$_1$: There is a positive correlation between Overall Usefulness and Accuracy, Table 6.14 displays adequate proof to accept H$_1$ where the correlation coefficient r = .708 and value of p = .000. As the r value reported is positive and p<0.01, it means that Overall Usefulness and Accuracy has a positive relation in the study and it is significant at 0.01 levels.

Table 6.14

Relation between Overall Usefulness and Accuracy

Factor		Overall Usefulness	Accuracy
Overall Usefulness	Pearson Correlation	1.000	.708
	Sig. (2-tailed)		.000
	N	189	189.000
Accuracy	Pearson Correlation	.708	1.000
	Sig. (2-tailed)	.000	
	N	189.000	189.000

6.5.2   Hypothesis Testing H$_2$

H$_2$: There is a positive correlation between Overall Usefulness and Decision Strategy

An adequate proof to accept H$_2$ is shown in Table 6.15 where the correlation coefficient r = .706 and value of p = .000. As the r value reported is positive and p<0.01, it means that Overall Usefulness and Decision Strategy has a positive relation in the study and it is significant at 0.01 levels.

Table 6.15

Relation between Overall Usefulness and Decision Strategy

Factor		Overall Usefulness	Strategy
Overall Usefulness	Pearson Correlation	1.000	.706
	Sig. (2-tailed)		.000
	N	189.000	189.000
Decision Strategy	Pearson Correlation	.706	1.000
	Sig. (2-tailed)	.000	
	N	189.000	189.000

6.5.3 Hypothesis Testing H₃

H_3: There is a positive correlation between Overall Usefulness and Satisfaction.

The evidence presented in Table 6.16 shows that H_3 is accepted where the highest value of correlation coefficient r = .806 and value of p = .000. As the r value reported is positive and p<0.01, it means that Overall Usefulness and Satisfaction has a positive relation in the study and it is significant at 0.01 levels.

Table 6.16

Relation between Overall Usefulness and Satisfaction

Factor		Overall Usefulness	Satisfaction
Overall Usefulness	Pearson Correlation	1.000	.806
	Sig. (2-tailed)		.000
	N	189.000	189.000
Satisfaction	Pearson Correlation	.806	1.000
	Sig. (2-tailed)	.000	
	N	189.00	189.000

6.5.4 Hypothesis Testing H4

H4: There is a positive correlation between Overall Usefulness and Knowledge Acquisition.

Table 6.17 displays adequate evidence to accept H4 where the correlation coefficient r = .610 and value of p = .000. As the r value reported is positive and p<0.01, it means that Overall Usefulness and Knowledge Acquisition has a positive relation in the study and it is significant at 0.01 levels.

Table 6.17

Relation between Overall Usefulness and Knowledge Acquisition

Factor		Overall Usefulness	Knowledge Acquisition
Overall Usefulness	Pearson Correlation	1.000	.610
	Sig. (2-tailed)		.000
	N	189.000	189.000
Knowledge Acquisition	Pearson Correlation	.610	1.000
	Sig. (2-tailed)	.000	
	N	189.000	189.000

6.5.5 Mean Value for Overall Usefulness

As shown in previous section, a descriptive analysis was executed and the result as shown in Table 6.18 was used to the mean value of Overall Usefulness. The mean value and standard deviation of Overall Usefulness factor are the measurement items to validate the hypothesis.

Table 6.18

Descriptive Analysis of YouthPDA's Overall Usefulness

	Overall Usefulness
N	189.000
Mean	5.440
Standard deviation	.863

The mean value for YouthPDA Overall Usefulness is 5.44 with standard deviation = 0.863. In order understand the stated value; the gap classification of interval scales is enlightened by Zulkarnain (2001) where;

Gap = (highest score – lowest score)/number of scale

= (7 – 1) / 7

= 0.86

Thus, the following classifications for a 7-point scale are acquired for the response gap, as clarified in Table 6.19. According to the table, the mean value of the Overall Usefulness has to be more than 5.35 (High) to show that the hypothesis is supported.

Table 6.19

Classification for Response

Gap	Classification
1.00 – 1.86	Very low
1.87 – 2.73	Low
2.74 – 3.60	Fairly low
3.61 – 4.47	Average
4.48 – 5.34	Fairly high
5.35 – 6.21	High
6.22 – 7.00	Very high

The mean value for YouthPDA's Overall Usefulness is 5.44, and it is categorized under 'High' classification. Accordingly, this result is the evidence that the mean value of Overall Usefulness is high.

6.5.6 Discussion on Hypotheses Testing Result

Pearson Correlation tests that have been conducted to 189 subjects confirm that H_1, H_2, H_3, and H_4 were accepted. Moreover, these results also specify that:

- As Accuracy increases, Overall Usefulness also increases (positive correlation for H_1).

- As Decision Strategy increases, Overall Usefulness also increases (positive correlation for H_2).

- As Satisfaction increases, Overall Usefulness also increases (positive correlation for H_3).

- As Knowledge Acquisition increases, Overall Usefulness also increases (positive correlation for H_4).

Interestingly, all four hypotheses are not rejected and manage to support Overall Usefulness to have a high mean value. Figure 6.7 demonstrates the correlation results in relation to the usefulness measure of the YouthPDA.

Figure 6.7. Accuracy, Decision Strategy, Satisfaction, and Knowledge Acquisition relations to measure Usefulness of YouthPDA

The relationships between Accuracy, Decision Strategy, Satisfaction, and Knowledge Acquisition with the Overall Usefulness are positively correlated. With that, the overall results show adequate proof that YouthPDA is useful for youth in decision making.

6.6 Summary

YouthPDA is attentively designed for youth to help them in making decision in many areas of decision making. The application has been validated through prototyping method where the prototype consists of the study and career areas. A series of experiments were carried out to measure the usefulness of the prototype, which

include four dimensions; accuracy, decision strategy, satisfaction, and knowledge acquisition. The reliability of the measurement items is tested using Cronbach alpha, and the validity of the measurement items is tested using factor analysis. The Cronbach alpha values for all factors, which are larger than 0.6 are considered reliable and acceptable. On the other hand, the result also shows that the mean value is greater than 5 for all dimensions of usefulness, which indicated that the decision aid is helpful to the youth in study and career decision making.

Five hypotheses testing were conducted. The correlation test endorses that all the H_1 to H_4 with the dimensions (accuracy, decision strategy, satisfaction, and knowledge acquisition) were accepted as having positive correlations with the overall usefulness of YouthPDA. As for the overall mean value, the descriptive statistics confirmed that the mean score of Overall Usefulness is high.

It is important that the youth gain benefits from a decision aid that considers their personality and intelligence. The decision aid not only is meant to support the youths in making a choice, but the multi-criteria nature of the recommendation process is also meant for the youth to acquire knowledge.

CHAPTER SEVEN
DISCUSSION AND CONCLUSION

7.1 Overview

Decision aid is a potential tool to help a person in making decision. In constructing an ingenious aid, a good design model is necessary as a main backbone of the aid. There are four research questions that contribute to this study;

1. What are the relevant decision making criteria, techniques, and theoretical foundations for the youth PDA?

2. How to construct a conceptual design model for the youth PDA?

3. How useful is the conceptual design model of the youth PDA?

4. Is there any positive correlation between dimensions in usefulness of the youth PDA?

Besides, this study intention is to propose a conceptual design model for YouthPDA. The design model would include decision making techniques, criteria and conceptual design model. Therefore, the following are the specific objectives of the study:

1. To identify relevant decision making criteria, techniques, and theoretical foundations for YouthPDA.

2. To construct a conceptual design model for YouthPDA using the identified decision making techniques, criteria, and theoretical foundation.

3. To validate the conceptual design model of YouthPDA through expert reviews.

4. To measure correlation between dimensions in usefulness of YouthPDA via prototyping.

7.2   Research Question 1

What are the relevant decision making criteria, techniques, and theoretical foundations for YouthPDA?

Criteria are one of the major components in the design model. The main criteria are personality style and the intelligence level of the youth as well as youth's SPM result. These criteria have been evaluated in the YouthPDA prototype. The multi-criteria of the youth personality, intelligence and SPM's result have made the results of YouthPDA changed dynamically.

Decision making have a variety of techniques, and the chosen technique for YouthPDA design model development is Rule-based Reasoning using the Forward Chaining method. The selection is based on the observation of 13 developed aids and the suitability of criteria conditions in producing the design model.

On the other hand, several theory have been adopted in the decision making process which are PT, MI, Behavioural Decision, Cognitive Psychology, Utility, Preference as well as Dominance. All the theories have their own justifications as described previously.

7.3   Research Question 2

How to construct a conceptual design model for the youth PDA?

A conceptual design model for YouthPDA was constructed through three major components emphasis on decision making criteria, techniques, and theories and User Interface Design Principles, Graphic Design Principles, Interaction Styles and Design Elements.

Conceptual design model that able to provide options in decision making results is an alternative to designer for constructing a useful decision aid tool. The options or recommendations to user are changed based on their own multi-criteria input, such as different personality or multiple intelligence criteria resulting different recommendations. For instance, an 18 years old youth who has Extroverted personality with Linguistic intelligence (results from PT and MI tests in YouthPDA), will not has the same career recommendations if he has changed his character (re-sit for the PT and MI tests) to Introverted personality with Naturalist intelligence. Therefore, the conceptual design model is based on the character of the user.

7.4   Research Question 3

How useful is the conceptual design model of the youth PDA?

Experts review is used to validate the conceptual design model of YouthPDA. There are a few components in the conceptual design model that were examined. The experts were certifying the terms used in the main components, process in each component, the proposed elements and HCI components in the design model components. They were also providing constructive comments on the connectivity, usability and practicality of the conceptual design model. The finding shows that the conceptual design model of YouthPDA is useful as a guideline in developing a decision making tool.

7.5   Research Question 4

Is there any positive correlation between dimensions in usefulness of the youth PDA?

The YouthPDA has been measured for its usefulness by using a prototype. The prototype consists of two areas which are study and career decision making. A few groups of youth with a number of 189 respondents have gone through the testing using an instrument.   Accuracy, Decision Strategy, Satisfaction, Knowledge Acquisition, and Overall Usefulness are the five dimensions that are measured in the study. The reliability of YouthPDA, its predictive validity and perceived benefits are among the items verified in the Accuracy dimension.

The youth agreed that the perceived benefits of YouthPDA are correlated to the Overall Usefulness of the application. Meanwhile, the Decision Strategy dimension refers to the items for style, requirements and process of decision making of the youth. This dimension is shown to clearly be correlated to the Overall Usefulness too. The youth confirmed also that they were satisfied with the YouthPDA as it is able in helping them make decision; therefore they agreed that the application is indeed useful.

YouthPDA helps the youth in understanding relevant problem and raising awareness of the decision making process. They felt that the application lets them be independent. Overall, this resulted in making them agreed that the YouthPDA is useful.

Thus, it is shown that all the measured dimensions are positively correlated to the Overall Usefulness of the YouthPDA. The overall result shows that YouthPDA is accepted to be a useful tool for youth in decision making.

7.6   Discussion on Aims and Objectives of the Study

This study main intention is to propose a conceptual design model for YouthPDA. The design model includes decision making techniques, criteria and conceptual design model. The design model is built to certify the usefulness of the YouthPDA to youth. There are four specific objectives of the study to accomplish the main aim.

The main stated intention is accomplished through the achievement of four supporting objectives. The first objective was completed through the classification of relevant decision making techniques, criteria, and theoretical foundation for YouthPDA. The process of classification was made through content reviews, and comparative analysis (refer Chapter 2 and Chapter 4). The second objective was attained with the construction of the proposed conceptual design model for YouthPDA (refer Chapter 4). Then, the third objective was achieved with the validation of the proposed conceptual design model of YouthPDA through experts review (refer Chapter 4). Lastly, the fourth objective was completed with the evaluation of YouthPDA prototype to measure its usefulness and correlation between dimensions by using the constructed instrument (refer Chapter 6).

7.7 Limitations and Recommendations

Based on the carried out evaluation, there are two areas of limitations this study that may be improved for the next research. The two areas are design model, and the YouthPDA prototypes.

7.7.1 Design Model

YouthPDA's design model was constructed to include youth personal decision making process, design model components, and recommended HCI components. Youth personal decision making process involves intelligence, design and choice phase. Then, the design model components include i) criteria (personality style, multiple intelligence and SPM's result), ii) techniques (rule-based system, forward chaining), and iii) theories (PT, MI, behavioural decision, cognitive psychology, utility, preference and dominance). The user interface design principles, graphic design principles, interaction styles and design elements were included as vital elements of YouthPDA. The proposed components were gathered from analysis made by content analysis, comparative study, elicitation works and expert review. There are also a number of decision models that have been reviewed in order to acquire the common styles and features for YouthPDA's design model components with proper elements.

Experts review was executed in order to evaluate the appropriate proposed components and elements in the model. The study found out that there is still room for improvement to enhance the scope of YouthPDA. Applying it to as many decision making areas as possible could improve the overall usefulness of the model.

7.7.2 Prototype

An experiment was executed to a few groups of youth to determine the usefulness of YouthPDA application. The respondents are the real users of YouthPDA with different demographic backgrounds, which involve SPM holders, diploma students, and a few workers who were considered as youth. This fieldwork study has achieved a good mean value for each measured dimension (refer Chapter 5). However, among all, Satisfaction dimension was the lowest reading. This item is on the satisfaction of the recommended solutions. This may be due to their own immature attitude in completing two tests (PT and MI) that have been carried out. The two tests were designed to uncover the real personality and intelligence of the youth, and definitely the recommended solutions were based on their answers. If the youth were to sit for the tests without focus and giving false data, the implication is the results obtained are not precise.

Therefore, the youth should be informed in advance about the implications that would happen if they did not answer the tests honestly. Alternatively, the survey could be done more than once to make sure the youth knows and understands that whatever their answers in the two tests will affect the recommended solutions. As for the rest of the dimensions, majority of the youth agreed that YouthPDA is useful in helping them make decision.

7.8 Summary

YouthPDA is a personalized decision aid that is specifically designed for youth to help them choose their study and career path. By integrating data from both Personality Traits and Multiple Intelligences, the aid functions as a contextual aware

recommender system that works on rule based reasoning. This study was conducted in an organized manner to propose a design model to build YouthPDA application. The model consists of applicable components and elements were measured and validated through content analysis, comparative study, elicitation works and expert reviews. Next, the tested design model was used to construct a YouthPDA prototype. Findings show that the proposed YouthPDA is useful for youth in decision making.

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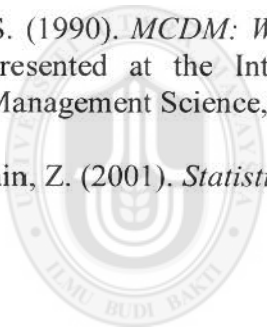
APPENDIX A

Instrument for Preliminary Study

Preliminary study on Personal Decision Aid (PDA) for youth

The major aim of this preliminary investigation is to identify area that is most applicable for youth to utilize the personal decision aid (PDA). Besides, this preliminary investigation will discover the aid types in each of the mentioned area.
* Required

The instrument consists of 3 parts. Please answer ALL questions.

Please tick the appropriate answer

PART A

Background

1. Gender *

- ○ Male
- ○ Female

2. Age *

_____

3. Race *

- ○ Malay
- ○ Chinese
- ○ Indian
- ○ Sabah/Sarawak
- ○ Other:

4. Education *

- ○ Secondary school
- ○ Diploma
- ○ Bachelor degree
- ○ Master degree
- ○ Doctorate degree (PhD)
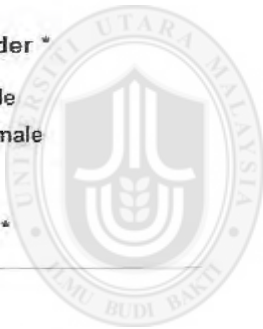
5. Employment Status *

○ Unemployed

○ Employed

○ Self-employed

○ Student

PART B

Decision Making

6. Have you made your own personal decision in any of the following? (You may choose more than one) *

☐ Study

☐ Career

☐ Lifestyle (e.g. fashion, music, sport, etc)

☐ Purchasing (e.g.gadget, car, etc)

☐ Friendship

☐ Politic

☐ Religion

☐ Marriage

7. How is your decision normally made? (You may choose more than one) *

☐ Decide on your own

☐ Get advice from parents/family

☐ Get advice from friends

☐ Get advice from Professional advice (e.g. counsellor/technology)

8. Decision aid is a way in helping a person to make decision by sorting out the available choices. In your opinion, do you need an aid in order to help you sort out the decision? *

○ Always

○ Sometimes

○ No

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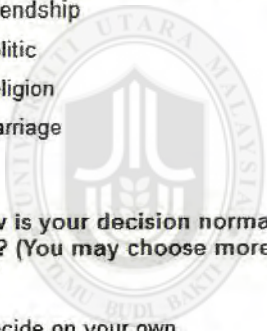
9. Personal Decision Aid is a computerized system that will assist a person by providing the best suggestion based on the list of options provided by them. If the intended system is available, would you use the personal decision aid? *

- ○ Yes
- ○ No

10. If your answer in question 9 is 'Yes', please tick the area that you might be interested in getting a personal decision aid. (You may choose more than one)

- ☐ Study
- ☐ Career
- ☐ Lifestyle (e.g. fashion, music, sport, etc)
- ☐ Purchasing (e.g.gadget, car, etc)
- ☐ Friendship
- ☐ Politic
- ☐ Religion
- ☐ Marriage
- ☐ Other:

11. Currently, there are plenty of Personal Decision Aid (PDA) published on the web especially in searching for partner, purchasing, as well as education namely MalaysianCupid.com, AsianDating.com, Hunch, Let Simon Decide, Choose It!, EduTools Education, Super Decision and many more. Are you aware of any of above mentioned PDAs? *

- ○ Yes. (If 'Yes' go to question 12 and 13)
- ○ No. (If 'No' go to question 13)

12. Have you tried using any of the decision aid before?

- ○ Yes
- ○ No

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13. In your opinion, would such aid be *

○ necessary

○ probably necessary

○ unnecessary

PART C

Given here are the areas that might become your PDA. Briefly state how can the PDA aid you?

14a. Study
example: choice of program, list qualified programs

_____

14b. Career
example: choice of career based on your qualification

_____

14c. Lifestyle
example: choice of fashion, list of suitable sports

_____
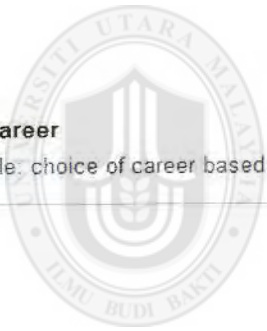
14d. Purchasing

example: choice of hand phone, tablet, car

14e. Friendship

example: choice for a special best friend

14f. Politic

example: list of political view

14g. Religion

example: choice of religion

14h. Marriage

example: suggest the best couple

**Please give your own area of
interest to use the PDA**

How can the PDA aid you?

Thank you for your cooperation

Submit
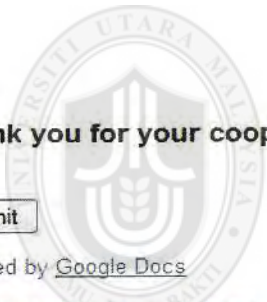
APPENDIX B

Official Appointment Letter by Dean

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PUSAT PENGAJIAN TEKNOLOGI MULTIMEDIA
DAN KOMUNIKASI
*SCHOOL OF MULTIMEDIA TECHNOLOGY
AND COMMUNICATION*
Universiti Utara Malaysia
06010 UUM SINTOK
KEDAH DARUL AMAN

Tel: 604-928 5801
Faks (Fax): 604-928 5804
Laman Web (Web): http://www.smmtc.uum.edu.my

KEDAH AMAN MAKMUR • BERSAMA MEMACU TRANSFORMASI

UUM/CAS (SMMTC)/P-48
January 12, 2015

Dr. Azizol bin Abdullah
Timbalan Dekan (Akademik dan HEP)
Fakulti Sains Komputer & Teknologi Maklumat
Universiti Putra Malaysia
43400 Serdang
Selangor

Dr.,

APPOINTMENT AS EXPERT REVIEWER FOR DYNAMIC AND MULTI-CRITERIA DESIGN MODEL OF YOUTH PERSONAL DECISION AID (YouthPDA)

Thank you for agreeing to involve as an expert in a PhD study with the following details:

Student Name	: Norfiza Ibrahim
Matric No	: 94054
School	: Multimedia Technology and Communication, Universiti Utara Malaysia
Research Title	: DYNAMIC AND MULTI-CRITERIA DESIGN MODEL OF YOUTH PERSONAL DECISION AID (YouthPDA)
Supervisor	: Prof. Dr. Norshuhada Shiratuddin and Dr. Siti Mahfuzah Sarif

For your information, the student will use that model for her research and need your expertise to review the proposed model in a few dimensions as stated in the reviewing form.

Your cooperation, time and assistance are greatly appreciated.

Thank you.

Sincerely,

DR. ROSLI BIN MOHAMMED
Dean   12.1.2015
School of Multimedia Technology and Communication
UUM College of Arts and Sciences
Universiti Utara Malaysia

c.c.: Prof. Dr. Norshuhada Shiratuddin, Supervisor 1
Dr. Siti Mahfuzah Sarif, Supervisor 2

Universiti Pengurusan Terkemuka
The Eminent Management University

APPENDIX C

Consent Form
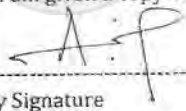
Document No.	Consent Form of Expert Reviewer for Design Model
01	**of Youth Personal Decision Aid (YouthPDA)** School of Multimedia Technology and Communication UUM College of Arts and Sciences Universiti Utara Malaysia (UUM)

1. I have accepted the official appointment letter from UUM. With the expertise and existing knowledge that I have, I volunteer to be an expert reviewer for "Dynamic and Multi-criteria Design Model of Youth Personal Decision Aid (YouthPDA)" proposed by Norfiza Ibrahim under supervision of Prof. Dr. Norshuhada Shiratuddin and Dr. Siti Mahfuzah Sarif, Universiti Utara Malaysia (UUM).

2. I understand that the expert review process is designed to gather information and feedbacks in improving the proposed model.

3. I understand that no part of the proposed model may be reproduced, stored in retrieved system, or transmitted in any form or by any means, electronic, mechanical photocopying, recording, or otherwise, without prior permission from the researcher and her supervisors.

4. I understand that the researcher will not identify me by name in any report using information obtained from the questionnaire, and that my confidentiality as a participant in this study will remain secure. Subsequent uses of records and data will be subjected to standard data use policies which protect the anonymity of individuals and institutions.

5. I understand that this study has been reviewed and approved by the School of Multimedia Technology and Communication, College of Arts and Science, UUM.

6. I have read and understood the explanation provided to me. I have had all my questions answered to my satisfaction, and I voluntarily agree to participate in this study.

7. I am given a copy of this consent form.

My Signature

DR. AZIZOL ABDULLAH
Deputy Dean
(Academic and Student Affairs)
Faculty of Computer Science and Information Technology
Universiti Putra Malaysia
My Printed Name and Official Stamp

11 - 8 - 2015

Date

Signature of the Researcher

For further information, please contact:
norfiza.ibrahim@yahoo.com/ shuhada@uum.edu.my

APPENDIX D

Usefulness Instrument

Measuring Usefulness of Youth Personal-Decision Aid (YouthPDA) Prototype in Selecting Study and Career

Researcher's Name	: Norfiza Ibrahim
Department	: School of Multimedia Technology and Communication Universiti Utara Malaysia, Sintok
Email	: norfiza.ibrahim@yahoo.com

Purpose

The purpose of this study is to measure the usefulness of the proposed YouthPDA in selecting study and career for youth. The proposed YouthPDA is divided into two areas named Study and Career. This study forms is part of Norfiza Ibrahim's PhD research at Universiti Utara Malaysia.

Procedures and Use

You have been invited to participate in this project. Participation involves completing an experiment. The experiment will take approximately 1 hour.

You are required to use both categories in YouthPDA application, i) Study and ii) Career to help you in deciding your study and career for your future. There are Personality Test and Multiple Intelligence Test that need to be fulfilled before you are allowed with the decision process. Please answer all the questions in the given test.

All of your details and responses will be completely confidential, and never shared with anyone else.

Consent

The completion of the experiment implies that you have read the above information, you have agreed to participate in this project and you understand and agreed to all the terms and conditions.

Queries or Concerns

If you have any queries or concerns about the research, please contact the above named researcher.

Have a nice day and thank you for participating!

Borang Soal Selidik untuk mengukur KEBERGUNAAN YouthPDA
Questionnaire for Measuring USEFULNESS of YouthPDA

Demografi Responden/Respondent's Demographic
(Tandakan jawapan yang paling sesuai/Tick your answer where appropriate)

Umur/Age: _____

Jantina/Gender :
(   ) Lelaki/Male
(   ) Perempuan/Female

Tahap Pendidikan/Education Level:
(   ) Ijazah Sarjana Muda/Bachelor Degree
(   ) Diploma/Diploma
(   ) Sekolah Menengah / Secondary School

Status Pekerjaan/Employment Status:
(   ) Tidak bekerja/ Unemployed
(   ) Bekerja/ Employed
(   ) Pelajar/ Student

ARAHAN: Bulatkan nombor yang paling sesuai dengan jawapan pilihan anda bagi setiap pernyataan di bawah. Sila gunakan skala berikut:
INSTRUCTION: Circle the number that fits your response best for each statement. Use the following scale:

7-Sangat setuju/*Strongly agree*
6-Setuju/*Agree*
5-Agak setuju/*Fairly agree*
4-Tidak pasti/*Undecided*
3-Agak tidak setuju/*Fairly disagree*
2-Tidak setuju/*Disagree*
1-Sangat tidak setuju/*Strongly disagree*

Kriteria-kriteria/Criteria	Skala/*Scale*
A. Ketepatan/ Accuracy	
1) Aplikasi ini boleh diharapkan untuk berfungsi sebaiknya. *This application can be relied to function properly.*	1 2 3 4 5 6 7
2) Aplikasi ini sesuai dengan cara saya membuat keputusan. *This application is suitable to my style of decision making.*	1 2 3 4 5 6 7
3) Aplikasi ini menyediakan bantuan yang diperlukan untuk saya membuat pilihan. *This application provides the help that I need to make a selection.*	1 2 3 4 5 6 7
4) Aplikasi ini menyediakan nasihat yang diperlukan untuk saya membuat pilihan. *This application provides the advice that I require to make my decision.*	1 2 3 4 5 6 7
5) Aplikasi ini sesuai digunakan walaupun ketika masa terhad untuk membuat keputusan. *This application is suitable even during limited time to make a decision.*	1 2 3 4 5 6 7
B. Strategi membuat keputusan/ Decision Strategy	
5) Bagi saya, proses membuat keputusan dalam aplikasi ini adalah logik. *The decision process in this application is logical to me.*	1 2 3 4 5 6 7
6) Bagi saya, proses membuat keputusan dalam aplikasi ini adalah mudah. *The decision process in this application is simple to me.*	1 2 3 4 5 6 7
7) Saya memahami proses membuat keputusan yang ada dalam aplikasi ini. *I understand how decision process in this application works.*	1 2 3 4 5 6 7
8) Saya dapati justifikasi keputusan yang diperolehi daripada aplikasi ini sangat mudah diinterpretasikan. *I found it very easy to interpret the decision justification provided by this application.*	1 2 3 4 5 6 7
C. Kepuasan/ Satisfaction	
9) Saya yakin dengan pilihan yang disyorkan. *I am satisfied with the recommended solution.*	1 2 3 4 5 6 7
10) Saya yakin dapat membuat pilihan dengan bantuan aplikasi ini. *I am confident that I am able to make selection with this application.*	1 2 3 4 5 6 7
11) Saya yakin dapat menjelaskan pilihan saya dengan bantuan aplikasi ini. *I am confident that I can justify the selection that I made with this application.*	1 2 3 4 5 6 7
12) Saya sangat berpuas hati dengan pengalaman menggunakan aplikasi ini. *I am very pleased with my experience using this application.*	1 2 3 4 5 6 7

D.	Pemerolehan / Knowledge Acquisition							
13)	Aplikasi ini menyedarkan saya bahawa adalah sukar untuk memperolehi semua kelebihan melalui satu pilihan. *This application makes me realize I cannot get everything from just one alternative.*	1	2	3	4	5	6	7
14)	Aplikasi ini memperlihatkan proses separa sedar saya semasa membuat keputusan. *This application shows my subconscious decision process.*	1	2	3	4	5	6	7
15)	Aplikasi ini membantu supaya saya tidak mudah dipengaruhi oleh orang lain semasa membuat pilihan. *This application helps me not to be easily influenced by others in making selection.*	1	2	3	4	5	6	7
16)	Aplikasi ini membuatkan saya kurang bergantung kepada orang lain semasa membuat pilihan. *This application makes me more independent of others in making a selection.*	1	2	3	4	5	6	7
17)	Banyak yang saya pelajari mengenai masalah ini dengan menggunakan aplikasi ini. *I learned a lot about the problem using this application.*	1	2	3	4	5	6	7
E.	Kebergunaan secara keseluruhan/Overall *usefulness*							
18)	Aplikasi ini membantu saya untuk membuat pilihan. *This application is capable of helping me in making a choice.*	1	2	3	4	5	6	7
19)	Aplikasi ini membolehkan saya untuk menilai keputusan yang dibuat dengan teliti. *This application allowed me to carefully consider the decision made.*	1	2	3	4	5	6	7
20)	Saya percaya masalah membuat pilihan telah diselesaikan. *I feel that the problem in making selection is solved.*	1	2	3	4	5	6	7
21)	Aplikasi ini ialah alat bantu yang menjelaskan apa yang saya kehendaki. *This application is an aid for me in clarifying what I want.*	1	2	3	4	5	6	7

Secara amnya/In general
(Bulatkan jawapan anda/Circle your answer)

1.	Saya akan menggunakan aplikasi ini lagi di masa akan datang. I will use this application again next time.	Yes	No
2.	Semua orang patut merujuk kepada aplikasi seperti ini sebelum memilih pengajian/kerjaya yang sesuai. Everyone should confer with this kind of application before choosing a study/career.	Yes	No
3.	Saya bersetuju yang penggunaan aplikasi ini membantu memendekkan masa untuk membuat pilihan. I agree that this application helps to reduce the time to make decision.	Yes	No

SOALAN TAMAT
END OF QUESTIONS

APPENDIX E

Expert Review Form

Document No.	**Expert Review Form of YouthPDA Design Model**
03	School of Multimedia Technology and Communication UUM College of Arts and Sciences Universiti Utara Malaysia (UUM)

Dear Prof. Dr. / Dr.,

EXPERT REVIEW OF YOUTHPDA DESIGN MODEL

I am Norfiza Ibrahim and currently pursuing PhD study in Multimedia at Universiti Utara Malaysia. My PhD research proposes the Design Model for Youth Personal Decision Aid (YouthPDA). It is aims to provide a design model in order to develop a decision aid that specifically designed to assist youth in decision making.

One part of this research is to evaluate the proposed model in a few dimensions as listed in the review form. You will see the review questions give you ample opportunity to use your expertise, experiences, interests and creativity. It would be greatly appreciated if you could complete this evaluation form.

The information supplied will be treated as confidential and will be used for research purposes which may be reported anonymously in academic publications.

Please feel free to contact me by email (norfiza.ibrahim@yahoo.com) in regards to any queries or my supervisor shuhada@uum.edu.my.

Thank you for your time and assistance.

Introduction:
Personal decision aids (PDA) found to be very helpful in making everyday decisions. There are various areas which can be assisted by the existing decision aids in the market. Most of the literatures show a list of options or alternatives provided by the decision aids are based on the list provided by the user only. However, the list does not necessarily correspond to a person's individual personality. Therefore, the type of personality and intelligence level of a person must be assessed prior to giving them a list of suitable alternatives for decision-making process. This on-going study related to design model development which specific to youth in assisting them making study and career decisions. Studies show that there is lack of decision aid provided specifically for youth that combines personal personality along with the type of multiple intelligences in the decision-making process. For that reason, this study focuses on the intelligent aspects in the development of intelligent decision aid application. The aid apparently integrates Personality Traits (PT) and Multiple Intelligence data in development of a computerized personal decision aid for youth named as Youth Personal Decision Aid (YouthPDA). Therefore, this study aims at development of precise design model of intelligent YouthPDA as guidance before a helpful decision aid will be utilized. The design model would include decision making techniques, criteria and conceptual design model.

Objective of expert review:
To conduct expert review of the proposed YouthPDA and its components.

Document No. 02	**Design Model of YouthPDA** School of Multimedia Technology and Communication UUM College of Arts and Sciences Universiti Utara Malaysia (UUM)

YOUTH PERSONAL DECISION MAKING PROCESS

PROBLEM IDENTIFICATION

Intelligence

Personality Trait Test → Multiple Intelligence Test

1. Setup user profiling
2. Store accepted threshold
3. Normalize user profile

STEPS

Design

- 1. Extract user information
- 2. Calculate decision.

OPTIONS

Choice

- Display recommendations

Agree?

Yes → Update database

No → Re-evaluate threshold

Note:
** - Compulsory
* - Recommended

DESIGN MODEL COMPONENTS**

CRITERIA**
- ✓ Personality style
- ✓ Intelligence level

TECHNIQUE**
- ✓ Rule-based Reasoning

THEORY**
- ✓ Personality Traits
- ✓ Multiple Intelligence
- ✓ Descriptive
- ✓ Normative
- ✓ Prescriptive
- ✓ Behavioural Decision
- ✓ Cognitive Psychology
- ✓ Utility
- ✓ Preference
- ✓ Dominance

EMBEDDED

HCI COMPONENTS
1. USER INTERFACE DESIGN PRINCIPLES
   - User familiarity**
   - Consistency**
   - Minimal surprise**
   - User guidance**
2. GRAPHIC DESIGN PRINCIPLES
   - Metaphor**
   - Clarity**
   - Consistency**
   - Alignment**
3. INTERACTION STYLES
   - Menu**
   - Object manipulation*
   - Form fills*
   - Pull-down*
   - Point & Click**
4. DESIGN ELEMENTS
   - Text**
   - Colours**
   - Images*
   - Icons**
   - Charts**

Instructions:
Please read and go through the given YouthPDA conceptual design model figure (Document No. 2). With your qualification and expertise, please provide feedback on the listed items.

EXPERT/REVIEWER DETAILS

Name : _____ *

Age : _____ *

Gender : Male [ ]   Female [ ]

Affiliation : _____ *

Working experience : _____ years *

Position : _____ *

(* *compulsory*)

ITEMS FOR REVIEW

Based on the proposed design model (as depicted in the given hand-out), please tick
(✓) your choice.

1. MAIN COMPONENTS	Needs very detail explanations	Need some explanations	Is easy to understand
Intelligence			
Design			
Choice			

2. PROCESS IN EACH OF COMPONENTS	Needs very detail explanations	Need some explanations	Is easy to understand
Intelligence *(Problem Identification)*			
Set up user profiling			
Store accepted threshold			
Normalize user profile			
Design			
Extract user information			
Calculate decision			
Choice			
Update database			
Re-evaluate threshold			

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3. THE PROPOSED ELEMENTS IN THE *DESIGN MODEL COMPONENTS*	Some are definitely not relevant	Some may be not relevant	All are relevant
Technique			
Criteria			
Theory			

4. THE PROPOSED HCI COMPONENTS IN THE *DESIGN MODEL COMPONENTS*	Some are definitely not relevant	Some may be not relevant	All are relevant
User Interface Design Principles			
Graphic Design Principles			
Interaction Styles			
Design Elements			

Please provide answers to these questions

5. The connections and flows of all the elements are logical.

    [Yes/No]

6. The model is usable to the development of Youth Personal Decision Aid.

    [Yes/No]

7. Overall, the design model is practicable.

    [Yes/No]

8. What is still lacking in the model (to make it more comprehensive)?

_____

_____

_____

_____

9. Please write your further comments/recommendations below:

_____

_____

_____

_____

Thank you for your cooperation

APPENDIX F

Coding for Determining Career Recommendations

```
/*CAREER MULTIPLE INTELLIGENT TEST
*/
package youthpda;

import java.awt.Dimension;
import java.awt.DisplayMode;
import java.awt.GraphicsDevice;
import java.awt.Toolkit;
import java.awt.Window;
import javax.swing.JFrame;
import javax.swing.JOptionPane;
//right click for layout and sett null layout in order to put label
as a background, so that it will be settled as a background

public class IUCareerMITest extends javax.swing.JInternalFrame {

    AdoDBMultipleINtelligentTest db;
    Imainform dataMain;
    TbQMultipleIntelligence tb ;
    Integer kode = 1;
    Integer StartCode = 0;
    Integer EditCode = 1;
    String username = null;
    Boolean editStatus = false;
    private Integer pilih;
    private Integer SPMdomnt;
    /**
     * Creates new form TFUserMultipleIntelligenceTest*/
      /**
     * Creates new form UIMain */

    public void refresh()
    {   //First View of Questionnaire
        db.refreshCount();
        kode = 1;
        setVIew(kode);
        String kodedata = Integer.toString(kode);
        kodeText.setText(kodedata+"/10");
         NextButton.setText("Next");
        NextButton.setEnabled(true);
        backButton.setEnabled(false);
    }
    public IUCareerMITest() {
        initComponents();
    }
     public IUCareerMITest(Imainform main, Dimension dm,String
user,Boolean status,Integer Pilihan,Integer SPM) {

        //check if already take a test or not
        initComponents();
        db = new AdoDBMultipleINtelligentTest();
        this.refresh();
        dataMain = main;
        username = user;
        //set username
        name.setText(username);
        //Status Edit Test;
        pilih = Pilihan;
        editStatus = status;
        SPMdomnt = SPM;
```

```java
    //middle screen
    Dimension jInternalFrameSize = this.getSize();
    this.setLocation((dm.width - jInternalFrameSize.width)/2,
    (dm.height- jInternalFrameSize.height)/2);
    }
    //This procedure is settled in order to show towards user what
questions that is being shown
    public void setVIew(Integer kode)
    {  //setting questions list
        db.questions_classifier(kode);

        StartCode = Integer.parseInt(db.getCode1());
        System.out.println("Startcode = "+StartCode);
        Integer EndCode = StartCode+7;
        int i = 0;
        EditCode = StartCode;
        while(StartCode <= EndCode)
    {
        db.getDataFromTable(StartCode);
        tb = db.getDataFromTable(StartCode);
        Integer selectedStatus = tb.getCount();
        Boolean check = false;
        if(selectedStatus == 1)
        {
            check = true;
        }
        if(i == 0)
        {
            Text1.setText(tb.getQuestion());
            Text1.setSelected(check);
        }
        else if(i == 1)
        {
            Text2.setText(tb.getQuestion());
            Text2.setSelected(check);
        }
        else if(i == 2)
        {
            Text3.setText(tb.getQuestion());
            Text3.setSelected(check);
        }
        else if(i == 3)
        {
            Text4.setText(tb.getQuestion());
            Text4.setSelected(check);
        }
        else if(i == 4)
        {
            Text5.setText(tb.getQuestion());
            Text5.setSelected(check);
        }
        else if(i == 5)
        {
            Text6.setText(tb.getQuestion());
            Text6.setSelected(check);
        }
        else if(i == 6)
        {
            Text7.setText(tb.getQuestion());
            Text7.setSelected(check);
        }
```

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```java
            else if(i == 7)
            {
                Text8.setText(tb.getQuestion());
                Text8.setSelected(check);
            }
            i++;
            StartCode++;
        }
    }
    /**
     * This method is called from within the constructor to
initialize the form.*/
    @SuppressWarnings("unchecked")
    // <editor-fold defaultstate="collapsed" desc="Generated
Code">//GEN-BEGIN:initComponents
    private void initComponents() {

        jButton1 = new javax.swing.JButton();
        jPanel1 = new javax.swing.JPanel();
        jLabel3 = new javax.swing.JLabel();
        jLabel15 = new javax.swing.JLabel();
        Text2 = new javax.swing.JCheckBox();
        Text1 = new javax.swing.JCheckBox();
        Text3 = new javax.swing.JCheckBox();
        Text4 = new javax.swing.JCheckBox();
        Text5 = new javax.swing.JCheckBox();
        Text6 = new javax.swing.JCheckBox();
        Text7 = new javax.swing.JCheckBox();
        jLabel16 = new javax.swing.JLabel();
        jSeparator1 = new javax.swing.JSeparator();
        kodeText = new javax.swing.JLabel();
        Text8 = new javax.swing.JCheckBox();
        name1 = new javax.swing.JLabel();
        name = new javax.swing.JLabel();
        backButton = new javax.swing.JButton();
        NextButton = new javax.swing.JButton();
        refresh = new javax.swing.JButton();
        jLabel4 = new javax.swing.JLabel();

        setBorder(new
javax.swing.border.SoftBevelBorder(javax.swing.border.BevelBorder.RA
ISED));
        setClosable(true);
        setForeground(new java.awt.Color(51, 51, 0));
        setTitle("Multiple Intelligence Test");
        addInternalFrameListener(new
javax.swing.event.InternalFrameListener() {
            public void
internalFrameActivated(javax.swing.event.InternalFrameEvent evt) {
            }
            public void
internalFrameClosed(javax.swing.event.InternalFrameEvent evt) {
                formInternalFrameClosed(evt);
            }
            public void
internalFrameClosing(javax.swing.event.InternalFrameEvent evt) {
            }
            public void
internalFrameDeactivated(javax.swing.event.InternalFrameEvent evt) {
            }
```

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```
                public void
internalFrameDeiconified(javax.swing.event.InternalFrameEvent evt) {
                }
                public void
internalFrameIconified(javax.swing.event.InternalFrameEvent evt) {
                }
                public void
internalFrameOpened(javax.swing.event.InternalFrameEvent evt) {
                }
        });
        getContentPane().setLayout(new
org.netbeans.lib.awtextra.AbsoluteLayout());

        jButton1.setFont(new java.awt.Font("Calibri", 1, 12)); //
NOI18N
        jButton1.setText("BACK");
        jButton1.addActionListener(new
java.awt.event.ActionListener() {
                public void actionPerformed(java.awt.event.ActionEvent
evt) {
                        jButton1ActionPerformed(evt);
                }
        });
        getContentPane().add(jButton1, new
org.netbeans.lib.awtextra.AbsoluteConstraints(1070, 550, -1, -1));

        jPanel1.setBackground(new java.awt.Color(255, 255, 255));

jPanel1.setBorder(javax.swing.BorderFactory.createEtchedBorder());
        jPanel1.setForeground(new java.awt.Color(0, 0, 204));

        jLabel3.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        jLabel3.setForeground(new java.awt.Color(51, 51, 255));
        jLabel3.setText("I like to");

        jLabel15.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        jLabel15.setText("Select one or more responses from the list
below: ");

        Text2.setBackground(new java.awt.Color(255, 255, 255));
        Text2.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text2.setText("Draw and create");
        Text2.addMouseListener(new java.awt.event.MouseAdapter() {
                public void mouseReleased(java.awt.event.MouseEvent evt)
{
                        Text2MouseReleased(evt);
                }
        });
        Text1.setBackground(new java.awt.Color(255, 255, 255));
        Text1.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text1.setText("text1 ");
        Text1.addMouseListener(new java.awt.event.MouseAdapter() {
                public void mouseReleased(java.awt.event.MouseEvent evt)
{
                        Text1MouseReleased(evt);
                }
        });
```

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```
        Text3.setBackground(new java.awt.Color(255, 255, 255));
        Text3.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text3.setText("Collect things such as rocks");
        Text3.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text3MouseReleased(evt);
            }
        });
        Text4.setBackground(new java.awt.Color(255, 255, 255));
        Text4.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text4.setText("Sing");
        Text4.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text4MouseReleased(evt);
            }
        });
        Text5.setBackground(new java.awt.Color(255, 255, 255));
        Text5.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text5.setText("Touch object when looking at them");
        Text5.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text5MouseReleased(evt);
            }
        });
        Text6.setBackground(new java.awt.Color(255, 255, 255));
        Text6.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text6.setText("Teach others");
        Text6.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text6MouseReleased(evt);
            }
        });

        Text7.setBackground(new java.awt.Color(255, 255, 255));
        Text7.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text7.setText("Keep a diary");
        Text7.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text7MouseReleased(evt);
            }
        });
        jLabel16.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        jLabel16.setText("Question Part");

        kodeText.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        kodeText.setText("jLabel4");

        Text8.setBackground(new java.awt.Color(255, 255, 255));
```

```java
        Text8.setFont(new java.awt.Font("Calibri", 0, 14)); //
NOI18N
        Text8.setText("Keep a diary");
        Text8.addMouseListener(new java.awt.event.MouseAdapter() {
            public void mouseReleased(java.awt.event.MouseEvent evt)
{
                Text8MouseReleased(evt);
            }
        });
        name1.setFont(new java.awt.Font("Calibri", 1, 14)); //
NOI18N
        name1.setForeground(new java.awt.Color(0, 0, 153));
        name1.setText("Username :");

        name.setFont(new java.awt.Font("Calibri", 1, 14)); // NOI18N
        name.setForeground(new java.awt.Color(0, 0, 153));
        name.setText("jLabel35");

        org.jdesktop.layout.GroupLayout jPanel1Layout = new
org.jdesktop.layout.GroupLayout(jPanel1);
        jPanel1.setLayout(jPanel1Layout);
        jPanel1Layout.setHorizontalGroup(

jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayout.LE
ADING)
            .add(jPanel1Layout.createSequentialGroup()
                .addContainerGap()

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.LEADING)
                    .add(jLabel15)
                    .add(jPanel1Layout.createSequentialGroup()
                        .add(216, 216, 216)
                        .add(jLabel16)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                        .add(kodeText))
                    .add(jPanel1Layout.createSequentialGroup()
                        .add(jLabel3)
                        .add(132, 132, 132)
                        .add(jSeparator1,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE, 249,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE))
                    .add(0, 212, Short.MAX_VALUE))
                .add(jPanel1Layout.createSequentialGroup()

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.LEADING)
                    .add(jPanel1Layout.createSequentialGroup()
                        .add(31, 31, 31)

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.LEADING)

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.TRAILING, false)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text2,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, 594, Short.MAX_VALUE)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text1,
```

```
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE))

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.TRAILING, false)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text7,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text6,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text8,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, 566, Short.MAX_VALUE))

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.TRAILING, false)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text5,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, 570, Short.MAX_VALUE)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text3,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)

.add(org.jdesktop.layout.GroupLayout.LEADING, Text4,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE))))
                        .add(jPanel1Layout.createSequentialGroup()
                            .addContainerGap()
                            .add(name1,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE, 73,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                            .add(name,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE, 130,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE)))

.addContainerGap(org.jdesktop.layout.GroupLayout.DEFAULT_SIZE,
Short.MAX_VALUE))
        );
        jPanel1Layout.setVerticalGroup(

jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayout.LE
ADING)
            .add(jPanel1Layout.createSequentialGroup()

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.BASELINE)
                    .add(name)
                    .add(name1))

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.BASELINE)
                    .add(kodeText)
                    .add(jLabel16))
```

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```
.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)

.add(jPanel1Layout.createParallelGroup(org.jdesktop.layout.GroupLayo
ut.LEADING)
                        .add(jPanel1Layout.createSequentialGroup()
                            .add(jSeparator1,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE, 13,
org.jdesktop.layout.GroupLayout.PREFERRED_SIZE)
                            .add(35, 35, 35)
                            .add(jLabel15)
                            .add(18, 18, 18)
                            .add(Text1)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.UNRELATED)
                            .add(Text2)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                            .add(Text3)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                            .add(Text4))
                        .add(jLabel3))

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                    .add(Text5)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                    .add(Text6)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED)
                    .add(Text7)

.addPreferredGap(org.jdesktop.layout.LayoutStyle.RELATED,
org.jdesktop.layout.GroupLayout.DEFAULT_SIZE, Short.MAX_VALUE)
                    .add(Text8)
                    .addContainerGap())
        );
        getContentPane().add(jPanel1, new
org.netbeans.lib.awtextra.AbsoluteConstraints(110, 120, 680, -1));

        backButton.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        backButton.setText("Back");
        backButton.setEnabled(false);
        backButton.addActionListener(new
java.awt.event.ActionListener() {
            public void actionPerformed(java.awt.event.ActionEvent
evt) {
                backButtonActionPerformed(evt);
            }
        });
        getContentPane().add(backButton, new
org.netbeans.lib.awtextra.AbsoluteConstraints(280, 480, 117, 61));

        NextButton.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        NextButton.setText("Next");
        NextButton.addActionListener(new
java.awt.event.ActionListener() {
            public void actionPerformed(java.awt.event.ActionEvent
evt) {
```

```
                    NextButtonActionPerformed(evt);
            }
        });
        getContentPane().add(NextButton, new
org.netbeans.lib.awtextra.AbsoluteConstraints(410, 480, 129, 61));

        refresh.setFont(new java.awt.Font("Calibri", 1, 24)); //
NOI18N
        refresh.setText("Restart");
        refresh.addActionListener(new
java.awt.event.ActionListener() {
            public void actionPerformed(java.awt.event.ActionEvent
evt) {
                refreshActionPerformed(evt);
            }
        });
        getContentPane().add(refresh, new
org.netbeans.lib.awtextra.AbsoluteConstraints(550, 480, 143, 61));

        jLabel4.setIcon(new
javax.swing.ImageIcon(getClass().getResource("/youthpda/image/MIBack
Gr2.jpg"))); // NOI18N
        getContentPane().add(jLabel4, new
org.netbeans.lib.awtextra.AbsoluteConstraints(0, 0, 1140, 580));

        pack();
    }// </editor-fold>//GEN-END:initComponents

    private void
NextButtonActionPerformed(java.awt.event.ActionEvent evt) {//GEN-
FIRST:event_NextButtonActionPerformed
        // TODO add your handling code here:
        String newLine = System.getProperty("line.separator");
        if(NextButton.getText()=="Finish")
        {
            int result = db.calTheRow();
            if(result < 10)
            {
                JOptionPane.showInternalMessageDialog(this,"Please
select at least 10 statements"+newLine+"to describe you as a
learner","WARNING MESSAGE",JOptionPane.OK_OPTION);
            }
            else
            {
                int dialog = JOptionPane.YES_NO_OPTION;
             int confirm;

            confirm = JOptionPane.showInternalConfirmDialog(this,
"Want to process?", "Confirmation Message", dialog);
            if(confirm == 0)
            {
             setVIew(kode);
             //Before calculation// check how many checklist

             //calculate the Multiple test
             //here data(s) are calculated and saved
             db.calculateResult(username,editStatus);
            //get data n send to jFrame result
```

```java
                JOptionPane.showInternalMessageDialog(this, "Thanks for
accomplish this questionaire"+newLine+"Press (OK) to continue",
"INFORMATION MESSAGE", JOptionPane.INFORMATION_MESSAGE);
                if(dialog == 0)
                {
                    System.out.println("Pilihan mu adaalah  = "+pilih );
                        db.refreshCount();
                        //Pilihan merupakan saringan antara study and
career back to requisite userInterface
                    this.dispose();
                }
            //refresh back the values inside Multiple Intelligences
                db.refreshMV();
                refresh();
                }
                }
        }
        else
        {
            kode++;
            setVIew(kode);
            if (kode==0)
            {
                backButton.setEnabled(false);
            }
            else if(kode>0 && kode<11)
            {
                backButton.setEnabled(true);
            }
            if(kode==10){
                NextButton.setText("Finish");
            }
            String kodedata = Integer.toString(kode);

            kodeText.setText(kodedata+"/10");
        }
    }//GEN-LAST:event_NextButtonActionPerformed

    private void
backButtonActionPerformed(java.awt.event.ActionEvent evt) {//GEN-
FIRST:event_backButtonActionPerformed
        // TODO add your handling code here:
        NextButton.setText("Next");
        kode--;
        setVIew(kode);
        if(kode==1)
        {
            backButton.setEnabled(false);
            kode = 1;
        }
        if (kode < 10)
        {
            NextButton.setEnabled(true);
        }
        String kodedata = Integer.toString(kode);
        kodeText.setText(kodedata+"/10");

    }//GEN-LAST:event_backButtonActionPerformed

    private void refreshActionPerformed(java.awt.event.ActionEvent
evt) {//GEN-FIRST:event_refreshActionPerformed
```

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```java
        // TODO add your handling code here:
        int dialog = JOptionPane.YES_NO_CANCEL_OPTION;
        int choice = JOptionPane.showInternalConfirmDialog(this,
"Restart the system?", "WARNING MESSAGE",dialog);
        if(choice == 0)
        {
            refresh();
        }
    }//GEN-LAST:event_refreshActionPerformed

    private void
formInternalFrameClosed(javax.swing.event.InternalFrameEvent evt)
{//GEN-FIRST:event_formInternalFrameClosed
        // TODO add your handling code here:
        db.refreshCount();
            if(pilih == 0)
                {
dataMain.callRequisteInterface(name.getText());
                }
                else if(pilih == 1)
                {
                    //dataMain.callIUrequisiteSPM(SPMdomnt,
name.getText());
                }
    }//GEN-LAST:event_formInternalFrameClosed

    private void Text2MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text2MouseReleased
        // TODO add your handling code here:
         if (Text2.isSelected() == true)
        {
            db.edit_data(EditCode+1, true);
        }
        else
        {
            db.edit_data(EditCode+1, false);
        }
    }//GEN-LAST:event_Text2MouseReleased

    private void Text3MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text3MouseReleased
        // TODO add your handling code here:
         if (Text3.isSelected() == true)
        {
            db.edit_data(EditCode+2, true);
        }
        else
        {
            db.edit_data(EditCode+2, false);
        }
    }//GEN-LAST:event_Text3MouseReleased

    private void Text4MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text4MouseReleased
        // TODO add your handling code here:
         if (Text4.isSelected() == true)
        {
            db.edit_data(EditCode+3, true);
        }
        else
        {
```

```java
                db.edit_data(EditCode+3, false);
            }
    }//GEN-LAST:event_Text4MouseReleased

    private void Text5MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text5MouseReleased
        // TODO add your handling code here:
            if (Text5.isSelected() == true)
        {
            db.edit_data(EditCode+4, true);
        }
        else
        {
            db.edit_data(EditCode+4, false);
        }
    }//GEN-LAST:event_Text5MouseReleased

    private void Text6MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text6MouseReleased
        // TODO add your handling code here:
         if (Text6.isSelected() == true)
        {
            db.edit_data(EditCode+5, true);
        }
        else
        {
            db.edit_data(EditCode+5, false);
        }
    }//GEN-LAST:event_Text6MouseReleased

    private void Text7MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text7MouseReleased
        // TODO add your handling code here:
          if (Text7.isSelected() == true)
        {
            db.edit_data(EditCode+6, true);
        }
        else
        {
            db.edit_data(EditCode+6, false);
        }
    }//GEN-LAST:event_Text7MouseReleased

    private void Text1MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text1MouseReleased
        // TODO add your handling code here:
         if (Text1.isSelected()==true)
        {
            db.edit_data(EditCode, true);
            System.out.println("TRUE");
        }
        else
        {
            db.edit_data(EditCode, false);
            System.out.println("FALSE");
        }
    }//GEN-LAST:event_Text1MouseReleased

    private void Text8MouseReleased(java.awt.event.MouseEvent evt)
{//GEN-FIRST:event_Text8MouseReleased
        // TODO add your handling code here:
```

```java
        if (Text8.isSelected()==true)
        {
            db.edit_data(EditCode+7, true);
            System.out.println("TRUE");
        }
        else
        {
            db.edit_data(EditCode+7, false);
            System.out.println("FALSE");
        }
    }//GEN-LAST:event_Text8MouseReleased

    private void jButton1ActionPerformed(java.awt.event.ActionEvent
evt) {//GEN-FIRST:event_jButton1ActionPerformed
        // TODO add your handling code here:
         db.refreshCount();
            if(pilih == 0)
                {
dataMain.callRequisteInterface(name.getText());
                }
                else if(pilih == 1)
                {
                 //    dataMain.callIUrequisiteSPM(SPMdomnt,
name.getText());
                }
            this.hide();
    }//GEN-LAST:event_jButton1ActionPerformed

// Variables declaration - do not modify//GEN-BEGIN:variables
    private javax.swing.JButton NextButton;
    private javax.swing.JCheckBox Text1;
    private javax.swing.JCheckBox Text2;
    private javax.swing.JCheckBox Text3;
    private javax.swing.JCheckBox Text4;
    private javax.swing.JCheckBox Text5;
    private javax.swing.JCheckBox Text6;
    private javax.swing.JCheckBox Text7;
    private javax.swing.JCheckBox Text8;
    private javax.swing.JButton backButton;
    private javax.swing.JButton jButton1;
    private javax.swing.JLabel jLabel15;
    private javax.swing.JLabel jLabel16;
    private javax.swing.JLabel jLabel3;
    private javax.swing.JLabel jLabel4;
    private javax.swing.JPanel jPanel1;
    private javax.swing.JSeparator jSeparator1;
    private javax.swing.JLabel kodeText;
    private javax.swing.JLabel name;
    private javax.swing.JLabel name1;
    private javax.swing.JButton refresh;
    // End of variables declaration//GEN-END:variables
}
```

```
/*CAREER RESULTS
 */
package youthpda;

import java.awt.AWTException;
import java.awt.Dimension;
import java.awt.Rectangle;
import java.awt.Robot;
import java.awt.Toolkit;
import java.awt.image.BufferedImage;
import java.io.File;
import java.io.IOException;
import javax.imageio.ImageIO;
import javax.swing.JFileChooser;
import javax.swing.JOptionPane;

public class IUCareerResults extends javax.swing.JInternalFrame {

    Integer M1,M2,M3,M4,M5,M6,M7,M8;
    private AdoDBMultipleINtelligentTest dbMul;
    private AdoDBPersonality2 dbPer;
    private String user;
    private TbMultipleIntelligence tb;
    private Imainform TF;

    /**Creates new form TestAja */
    public IUCareerResults() {
        initComponents();
    }
    public IUCareerResults(String username,Dimension dm, Imainform
main) {
        initComponents();

        dbMul = new AdoDBMultipleINtelligentTest();
        user = username;
        TbMultipleUSer tbnya = dbMul.getDataMIUser(username);
        TF = main;
      /*
        M1 = tbnya.getlinguistic();
        M2 = tbnya.getlogic();
        M3 = tbnya.getmusical();
        M4 = tbnya.getbody();
        M5 = tbnya.getspacial();
        M6 = tbnya.getinterpersonal();
        M7 = tbnya.getintrapersonal();
        M8 = tbnya.getnaturalistic();
        */
        dbPer = new AdoDBPersonality2();

        // String descriptionString =
        String newLine = System.getProperty("line.separator");
        //get type of username BASED ON PERSONALITY OF USER
        String type = dbPer.getTypeOfUser(username);
        //get description from table PERSONALITY2
        String desc = dbPer.getDescriptionOfType(type);
        System.out.println("Ini the highest for Personality2 careers
= "+desc);
        //Split the string
        String s = desc;
        String words[] = s.split(" ");
        //Setting the career (The most Prominant)
```

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```java
        c1.setText(words[0]);
        c2.setText(words[1]);
        c3.setText(words[2]);
        c4.setText(words[3]);
        c5.setText(words[4]);
        c6.setText(words[5]);

  //setting the second rank (based on multiple intelligent)
  //in getColoumnName function the highest/the greatest MI is selected
        String highestMI = dbMul.getColoumName(username);
  //in here the complete descriptions are taken here... for example
  the highest was logic, So that in getCareerTbCareer The explanation
  will be captured
        String careerMI = dbMul.getCareerTbCareer(highestMI);
        String cMI = careerMI;
        System.out.println("Ini the second highers for MI careers =
"+cMI);
        String wordsMI[] = cMI.split(" ");

        d1.setText(wordsMI[0]);
        d2.setText(wordsMI[1]);
        d3.setText(wordsMI[2]);
        d4.setText(wordsMI[3]);
        d5.setText(wordsMI[4]);
        d6.setText(wordsMI[5]);

        //for the "f" data;
        //This from the continuing Personality of user from
TB_PERSONALITY_CAREER (Personality Types)
        TbQPersonalityDetails tbPD =
dbPer.getPersonalityDetails(username);
        String careers = tbPD.getCareer();
        String cMI2 = careers;
        System.out.println(careers);
        String wordsPT2[] = cMI2.split(" ");
        f1.setText(wordsPT2[0]);
        f2.setText(wordsPT2[1]);
        f3.setText(wordsPT2[2]);
        f4.setText(wordsPT2[3]);
        f5.setText(wordsPT2[4]);
        f6.setText(wordsPT2[5]);

        f7.setText(wordsPT2[6]);
        f8.setText(wordsPT2[7]);
        f9.setText(wordsPT2[8]);

        f10.setText(wordsPT2[9]);
        f11.setText(wordsPT2[10]);
        f12.setText(wordsPT2[11]);

        System.out.println(careers);

        TbQPersonalityDetails tbPD2 =
dbPer.getPersonalityDetails2();
        String careers2 = tbPD2.getCareer();
        String cMI3 = careers2;
        String wordsPT3[] = cMI3.split(" ");

        f13.setText(wordsPT2[12]);
        f14.setText(wordsPT2[13]);
        f15.setText(wordsPT2[14]);
```

```java
        f16.setText(wordsPT2[15]);
        f17.setText(wordsPT2[16]);
        f18.setText(wordsPT2[17]);
        f19.setText(wordsPT2[18]);
        f20.setText(wordsPT2[19]);
        f21.setText(wordsPT2[20]);
        f22.setText(wordsPT2[21]);
        f23.setText(wordsPT2[22]);
        f24.setText(wordsPT2[23]);

        f25.setText(wordsPT2[24]);
        f26.setText(wordsPT2[25]);
        f27.setText(wordsPT2[26]);
        f28.setText(wordsPT2[27]);
        f29.setText(wordsPT2[28]);
        f30.setText(wordsPT2[29]);
        f31.setText(wordsPT2[30]);
        f32.setText(wordsPT2[31]);
        f33.setText(wordsPT2[32]);
        f34.setText(wordsPT2[33]);


        e1.setText(wordsPT2[34]);
        e2.setText(wordsPT2[35]);
        e3.setText(wordsPT2[36]);
        e4.setText(wordsPT2[37]);
        e5.setText(wordsPT2[38]);
        e6.setText(wordsPT2[39]);

        Dimension jFrameSize = this.getSize();
        this.setLocation((dm.width - jFrameSize.width)/2,
        (dm.height- jFrameSize.height)/2);
    }
/**
    * This method is called from within the constructor to
initialize the form.*/
    @SuppressWarnings("unchecked")
    // <editor-fold defaultstate="collapsed" desc="Generated
Code">//GEN-BEGIN:initComponents
    private void initComponents() {

        jLabel2 = new javax.swing.JLabel();
        jButton1 = new javax.swing.JButton();
        jPanel1 = new javax.swing.JPanel();
        f1 = new javax.swing.JLabel();
        f2 = new javax.swing.JLabel();
        e4 = new javax.swing.JLabel();
        d3 = new javax.swing.JLabel();
        f3 = new javax.swing.JLabel();
        f4 = new javax.swing.JLabel();
        d5 = new javax.swing.JLabel();
        f5 = new javax.swing.JLabel();
        f6 = new javax.swing.JLabel();
        e5 = new javax.swing.JLabel();
        c2 = new javax.swing.JLabel();
        f7 = new javax.swing.JLabel();
        f8 = new javax.swing.JLabel();
        f9 = new javax.swing.JLabel();
        f10 = new javax.swing.JLabel();
        f11 = new javax.swing.JLabel();
        f12 = new javax.swing.JLabel();
```

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```
        d6 = new javax.swing.JLabel();
        f13 = new javax.swing.JLabel();
        f14 = new javax.swing.JLabel();
        f15 = new javax.swing.JLabel();
        f31 = new javax.swing.JLabel();
        c6 = new javax.swing.JLabel();
        e3 = new javax.swing.JLabel();
        f16 = new javax.swing.JLabel();
        c4 = new javax.swing.JLabel();
        f17 = new javax.swing.JLabel();
        f18 = new javax.swing.JLabel();
        f19 = new javax.swing.JLabel();
        d2 = new javax.swing.JLabel();
        f20 = new javax.swing.JLabel();
        f21 = new javax.swing.JLabel();
        c3 = new javax.swing.JLabel();
        f22 = new javax.swing.JLabel();
        f23 = new javax.swing.JLabel();
        e6 = new javax.swing.JLabel();
        f24 = new javax.swing.JLabel();
        f25 = new javax.swing.JLabel();
        e2 = new javax.swing.JLabel();
        f26 = new javax.swing.JLabel();
        f27 = new javax.swing.JLabel();
        f28 = new javax.swing.JLabel();
        c5 = new javax.swing.JLabel();
        f29 = new javax.swing.JLabel();
        f30 = new javax.swing.JLabel();
        f32 = new javax.swing.JLabel();
        d1 = new javax.swing.JLabel();
        e1 = new javax.swing.JLabel();
        c1 = new javax.swing.JLabel();
        f33 = new javax.swing.JLabel();
        f34 = new javax.swing.JLabel();
        d4 = new javax.swing.JLabel();
        background = new javax.swing.JLabel();

        setBorder(new
javax.swing.border.SoftBevelBorder(javax.swing.border.BevelBorder.RA
ISED));
        setClosable(true);
        setTitle("Career Recommedation Results");
        getContentPane().setLayout(new
org.netbeans.lib.awtextra.AbsoluteLayout());

        jLabel2.setFont(new java.awt.Font("Calibri", 0, 18)); //
NOI18N
        jLabel2.setForeground(new java.awt.Color(255, 255, 255));
        jLabel2.setText("*Note: The bigger word in tag clouds
indicates the more prominent area for your future career");
        getContentPane().add(jLabel2, new
org.netbeans.lib.awtextra.AbsoluteConstraints(10, 520, -1, -1));

        jButton1.setFont(new java.awt.Font("Calibri", 1, 14)); //
NOI18N
        jButton1.setText("Back to Main Menu");
        jButton1.addActionListener(new
java.awt.event.ActionListener() {
            public void actionPerformed(java.awt.event.ActionEvent
evt) {   jButton1ActionPerformed(evt);
            }
```

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```
        });
        getContentPane().add(jButton1, new
org.netbeans.lib.awtextra.AbsoluteConstraints(750, 500, 240, 40));

        jPanel1.setBackground(new java.awt.Color(255, 255, 255));

        f1.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f1.setText("career");
        jPanel1.add(f1);

        f2.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f2.setText("career");
        jPanel1.add(f2);

        e4.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
        e4.setText("career");
        jPanel1.add(e4);

        d3.setFont(new java.awt.Font("Century Gothic", 0, 42)); //
NOI18N
        d3.setForeground(new java.awt.Color(255, 0, 0));
        d3.setText("career");
        jPanel1.add(d3);

        f3.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f3.setText("career");
        jPanel1.add(f3);

        f4.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f4.setText("career");
        jPanel1.add(f4);

        d5.setFont(new java.awt.Font("Century Gothic", 0, 24)); //
NOI18N
        d5.setText("career");
        jPanel1.add(d5);

        f5.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f5.setText("career");
        jPanel1.add(f5);

        f6.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f6.setText("career");
        jPanel1.add(f6);

        e5.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
        e5.setText("career");
        jPanel1.add(e5);

        c2.setFont(new java.awt.Font("Century Gothic", 0, 40)); //
NOI18N
        c2.setForeground(new java.awt.Color(255, 0, 0));
        c2.setText("career");
```

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```
        jPanel1.add(c2);

        f7.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f7.setText("career");
        jPanel1.add(f7);

        f8.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f8.setText("career");
        jPanel1.add(f8);

        f9.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f9.setText("career");
        jPanel1.add(f9);

        f10.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f10.setText("career");
        jPanel1.add(f10);

        f11.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f11.setText("career");
        jPanel1.add(f11);

        f12.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f12.setText("career");
        jPanel1.add(f12);

        d6.setFont(new java.awt.Font("Century Gothic", 0, 24)); //
NOI18N
        d6.setText("career");
        jPanel1.add(d6);

        f13.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f13.setText("career");
        jPanel1.add(f13);

        f14.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f14.setText("career");
        jPanel1.add(f14);

        f15.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f15.setText("career");
        jPanel1.add(f15);

        f31.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f31.setText("career");
        jPanel1.add(f31);

        c6.setFont(new java.awt.Font("Century Gothic", 0, 39)); //
NOI18N
        c6.setText("career");
        jPanel1.add(c6);
```

```java
        e3.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
        e3.setText("career");
        jPanel1.add(e3);

        f16.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f16.setText("career");
        jPanel1.add(f16);

        c4.setFont(new java.awt.Font("Century Gothic", 0, 39)); //
NOI18N
        c4.setText("career");
        jPanel1.add(c4);

        f17.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f17.setText("career");
        jPanel1.add(f17);

        f18.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f18.setText("career");
        jPanel1.add(f18);

        f19.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f19.setText("career");
        jPanel1.add(f19);

        d2.setFont(new java.awt.Font("Century Gothic", 0, 42)); //
NOI18N
        d2.setForeground(new java.awt.Color(255, 0, 0));
        d2.setText("career    ");
        jPanel1.add(d2);

        f20.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f20.setText("career");
        jPanel1.add(f20);

        f21.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f21.setText("career");
        jPanel1.add(f21);

        c3.setFont(new java.awt.Font("Century Gothic", 0, 24)); //
NOI18N
        c3.setText("career");
        jPanel1.add(c3);

        f22.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f22.setText("career");
        jPanel1.add(f22);

        f23.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f23.setText("career");
        jPanel1.add(f23);
```

```
            e6.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
            e6.setText("career");
            jPanel1.add(e6);

            f24.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f24.setText("career");
            jPanel1.add(f24);

            f25.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f25.setText("career");
            jPanel1.add(f25);

            e2.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
            e2.setText("career");
            jPanel1.add(e2);

            f26.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f26.setText("career");
            jPanel1.add(f26);

            f27.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f27.setText("career");
            jPanel1.add(f27);

            f28.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f28.setText("career");
            jPanel1.add(f28);

            c5.setFont(new java.awt.Font("Century Gothic", 0, 24)); //
NOI18N
            c5.setText("career");
            jPanel1.add(c5);

            f29.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f29.setText("career");
            jPanel1.add(f29);

            f30.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f30.setText("career");
            jPanel1.add(f30);

            f32.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
            f32.setText("career");
            jPanel1.add(f32);

            d1.setFont(new java.awt.Font("Century Gothic", 0, 42)); //
NOI18N
            d1.setForeground(new java.awt.Color(255, 0, 0));
            d1.setText("career");
            jPanel1.add(d1);
```

```java
        e1.setFont(new java.awt.Font("Century Gothic", 0, 18)); //
NOI18N
        e1.setText("career");
        jPanel1.add(e1);

        c1.setFont(new java.awt.Font("Century Gothic", 0, 40)); //
NOI18N
        c1.setForeground(new java.awt.Color(255, 0, 0));
        c1.setText("career");
        jPanel1.add(c1);

        f33.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f33.setText("career");
        jPanel1.add(f33);

        f34.setFont(new java.awt.Font("Century Gothic", 0, 11)); //
NOI18N
        f34.setText("career");
        jPanel1.add(f34);

        d4.setFont(new java.awt.Font("Century Gothic", 0, 42)); //
NOI18N
        d4.setForeground(new java.awt.Color(255, 0, 0));
        d4.setText("career");
        jPanel1.add(d4);

        getContentPane().add(jPanel1, new
org.netbeans.lib.awtextra.AbsoluteConstraints(0, 80, 990, 440));

        background.setIcon(new
javax.swing.ImageIcon(getClass().getResource("/youthpda/image/Result
sCareer.jpg"))); // NOI18N
        getContentPane().add(background, new
org.netbeans.lib.awtextra.AbsoluteConstraints(-20, 0, 1030, 550));

        pack();
    }// </editor-fold>//GEN-END:initComponents

    private void jButton1ActionPerformed(java.awt.event.ActionEvent
evt) {//GEN-FIRST:event_jButton1ActionPerformed
        // TODO add your handling code here:
        //for screen shot the application
        /*
        //create a BufferedImage to store the screen capture.
        BufferedImage image = null;
        try {
            //Robot().createScreenCapture returns a BufferedImage
the size of the screen with Toolkit's getScreenSize().
            image = new Robot().createScreenCapture(new
Rectangle(Toolkit.getDefaultToolkit().getScreenSize()));
        }
        catch(AWTException e) {
            e.printStackTrace();
        }
//represents file to be saved.
        File file = null;
//JFileChooser used for openong save dislog in which you type the
name of your screenshot.
        JFileChooser choose = new JFileChooser();
```

```
//pop up a save dialog in this JFrame window.
        int result = choose.showSaveDialog(this);

//JFileChooser's showSaveDialog() returns an int, and if that int
represents the static field CANCEL_OPTION, the user has pressed
cancel on the save dialog.  In this case, we simply return.
        if (result == JFileChooser.CANCEL_OPTION)
            return;

//if user types in a file name and clicks 'save' in the dialog box,
then the file typed in becomes the file to be saved.
        else
            file = choose.getSelectedFile();
        try {
//we write the file to be saved with ImageIO.write().  We supply the
image, the file type, jpg, and the file, which is 'file'.
            ImageIO.write(image, "jpg", file);
        }
        catch(IOException ioe) {
            ioe.printStackTrace();
        }
        */
        //for going back to main menu
        Integer filter = JOptionPane.showInternalConfirmDialog(this,
"back to main menu, are you sure ?!?", "QUESTION MESSAGE",
JOptionPane.YES_NO_OPTION);
        if(filter == 0)
        {
            TF.callUIInterfaceUser(user);
            this.dispose();
        }
    }//GEN-LAST:event_jButton1ActionPerformed
// Variables declaration - do not modify//GEN-BEGIN:variables
    private javax.swing.JLabel background;
    private javax.swing.JLabel c1;
    private javax.swing.JLabel c2;
    private javax.swing.JLabel c3;
    private javax.swing.JLabel c4;
    private javax.swing.JLabel c5;
    private javax.swing.JLabel c6;
    private javax.swing.JLabel d1;
    private javax.swing.JLabel d2;
    private javax.swing.JLabel d3;
    private javax.swing.JLabel d4;
    private javax.swing.JLabel d5;
    private javax.swing.JLabel d6;
    private javax.swing.JLabel e1;
    private javax.swing.JLabel e2;
    private javax.swing.JLabel e3;
    private javax.swing.JLabel e4;
    private javax.swing.JLabel e5;
    private javax.swing.JLabel e6;
    private javax.swing.JLabel f1;
    private javax.swing.JLabel f10;
    private javax.swing.JLabel f11;
    private javax.swing.JLabel f12;
    private javax.swing.JLabel f13;
    private javax.swing.JLabel f14;
    private javax.swing.JLabel f15;
    private javax.swing.JLabel f16;
    private javax.swing.JLabel f17;
```

```java
        private javax.swing.JLabel f18;
        private javax.swing.JLabel f19;
        private javax.swing.JLabel f2;
        private javax.swing.JLabel f20;
        private javax.swing.JLabel f21;
        private javax.swing.JLabel f22;
        private javax.swing.JLabel f23;
        private javax.swing.JLabel f24;
        private javax.swing.JLabel f25;
        private javax.swing.JLabel f26;
        private javax.swing.JLabel f27;
        private javax.swing.JLabel f28;
        private javax.swing.JLabel f29;
        private javax.swing.JLabel f3;
        private javax.swing.JLabel f30;
        private javax.swing.JLabel f31;
        private javax.swing.JLabel f32;
        private javax.swing.JLabel f33;
        private javax.swing.JLabel f34;
        private javax.swing.JLabel f4;
        private javax.swing.JLabel f5;
        private javax.swing.JLabel f6;
        private javax.swing.JLabel f7;
        private javax.swing.JLabel f8;
        private javax.swing.JLabel f9;
        private javax.swing.JButton jButton1;
        private javax.swing.JLabel jLabel2;
        private javax.swing.JPanel jPanel1;
        // End of variables declaration//GEN-END:variables
}
```